Federal Supply Service
U.S. General Services Administration

Authorized Federal Supply Schedule Price List

On-line access to contract ordering information, terms and conditions, up-to-date pricing, and the option to create an electronic delivery order are available through GSAAAdvantage®, a menu-driven database system. The INTERNET address GSA Advantage® is: GSAAdvantage.gov.

Schedule Title:
MAS – Multiple Award Schedule

FSC Group:
B – Facilities
G – Miscellaneous
J - Security and Protection

PSC Codes:
N099 – Installation of Miscellaneous Equipment
6350 – Miscellaneous Alarm, Signal, Security Detection Systems

Contract Number:
47QSWA20D002A

Mod Number:
Price List updated through Mod# PS-0019 effective August 12, 2022.

Contract Period:
Base Term: 12/10/2019 to 12/9/2024
Option 1 Term: 12/10/2024 to 12/9/2029
Option 2 Term: 12/10/2029 to 12/9/2034
Option 3 Term: 12/10/2034 to 12/9/2039

Contractor Info:
TRANE U.S. INC.
3600 PAMMEL CREEK RD
LA CROSSE, WI 54601-7511
651-407-4216
www.trane.com
GSASchedule@Trane.com

Business Size:
Large
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information for Ordering Activities</td>
<td>3</td>
</tr>
<tr>
<td>Trane Sales Offices in the United States</td>
<td>7</td>
</tr>
<tr>
<td>Product and Services Price List:</td>
<td></td>
</tr>
<tr>
<td>+ Rotary Liquid Chillers &amp; Scroll Liquid Chillers</td>
<td>12</td>
</tr>
<tr>
<td>+ CenTraVac™ Water-Cooled Centrifugal Liquid Chillers</td>
<td>13</td>
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<tr>
<td>+ Air-Cooled Liquid Chillers, Single-Zone Rooftop Air Conditioners, &amp; Split System Air-Cooled Condensing Units</td>
<td>14</td>
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<tr>
<td>+ Split System Units</td>
<td>15</td>
</tr>
<tr>
<td>+ Light Commercial Unit (LCU) &amp; Small Split Systems</td>
<td>16</td>
</tr>
<tr>
<td>+ Split System Air Handlers</td>
<td>17</td>
</tr>
<tr>
<td>+ Precedent Rooftop Units</td>
<td>18</td>
</tr>
<tr>
<td>+ Climate Change Air Handlers</td>
<td>19</td>
</tr>
<tr>
<td>+ Water Source Heat Pumps</td>
<td>20</td>
</tr>
<tr>
<td>+ Unit Ventilators</td>
<td>21</td>
</tr>
<tr>
<td>+ Coil Products</td>
<td>22</td>
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<tr>
<td>+ Building Energy Management &amp; Control Products</td>
<td>23</td>
</tr>
<tr>
<td>+ Building Automation Systems (BAS) Training Seminars</td>
<td>24</td>
</tr>
<tr>
<td>+ Trane Rental Services</td>
<td>27</td>
</tr>
<tr>
<td>+ Customer Direct Service (CDS) Software</td>
<td>32</td>
</tr>
<tr>
<td>+ Customer Direct Service (CDS) Training Seminars</td>
<td>33</td>
</tr>
<tr>
<td>+ Educational Literature &amp; Materials</td>
<td>37</td>
</tr>
<tr>
<td>+ GSA Pricing of Labor</td>
<td>59</td>
</tr>
<tr>
<td>+ GSA Hourly Billing Rates (Davis Bacon Act)</td>
<td>64</td>
</tr>
<tr>
<td>+ Trane Parts</td>
<td>65</td>
</tr>
<tr>
<td>+ Synexis Indoor Air Quality (IAQ) Products</td>
<td>66</td>
</tr>
<tr>
<td>+ Software Descriptive Literature</td>
<td>67</td>
</tr>
<tr>
<td>+ Course Descriptions</td>
<td>69</td>
</tr>
</tbody>
</table>
INFORMATION FOR ORDERING OFFICES

1a. Awarded Special Item Numbers:

<table>
<thead>
<tr>
<th>SIN</th>
<th>Description</th>
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<tbody>
<tr>
<td>334512</td>
<td>Total Solutions Support for Facility Management Systems</td>
</tr>
<tr>
<td>334290</td>
<td>Security and Detection Systems</td>
</tr>
<tr>
<td>238910</td>
<td>Installation and Site Preparation Services</td>
</tr>
<tr>
<td>OLM</td>
<td>Order Level Materials</td>
</tr>
<tr>
<td>561210FAC</td>
<td>Complete Facilities Maintenance and Management</td>
</tr>
<tr>
<td>541690E</td>
<td>Energy Consulting Services</td>
</tr>
<tr>
<td>ANCRA</td>
<td>Ancillary Repair and Alteration</td>
</tr>
<tr>
<td>ANCILLARY</td>
<td>Ancillary Supplies and Services</td>
</tr>
</tbody>
</table>

1b. Lowest Price Model Number and Lowest Unit Price for the Special Item Number Awarded in the Contract – See Pricing.

1c. Hourly Rates – See Pricing.

2. Maximum Order:

- SIN 334512: $250,000 per order.
- SIN 334290: $250,000 per order.
- SIN 238910: $250,000 per order.
- SIN OLM: $250,000 per order.
- SIN 561210FAC: $1,000,000 per order.
- SIN 541690E: $1,000,000 per order.
- SIN ANCRA: $250,000 per order.
- SIN ANCILLARY: $250,000 per order.

Pursuant to FAR 8.405-1, The Maximum Order established in Schedule contracts is the threshold at which it is advantageous for an ordering office to seek further concessions from a Contractor. The Contractor may accept an order of any amount, including one exceeding the maximum order threshold. For an order in an amount above the maximum order threshold for the specific SIN in the contract, a Government purchaser should seek further concessions from the Contractor. When presented with such a request, the Contractor may grant additional concessions, offer the product at the existing contract price, or refuse the order.

3. Minimum Order:

$100.00 per order.

4. Geographic Coverage (delivery area):


5. Points of Production (city, county, and state or foreign country):

<table>
<thead>
<tr>
<th>Name of Manufacturer</th>
<th>Production Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trane U.S. Inc.</td>
<td>3600 Pammel Creek Road LaCrosse</td>
</tr>
<tr>
<td></td>
<td>LaCrosse County Wisconsin 54601-7599</td>
</tr>
<tr>
<td></td>
<td>Phone: 608-787-2000</td>
</tr>
<tr>
<td></td>
<td>Phone (Marketing): 608-787-3907</td>
</tr>
<tr>
<td></td>
<td>Fax: 608-787-2204</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.trane.com">www.trane.com</a></td>
</tr>
<tr>
<td>Trane U.S. Inc.</td>
<td>4833 White Bear Parkway St. Paul</td>
</tr>
<tr>
<td></td>
<td>Ramsey County Minnesota 55110</td>
</tr>
<tr>
<td></td>
<td>Phone: 1-800-877-1327</td>
</tr>
<tr>
<td></td>
<td>Fax: 651-407-4197</td>
</tr>
<tr>
<td></td>
<td>E-mail: <a href="mailto:GSASchedule@trane.com">GSASchedule@trane.com</a></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.trane.com">www.trane.com</a></td>
</tr>
<tr>
<td>Trane U.S. Inc.</td>
<td>3600 Pammel Creek Road CDS</td>
</tr>
<tr>
<td></td>
<td>Wisconsin 54601-7511</td>
</tr>
<tr>
<td></td>
<td>Phone: 608-787-3005</td>
</tr>
<tr>
<td></td>
<td>Fax: 608-787-3005</td>
</tr>
<tr>
<td></td>
<td>E-mail: <a href="mailto:cdshelp@trane.com">cdshelp@trane.com</a></td>
</tr>
<tr>
<td></td>
<td><a href="http://www.trane.com">www.trane.com</a></td>
</tr>
<tr>
<td>Trane U.S. Inc.</td>
<td>101 William White Boulevard Pueblo</td>
</tr>
<tr>
<td></td>
<td>Colorado 81001-4800</td>
</tr>
<tr>
<td></td>
<td>Phone: 1-888-244-5537</td>
</tr>
<tr>
<td></td>
<td>Fax: 719-585-3896</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.trane.com">www.trane.com</a></td>
</tr>
<tr>
<td>Trane U.S. Inc.</td>
<td>2701 Wilma Rudolph Blvd. Clarksville</td>
</tr>
<tr>
<td></td>
<td>Montgomery County Tennessee 37040-5846</td>
</tr>
</tbody>
</table>
Trane U.S. Inc. 182 Colton Belt Parkway
McGregor
McLennan County
Texas 76657-3411
Phone: 254-299-6300
Fax: 254-299-6671
www.trane.com

Trane U.S. Inc. Inland Marketing Services
3030 Airport Road
La Crosse
La Crosse County
Wisconsin 54603-1251
Phone: 608-787-3926
Fax: 608-783-4705
www.trane.com

Trane U.S. Inc. 4500 Morris Field Drive
Charlotte
Mecklenberg County
North Carolina 28208
Phone: 800-755-5115
Fax: 704-398-4681
www.trane.com

Trane U.S. Inc. 1515 Mercer Road
Lexington
Lexington-Fayette County
Kentucky 40511
Phone: 800-228-1666
Fax: 859-288-2618
www.trane.com

Trane U.S. Inc. 7610 Industrial Highway
Macon
Bibb County
Georgia 31216
Phone: 478-781-6495
Fax: 478-784-4239
www.trane.com

Trane U.S. Inc. Lynn Haven Unit
200 Aberdeen Loop
Panama City
Bay County
Florida 32405
Phone: 850-271-6030
Fax: 850-271-6040
www.trane.com

Trane U.S. Inc. 141 Commons Pkwy
Columbia
Lexington County
South Carolina 29203

Phone: 1-877-788-7263
www.trane.com

Trane U.S. Inc. 9900 Aire Circle
Fort Smith
Arkansas 72916
Phone: 479-648-7400
Fax: 479-648-7499
www.trane.com

Trane U.S. Inc. Grand Rapids
5005 Corporate Exchange Blvd SE
Grand Rapids
Michigan 49512
Phone: 844-801-6048
www.trane.com

Trane U.S. Inc. Rushville
1300 N. Benjamin St.
Rushville
Indiana 46173
Phone: 765-932-7200
www.trane.com

6. Discounts from Commercial List Prices:
   GSA Net Prices are shown on the attached GSA Price List. Negotiated discount has been deducted
   and the IFF has been included.

7. Quantity Discounts:
   To be determined at the Task Order Level.

8. Prompt Payment Terms:
   Prompt payment is ½% 10 days Net 30 days from
date of invoice or date of acceptance, whichever is
later. Credit card transactions are excluded.

   Information for Ordering Offices: Prompt Payment Terms cannot be negotiated out of the contractual
agreement in exchange for other concessions."

9a. Government Commercial Credit Card:
   Government purchase cards are accepted.

9b. Government Commercial Credit Card:
   Government purchase cards are accepted above
the micro-purchase threshold.

10. Foreign Items (list items by country of origin):
    None

11a. Time of Delivery:
As negotiated at the Task Order Level.

11b. Expedited Delivery:
As negotiated at the Task Order Level.

11c. Overnight and 2-Day Delivery:
As negotiated at the Task Order Level.

11d. Urgent Requirements:
As negotiated at the Task Order Level.

12. FOB Point:
Shipment shall be F.O.B. Destination with title passing to the Government upon delivery by the carrier, freight allowed and prepaid. The contractor shall be responsible for all expenses connected with the return of defective products or parts. The Government shall be responsible for expenses connected with all other returns. A restocking fee of 15% of the purchase price shall be charged to the Government for the return of non-defective products or parts.

13a. Ordering Address:
See “Trane Sales Offices” section for listing of ordering addresses.

13b. Ordering Procedures:
For supplies and services, the ordering procedures, information on Blanket Purchase Agreements (BPA’s) are found in Federal Acquisition Regulation (FAR) 8.405-3.

14. Payment Address:
Payment may be made to:
Trane U.S. Inc.
4833 White Bear Parkway
St. Paul, MN 55110

or to Trane U.S. Inc. in care of one of the Participating Dealers listed in the “Trane Sales Offices” section.

Trane may direct a purchasing office to forward payment to one of the following “remit to” addresses, which will be listed on the invoice:

- Trane U.S. Inc.
  P.O. Box 406469
  Atlanta, GA 30384-6469

- Trane U.S. Inc.
  P. O. Box 98167
  Chicago, IL 60693

15. Warranty Provisions:
Standard Commercial Warranty applies. Contact the contractor for a copy of the warranty.

16. Export Packing Charges:
Point of Exportation for all other overseas locations. In place of a delivery/installation date for equipment, a shipping date shall be specified on the order. The Contractor shall pay for shipment to a CONUS APO/FPO. At the option of the Government, F.O.B. will be Point of Origin, with freight prepaid and invoiced. Authorization for all shipping, export, and other charges must be included on the Government order.

17. Terms and Conditions of Government Purchase Card Acceptance (any thresholds above the micropurchase level):
No special concessions granted.

18. Terms and Conditions of Rental, Maintenance, or Repair:
For locations in the 48 contiguous states, Alaska, Hawaii, Puerto Rico, and Washington, D.C., maintenance and repair is performed by the sales offices listed in the attached list of Trane Sales Offices in the United States, based on terms and prices set at each sales office. Contact each sales office for maintenance and repair available.

19. Terms and Conditions of Installation:
Installation for locations in the 48 contiguous states, Alaska, Hawaii, Puerto Rico, and Washington, D.C. is performed by the sales offices listed in the attached list of Trane Sales Offices in the United States, based on terms and prices set by each sales office.

20. Terms and Conditions of Repair Parts:
Repair parts are stocked and sold by the sales offices listed under the section “Trane Sales Offices.”

20a. Terms and Conditions for any other services.
None.

21. List of Service and Distribution Points:
See Attached List of Trane Sales Offices.

22. List of Participating Dealers:
See Attached List of Trane Sales Offices.

23. Preventive Maintenance:
Preventive Maintenance is performed by the sales offices shown on attached list of Trane Sales Offices.

24a. Environmental Attributes (e.g., recycled content, energy efficiency, and/or reduced pollutants):

The right HVAC system is critical to green building and there are many HVAC strategies to help address energy, indoor environmental quality and water elements that in turn, can help earn LEED credits. Trane, as a leading global supplier of HVAC systems, services and solutions, helps achieve green building goals. Here are just some of the ways that Trane offering is helping buildings go green and attain LEED certification.

Designing and Engineering Your Green Building - TRACE™ 700 is the complete design tool for load, system, energy and economic analysis, and is used to earn LEED EAc1 points. TRACE 700 complies with Appendix G for Performance Rating Method of ASHRAE Standard 90.1-2007 for LEED analysis, and was the first simulation software approved by the IRS for energy-savings certification (EPAct). TRACE is also tested in compliance with ANSI/ASHRAE Standard 140–2007.

Constructing Your Green Building - EarthWise™ Systems use state-of-the-art Trane products, systems and controls to optimize performance. This includes the ability to balance installed cost and operating cost while improving comfort, indoor air quality, and acoustics. EarthWise Systems provide high efficiency/low emissions performance that can be documented over the entire lifetime of the building.

EarthWise™ CenTraVac Chillers are rated by the U.S. Environmental Protection Agency as best-in-class energy-efficient designs and FEMP designation. CenTraVac Chillers are also a three time Climate Protection Award winner as the most energy-efficient, lowest-emission large chillers available and are the only chillers in the world to earn Environmental Product Declaration (EPD) registration following the requirements of ISO 14025.

Voyager™, Precedent™, and Intellipak™ commercial rooftop air conditioner units and Odyssey™ split system performance meets or exceeds ASHRAE 90.1 standard. This standard sets acceptable energy efficiency performance requirements and is used by the DOE for both NAECA and EPAct. Some product lines have 2 or 3 tiers of efficiency levels available to choose from and some Voyager™ Model TC* and YC* are Energy Star.

Trane Axiom™ water-source heat pumps (WSHP) deliver high-performance heating and cooling with exceptional efficiency: up to 40 EER on select systems. Within Trane’s WSHP line, units are offered for the application of Geothermal and other WSHP systems that help your buildings work better and is a highly efficient technology that uses the ground as a heat source in winter and as a heat sink in summer. Technology is considered a Renewable Energy.

Operating and Controlling Your Green Building - Tracer™ controls provide advanced control of complex systems to achieve energy savings and measure performance. Trane 2,000 factory-authorized service professionals, over 300 LEED AP Certified, and over 145 Certified Energy Managers contribute to efficient and sustainable building operations.

Products are identified with environmentally sustainable products symbols in Trane Price List (Catalog or GSA Advantage) as appropriate. Trane currently has products with the following sustainable products symbol designations.
### TRANE SALES OFFICES

<table>
<thead>
<tr>
<th>TRANE COMPANY-OWNED LOCAL SALES OFFICE</th>
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<tbody>
<tr>
<td><strong>Albany, NY – Central New York</strong></td>
<td></td>
</tr>
<tr>
<td>(518) 785-1315</td>
<td></td>
</tr>
<tr>
<td>FAX: (518) 785-4359 - Sales</td>
<td></td>
</tr>
<tr>
<td>301 Old Niskayuna Road, Latham, New York 12110-2214</td>
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| **Albuquerque, NM**                     |  |
| (505) 884-2044                         |  |
| FAX: (505) 884-2449                   |  |
| 5501 San Diego Avenue NE, Albuquerque, New Mexico 87113 |  |

| **Allentown, PA**                      |  |
| (484) 223-1730                         |  |
| FAX: (484) 2231-1824                  |  |
| 3925 Tilghman Street, Suite 70, Allentown, PA 18104 |  |

| **Anchorage, AK**                      |  |
| (907) 267-7400                         |  |
| FAX: (907) 267-7481                   |  |
| 12011 Industry Way, Bldg C1, Anchorage, AK 99515 |  |

| **Appleton, WI**                       |  |
| (920) 734-4531                         |  |
| FAX: (920) 734-2044                   |  |
| 2500 N. Lyndale Drive, Appleton, Wisconsin 54914 |  |

| **Asheville, NC**                      |  |
| (828) 377-8664                         |  |
| FAX: (828) 377-5848                   |  |
| 1400 Sweeten Creek Road, Asheville, NC 28803 |  |

| **Atlanta, GA**                        |  |
| (404) 321-7500                         |  |
| FAX: (404) 636-5204                   |  |
| 4000 Dekalb Technology Pkwy, Suite 100, Atlanta, Georgia 30340 |  |

| **Augusta, GA**                        |  |
| (706) 738-8157                         |  |
| FAX: (706) 738-7842                   |  |
| 3342 Commerce Drive, Augusta, GA 30909 |  |

| **Austin, TX**                         |  |
| (512) 416-8822                         |  |
| FAX: (512) 416-8894                   |  |
| 9801 Metric Blvd., Suite 400, Austin, TX 78758 |  |

| **Baltimore, MD**                      |  |
| (410) 403-2200                         |  |
| FAX: (410) 403-2225                   |  |
| 10947 Golden West Drive, Suite 100, Hunt Valley, Maryland 21031 |  |

| **Baton Rouge, LA**                    |  |
| (225) 298-4280                         |  |
| FAX: (225) 291-9472                   |  |
| 11534 Cloverland Avenue, Baton Rouge, LA 70879-8158 |  |

| **Birmingham, AL**                     |  |
| (205) 747-4000                         |  |
| FAX: (205) 747-4006                   |  |
| 1030 London Drive, Suite 100, Birmingham, Alabama 35211 |  |

| **Boston, MA**                         |  |
| (781) 938-9700                         |  |
| FAX: (781) 938-8912                   |  |
| 181 Ballardvale Street, Wilmington, Massachusetts 01887 |  |

| **Burlington, VT**                     |  |
| (802) 364-3816                         |  |
| FAX: (802) 364-5093                   |  |
| 175 Leroy Road, Williston, VT 05495 |  |

| **Cape Girardeau, MO**                 |  |
| (573) 334-0591                         |  |
| FAX: (573) 334-0680                   |  |
| 1078 Wolverine Lane #D, Cape Girardeau, MO 63701 |  |

| **Charleston, SC**                     |  |
| (843) 375-4775                         |  |
| FAX: (843) 375-4776                   |  |
| 2011 Clements Ferry Road, Charleston, SC 29492 |  |

| **Charlotte, NC**                      |  |
| (704) 525-9600                         |  |
| FAX: (704) 525-8582                   |  |
| 4501 South Tryon Street, P.O. Box 240605 (28224) | Charlotte, North Carolina 28217 |  |

| **Chattanooga, TN**                     |  |
| (223) 295-2000                         |  |
| FAX: (223) 295-2019                   |  |
| 6138 Preservation Drive, Suite 500, Chattanooga, TN 37416 |  |

| **Chicago, IL**                        |  |
| (630) 734-3200                         |  |
| FAX: (630) 782-2040                   |  |
| 7100 South Madison, Willowbrook, Illinois 60527-5505 |  |

| **Cincinnati, OH**                     |  |
| (513) 771-8884                         |  |
| FAX: (513) 772-7281                   |  |
| 10300 Springfield Pike, Cincinnati, Ohio 45215 |  |

| **Colorado Springs, CO**               |  |
| (719) 999-3900                         |  |
| FAX: (719) 268-0304                   |  |
| 1424 N. Nevada Avenue, Colorado Springs, CO 80907 |  |

| **Columbia, SC**                       |  |
| (803) 936-4700                         |  |
| FAX: (803) 936-4715                   |  |
| 111 Lott Court, West Columbia, South Carolina 29169 |  |

| **Columbus, OH**                       |  |
| (614) 473-3500                         |  |
| FAX: (614) 473-3501                   |  |
| 2300 City Gate Drive, Suite 100, Columbus, Ohio 43219-3652 |  |

| **Dallas, TX (TSO)**                   |  |
| (972) 406-6000                         |  |
| FAX: (972) 243-1398                   |  |
| P.O. Box 814609, Dallas, Texas 75381-4609 | 1400 Valwood Parkway, Suite 100, Carrollton, Texas 75006 |  |

| **Davenport, IA**                      |  |
| (563) 468-4000                         |  |
| FAX: (563) 391-0277                   |  |
| 4801 Grand Ave., Davenport, Iowa 52807 |  |

| **Denver, CO**                         |  |
| (303) 228-3300                         |  |
| FAX: (303) 228-2828                   |  |
| 445 Bryant St., Unit 5, Denver, Colorado 80204 |  |

| **Detroit, MI**                        |  |
| (313) 228-3300                         |  |
| FAX: (313) 228-2828                   |  |
| 445 Bryant St., Unit 5, Detroit, MI 48223 |  |

| **El Paso, TX**                        |  |
| (915) 593-3484                         |  |
| FAX: (915) 593-3490                   |  |
| 1405 Vanderbilt Drive, El Paso, TX 79935 |  |

| **Fargo, ND**                          |  |
| (701) 235-0521                         |  |
| FAX: (701) 293-3136                   |  |
| 300 45th Street SW, Fargo, North Dakota 58103 |  |
FAX: (973) 887-8844
4 Wood Hollow Road
Parsippany, New Jersey 07054-0436

Oklahoma, OK
(405) 787-2237
FAX: (405) 787-0752
305 Hudiburg Circle
Oklahoma City, Oklahoma 73108

Omaha, NE
(402) 331-7111
FAX: (402) 331-5200
5720 S. 77th Street
Ralston, Nebraska 68127-4202

Orlando, FL
(407) 660-1111
FAX: (407) 660-0303
2301 Lucien Way, Suite 430
Maitland, FL 32751

Pensacola, FL
(850) 473-3840
FAX: (850) 505-9915
580 East Burgess Road
Pensacola, FL 32504

Phoenix, AZ
(602) 258-3513
FAX: (602) 258-0171
850 West Southern Ave
Tempe, Arizona 85282

Pittsburgh, PA
(412) 747-3000
FAX: (412) 747-4550
305 Hudiburg Circle
Oklahoma City, Oklahoma 73108

Portland, ME
(207) 828-1777
FAX: (207) 828-1511
860 Spring St. Unit 1
Westbrook, Maine 04092

Providence, RI
(401) 434-3145
FAX: (401) 434-8537
50 Vision Blvd.
East Providence, Rhode Island 02914

Rapid City, SD
(605) 342-7929
FAX: (605) 342-7930
6807 Sturgie Road
Black Hawk, SD 57718

Reno, NV
(775) 856-3343
FAX: (775) 856-1704
5595 Equity Avenue, Suite 100
Reno, Nevada 89502

Richmond, VA
(804) 747-3588
FAX: (804) 273-0119
10040 Lakeridge Parkway, Suite 100
Ashland, Virginia 23005

Roanoke, VA
(540) 563-2828
FAX: (540) 566-4958
2303 Tran Drive
Roanoke, Virginia 24017

Rochester, NY – Central New York
(585) 256-2500
FAX: (585) 256-0067
75 Town Centre Drive, Suite 300
Rochester, New York 14623

Salt Lake City, UT (CSO)
(801) 972-3352
FAX: (801) 972-3353
2817 South 1030 West
Salt Lake City, Utah 84119

San Antonio, TX
(210) 657-6091
FAX: (210) 657-1761
9535 Ball Street, Suite 1100
P.O. Box 34597 (78265)
San Antonio, Texas 78217

San Diego, CA
(619) 576-2500
FAX: (619) 576-2554
3565 Corporate Court
San Diego, California 92123

San Juan, PR
(787) 798-0999
PR #1, Km. 25.1,
Banco Quebrada Arenas
San Juan, Puerto Rico 00926-1900

Savannah, GA
(912) 965-0313
FAX: (912) 965-0314
3609 Ogeechee Blvd., Suite A
Savannah, GA 31405

Seattle, WA
(206) 634-4310
FAX: (206) 634-4314
2333 158th Court NE
Bellevue, Washington 98008

Sioux Falls, SD
(605) 336-8500
FAX: (605) 336-0824
3500 South First Avenue, Suite 150
Sioux Falls, SD 57105

South Bend, IN
(574) 288-4914
FAX: (574) 282-4874
2301 Bendix Drive, Suite 400

South Bend, Indiana 46628

Springfield, MA
(413) 746-3090
FAX: (413) 746-0537
90 Carando Drive
Springfield, MA 01104

Springfield, MO
(417) 863-2110
FAX: (417) 863-2111
540 N. Cedarbrook
Springfield, MO 65802-6324

St. Louis, MO
(636) 305-3800
FAX: (636) 349-0601
101 Matrix Commons Drive
Fenton, Missouri 63025

Syracuse, NY – Central New York
(315) 234-1500
FAX: (315) 433-9120
15 Technology Place
East Syracuse, New York 13057

Tallahassee, FL
(850) 574-1726
FAX: (850) 575-5880
109 Hamilton Park Drive, Suite 1
Tallahassee, FL 32304

Tucson, AZ
(520) 748-1234
FAX: (520) 748-1492
4520 S. Coach Drive
Tucson, AZ 85714

Tulsa, OK
(918) 250-5522
FAX: (918) 250-5419
2201 N. Willow Avenue
Broken Arrow, OK 74012

Toledo, OH - CO
(419) 491-2280
FAX: (419) 491-2279
1001 Hamilton Drive
Holland, Ohio 43528

West Palm Beach, FL
(561)- 683-1521
FAX: (561) 697-8714
6965 Vista Parkway North #11
West Palm Beach, FL 33411

Westchester, NY
(914) 593-0303
12 Skyline Drive
Hawthorne, NY 10532

Wilkes Barre, PA
(570) 654-0865
FAX: (570) 654-0861
120 Ida St.
P.O. Box 595 (67201)
Wichita, Kansas 67211

Wichita, KS
(316) 265-9655
FAX: (316) 265-1974
120 Ida St.
P.O. Box 595 (67201)
Wichita, Kansas 67211
TRANE INDEPENDENTLY-OWNED LOCAL SERVICE OFFICES

**Billings, MT**
(406) 248-4882  
FAX: (406) 248-5196  
3311 4th Avenue North, Suite 4  
Billings, MT 59104

**Buffalo, NY**
(716) 626-1260  
FAX: (716) 626-9412  
45 Earhart Drive, Suite 103  
Buffalo, New York 14221

**Charleston, WV**
(304) 346-0549  
FAX: (304) 346-8920  
540 Leon Sullivan Way (25301)  
P.O. Box 627  
Charleston, West Virginia 25322

**Cleveland, OH**
(440) 248-3400  
FAX: (440) 349-6980  
31200 Bainbridge Road  
P.O. Box 76129  
Solon, Ohio 44139

**Dayton, OH**
(937) 264-4343  
FAX: (937) 264-4360  
815 Falls Creek Drive  
Vandalia, OH 45377

**Des Moines, IA**
(515) 270-0004  
FAX: (515) 270-3835  
2220 NW 108th Street  
Clive, Iowa 50325

**Evansville, IN**
(812) 421-8725  
FAX: (812) 421-8735  
1024 East Sycamore Street  
Evansville, IN 47714

**Flint, MI**
(810) 767-7800  
FAX: (810) 767-9058  
5335 Hill 23 Drive  
Flint, Michigan 48507

**Fort Myers, FL**
(239) 275-9420  
FAX: (239) 275-9775  
6461 Topaz Court, Suite 1  
Fort Myers, FL 33966

**Great Falls, MT**
(406) 727-5111

**Greensboro, NC**
(336) 378-0670  
FAX: (336) 274-7487  
1915 N. Church Street  
P.O. Box 13587 (27415-3587)  
Greensboro, North Carolina 27405

**Houston, TX**
(713) 266-3900  
FAX: (713) 266-7011  
10555 Westpark Drive  
Houston, Texas 77042

**Jackson, MS**
(601) 956-9211  
FAX: (601) 957-9340  
746 S. Ridgewood Road  
P.O. Box 1557 (39158)  
Jackson, Mississippi 39157

**Lansing, MI**
(517) 337-6517  
FAX: (517) 337-9493  
3350 Pine Tree Road  
Lansing, Michigan 48911

**Las Vegas, NV**
(702) 876-7530  
FAX: (702) 876-5106  
3036 S. Valley View Blvd.  
Las Vegas, Nevada 89102

**Lexington, KY**
(859) 514-7000  
FAX: (859) 514-7870  
2350 Fortune Drive  
Lexington, KY 40509-4125

**Little Rock, AR**
(501) 661-0621  
FAX: (501) 661-9109  
1501 Westpark, Suite 9  
Little Rock, Arkansas 72204-2457

**Louisville, KY**
(502) 499-7000  
FAX: (502) 499-7870  
12700 Plantside Drive  
Louisville, Kentucky 40299-6387

**Norfolk, VA**
(757) 558-0200  
FAX: (757) 558-9715  
1100 Cavalier Blvd.  
P.O. Box 6276  
Norfolk, Virginia 23323

**Oakland, CA**
(510) 433-8940  
FAX: (510) 433-8954  
383 4th Street, #202  
Oakland, CA 94607

**Peoria, IL**
(309) 691-4224  
FAX: (309) 691-1366  
8718 N. University  
Peoria, Illinois 61615-1681

**Philadelphia, PA**
(610) 962-1600  
FAX: (612) 962-0230  
3606 Horizon Drive  
P.O. Box 1549  
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**Portland, OR**
(503) 620-8031  
FAX: (503) 639-1454  
Mailing Address:  
P.O. Box 23579  
Tigard, Oregon 97281  
Office Location:  
7257 SW Kable Lane  
Portland, Oregon 97224

**Raleigh, NC**
(919) 781-0458  
FAX: (919) 781-9195  
401 Kitty Hawk Drive  
Morrisville, NC 27560

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(408) 481-3600  
FAX: (408) 481-3666  
310 Soquel Way  
Sunnyvale, California 94085-4101

**Santa Rosa, CA**
(707) 542-4213  
FAX: (707) 542-9206  
987 Airway Court, Suite 18  
Santa Rosa, CA 95403

**Shreveport, LA**
(318) 865-5663  
FAX: (318) 861-8481  
P.O. Box 6761  
504 W. 67th Street  
Shreveport, Louisiana 71106

**Washington, DC**
(240) 306-3000  
FAX: (240) 306-3400  
30 W. Watkins Mill Road  
Gaithersburg, MD 20878

**Spokane, WA**
(509) 535-9057  
FAX: (509) 535-4354  
715 N. Hogan St.  
P.O. Box 3304  
Spokane, Washington 99220

**Tampa, FL**
(813) 877-8251  
FAX: (813) 877-8257  
902 Himes Avenue (33609)  
P.O. Box 18547 (33679)  
Tampa, Florida
<table>
<thead>
<tr>
<th>Wilmington, DE</th>
<th>Wilmington, NC</th>
</tr>
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<tbody>
<tr>
<td>(302) 395-0200</td>
<td>(910) 792-0339</td>
</tr>
<tr>
<td>FAX: (302) 395-0700</td>
<td></td>
</tr>
<tr>
<td>66 Southgate Blvd.</td>
<td></td>
</tr>
<tr>
<td>New Castle, Delaware 19720</td>
<td>6736 Netherlands Drive, Suite A</td>
</tr>
<tr>
<td></td>
<td>Wilmington, NC 28405</td>
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</table>

END OF TRANE SALES OFFICES
## Rotary Liquid Chillers & Scroll Liquid Chillers

**Water-Cooled Series R Rotary Liquid Chillers, Air-Cooled Series R Rotary Liquid Chillers, Water-Cooled and Condenser less Scroll Liquid Chillers, and Water-Cooled and Condenser less Series R Rotary Liquid Chillers**

<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
<th>Product Description</th>
<th>Product Code</th>
<th>GSA Price</th>
<th>Ecolabel</th>
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<tbody>
<tr>
<td>334512</td>
<td>RTHD</td>
<td>Water-Cooled Series R® Rotary Liquid Chillers (175-450 Tons) - Utilize a single compressor/single circuit design with R-134a refrigerant. This model uses the CH530 control panel.</td>
<td>153</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>CGAM</td>
<td>Air-Cooled Scroll Liquid Chillers (20-130 Tons) Uses HFC-410A refrigerant</td>
<td>664</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>RTAC</td>
<td>Air Cooled Series R® Rotary Liquid Chillers (130-500 Tons)</td>
<td>154</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>RTWD</td>
<td>Water-Cooled Series R Rotary Liquid Chillers (60-250 tons)</td>
<td>703</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>RTAE</td>
<td>StealthTM Helical Rotary Chiller (Model RTAE, 150-300 tons)</td>
<td>895</td>
<td>See Note 1 Below</td>
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</tr>
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</table>

### NOTES:

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.
## CenTraVac™ Water-Cooled Centrifugal Liquid Chillers

<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
<th>Product Description</th>
<th>Product Code</th>
<th>GSA Price</th>
<th>Ecolabel</th>
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</thead>
<tbody>
<tr>
<td>334512</td>
<td>CVHE</td>
<td>CenTraVac™ Water-Cooled Centrifugal Liquid Chillers (120-500 Tons)</td>
<td>347</td>
<td>See Note 1 Below</td>
<td><img src="image" alt="FEMP" /></td>
</tr>
<tr>
<td>334512</td>
<td>CVHF</td>
<td>CenTraVac™ Water-Cooled Centrifugal Liquid Chillers (325-2000 Tons)</td>
<td>347</td>
<td>See Note 1 Below</td>
<td><img src="image" alt="FEMP" /></td>
</tr>
<tr>
<td>334512</td>
<td>CVHL</td>
<td>CenTraVac™ Centrifugal Water-Cooled Chillers - Series L (400-1800 Tons)</td>
<td>347</td>
<td>See Note 1 Below</td>
<td><img src="image" alt="FEMP" /></td>
</tr>
<tr>
<td>334512</td>
<td>CVHS</td>
<td>CenTraVac™ Centrifugal Water-Cooled Chillers - Series S (180-390 Tons)</td>
<td>047</td>
<td>See Note 1 Below</td>
<td><img src="image" alt="FEMP" /></td>
</tr>
<tr>
<td>334512</td>
<td>CDHF</td>
<td>CenTraVac™ Water-Cooled Centrifugal Liquid Chillers (1500-3950 Tons)</td>
<td>347</td>
<td>See Note 1 Below</td>
<td><img src="image" alt="FEMP" /></td>
</tr>
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### NOTES:

1. **GSA Pricing:** A Customer should contact Trane for information on pricing and equipment specifications and configurations for the model centrifugal liquid chiller appropriate for the ordering office's needs.

2. **Centrifugal Chiller models:** Those that are configured and selected to achieve an energy efficiency performance better than 0.55 kW/ton are given the "Earthwise™" designation. The purchaser must contact his Trane representative to analyze selection options, chiller performance, pricing, and life-cycle cost benefits in choosing an Earthwise™ model that meets the specific job performance requirements. Earthwise™ chillers conform to the requirements of Executive Order 13123 by being in the top 25th percentile of efficiency for Centrifugal Chiller products sold in the marketplace. Earthwise™ chillers exceed the minimum performance recommendations established by the DOE, Federal Energy Management Program. Trane's Earthwise™ Chiller has received the EPA's Climate Protection Award or being the highest in energy efficiency and lowest in refrigerant emissions.

3. **FEMP ecolabel:** Products showing the FEMP ecolabel meet Federal Energy Management Program (FEMP) recommended performance standards that are in the upper 25% of energy efficiency of that product group, and required under Federal Acquisition Regulation (FAR) Subpart 23.2.
## Air-Cooled Liquid Chillers, Single-Zone Rooftop Air Conditioners, and Split System Air-Cooled Condensing Units

<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
<th>Product Description</th>
<th>Product Code</th>
<th>GSA Price</th>
<th>Ecolabel</th>
</tr>
</thead>
<tbody>
<tr>
<td>334512</td>
<td>YC*, TC*, TE*</td>
<td>Single-Zone Rooftop Air Conditioners (27 1/2 - 50 tons) Voyager</td>
<td>382</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>S*HL</td>
<td>Single-Zone Rooftop Air Conditioners (20 - 75 tons) IntelliPak</td>
<td>383</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>RAUJ</td>
<td>Split System Air-Cooled Condensing Units (20 - 60 tons)</td>
<td>361</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>RAUJ</td>
<td>Split System Air-Cooled Condensing Units (80 - 120 tons)</td>
<td>362</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>CAUC</td>
<td>Split System Air-Cooled Condensing Units (20 - 60 tons)</td>
<td>385</td>
<td>See Note 1 Below</td>
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</tr>
<tr>
<td>334512</td>
<td>CAUC</td>
<td>Split System Air-Cooled Condensing Units (80 - 120 tons)</td>
<td>386</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>TC*</td>
<td>Voyager 11 Access - 12.5-25 Ton - Packaged Optional Electric Heat/Cooling Rooftop Unit</td>
<td>463</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>WC*</td>
<td>Voyager 11 Access - 12.5-20 Ton - Packaged Heat Pump/Cooling Rooftop Unit</td>
<td>465</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>YC*</td>
<td>Voyager 11 Access - 12.5-25 Ton - Packaged Gas Heat/Cooling Rooftop Unit</td>
<td>467</td>
<td>See Note 1 Below</td>
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</tr>
<tr>
<td>334512</td>
<td>BAY*, FIY*</td>
<td>Voyager 11 Access - 12.5-25 Ton - Accessories</td>
<td>390</td>
<td>See Note 1 Below</td>
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</table>

**NOTES:**

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.
# Split System Units

<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
<th>Product Description</th>
<th>Product Code</th>
<th>GSA Price</th>
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</thead>
<tbody>
<tr>
<td>334512</td>
<td>TWA</td>
<td>Odyssey Split System Heat Pumps (6-20 Tons, 60 HZ)</td>
<td>411</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>TWE</td>
<td>Odyssey Split System Air Handlers (5-20 Tons, 60 HZ)</td>
<td>416</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>TTA</td>
<td>Odyssey Split System Air Conditioners Handlees (5-20 Tons, 60 HZ)</td>
<td>419</td>
<td>See Note 1 Below</td>
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<tr>
<td>334512</td>
<td>351</td>
<td>Odyssey Split System Accessoriers</td>
<td>351</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.
## Light Commercial (LCU) & Small Split Systems

<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
<th>Product Description</th>
<th>Product Code</th>
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</thead>
<tbody>
<tr>
<td>334512</td>
<td>161</td>
<td>Light Commercial Unit (LCU) Heaters</td>
<td>161</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>425</td>
<td>Accessories for Small Split Systems, Single Phase</td>
<td>425</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>428</td>
<td>Small Split System Heat Pumps, Single Phase</td>
<td>428</td>
<td>See Note 1 Below</td>
<td></td>
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</tbody>
</table>

### NOTES:

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.
## Split System Air Handlers

<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
<th>Product Description</th>
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<tbody>
<tr>
<td>334512</td>
<td>391</td>
<td>Small Split System Air Handler Accessories</td>
<td>391</td>
<td>See Note 1 Below</td>
<td></td>
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<tr>
<td>334512</td>
<td>420</td>
<td>Small Split System Air Handlers, Single Phase, Hyperion &amp; XB TEM</td>
<td>420</td>
<td>See Note 1 Below</td>
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</tr>
</tbody>
</table>

### NOTES:

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.
<table>
<thead>
<tr>
<th>SIN</th>
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<th>Product Description</th>
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<th>Ecolabel</th>
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</thead>
<tbody>
<tr>
<td>334512</td>
<td>Y*C</td>
<td>Precedent™ GE, 3-10 Tons Gas/Electric Packaged Rooftop Unit, 3 phase 60Hz</td>
<td>514</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>WSC</td>
<td>Precedent™ HP, 3-10 Tons Heat Pump Packaged Rooftop Unit, 3 phase 60Hz</td>
<td>516</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>T*C</td>
<td>Precedent™ AC 3-10 Tons Cooling Packaged Rooftop Unit, 3 phase 60Hz</td>
<td>518</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>Y*C</td>
<td>Precedent™ Packaged Rooftop AC products, 3-5 Tons, Gas/Electric, single phase 60 Hz</td>
<td>513</td>
<td>See Note 1 Below</td>
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</tr>
<tr>
<td>334512</td>
<td>WSC</td>
<td>Precedent™ Packaged Rooftop AC products, 3-5 Tons, Heat Pump, single phase 60 Hz</td>
<td>515</td>
<td>See Note 1 Below</td>
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</tr>
<tr>
<td>334512</td>
<td>T*C</td>
<td>Precedent™ Packaged Rooftop AC products, 3-5 Tons, Cooling, single phase 60 Hz</td>
<td>517</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>BAY*, SEN*</td>
<td>Precedent G/E - 3-10 Ton Accessories</td>
<td>289</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>YHC**7</td>
<td>Precedent™ 17 Plus Packaged Rooftop Air Conditioner, 17.5 SEER, 3-5 Tons, Gas/Electric, 3 phase 60 Hz</td>
<td>514</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>THC**7</td>
<td>Precedent™ 17 Plus Packaged Rooftop Air Conditioner, 17.5 SEER, 3-5 Tons, Cooling, 3 phase 60 Hz</td>
<td>518</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>YZC</td>
<td>Precedent™ eFlex™ Technology Packaged Rooftop Air Conditioners, 20 SEER, 3 – 5 Tons, DX Cooling and gas heat and, 3 phase 60 Hz</td>
<td>514</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
<tr>
<td>334512</td>
<td>TZC</td>
<td>Precedent™ eFlex™ Technology Packaged Rooftop Air Conditioners, 20 SEER, 3 – 5 Tons, DX Cooling and electric heat, 3 phase 60 Hz</td>
<td>518</td>
<td>See Note 1 Below</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.
<table>
<thead>
<tr>
<th>SIN</th>
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<tbody>
<tr>
<td>334512</td>
<td>50</td>
<td>Performance Climate Changer™ Air Handler - Unit Sizes 3-120.</td>
<td>50</td>
<td>See Note 1 Below</td>
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<tr>
<td>334512</td>
<td>200</td>
<td>Low Voltage Controls for Climate Changer Air Handling Units</td>
<td>200</td>
<td>See Note 1 Below</td>
<td></td>
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<tr>
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<td>958</td>
<td>Performance Climate Changers air handler UCCA</td>
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<td>Performance Climate Changers air handler controls</td>
<td>959</td>
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</tbody>
</table>

**NOTES:**

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.
# Water Source Heat Pumps

<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
<th>Product Description</th>
<th>Product Code</th>
<th>GSA Price</th>
<th>Ecolabel</th>
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<tbody>
<tr>
<td>334512</td>
<td>EXVE</td>
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**NOTES:**

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.

(2) All Units include Condensate Overflow, Copper Heat Exchanger and 24V Controls.
## Unit Ventilators

<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
<th>Product Description</th>
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<td>334512</td>
<td>VUVB</td>
<td>Vertical Classroom Unit Ventilators</td>
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<td>HUVB</td>
<td>Horizontal Classroom Unit Ventilators</td>
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<td>SHLA</td>
<td>Unit Ventilator Shelving and Accessories</td>
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<td>See Note 1 Below</td>
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<td>Wall Boxes</td>
<td>Unit Ventilator Accessories</td>
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**NOTES:**

(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office’s needs.
<table>
<thead>
<tr>
<th>SIN</th>
<th>Model Number</th>
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<tr>
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<td>081</td>
<td>Cooling Coils</td>
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<td>082</td>
<td>Heating Coils</td>
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<td>UniTrane Fan Coil Controls</td>
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<td>FF</td>
<td>Force-Flo Cabinet Heater</td>
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<td>See Note 1 Below</td>
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<td>334512</td>
<td>FC</td>
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<td>334512</td>
<td>BC</td>
<td>Blower Coil Air Handler</td>
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<td>334512</td>
<td>292</td>
<td>Blower Coil Controls</td>
<td>292</td>
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</table>

**NOTES:**
(1) GSA Pricing: A Customer should contact Trane for information on pricing and equipment specifications and configurations for the products to ensure appropriate for the ordering office's needs.
<table>
<thead>
<tr>
<th>SIN Number</th>
<th>Model Number</th>
<th>Product Description</th>
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<th>GSA Price</th>
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<tbody>
<tr>
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<td>4020 1199</td>
<td>Rover-Software Upgrade Package (s/w)</td>
<td>104</td>
<td>$213.30</td>
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<td>334512</td>
<td>X4509151301</td>
<td>Kit - Tracer TU Complete</td>
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### Service Tools

<table>
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<tbody>
<tr>
<td>334512</td>
<td>X13651612010</td>
<td>Tracer Communication Bridge (Comm3 &amp; Comm4): BMTW &amp; BMTS to BMTB Retrofit Kit</td>
<td>159</td>
<td>$1,043.02</td>
</tr>
<tr>
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<td>X13651613010</td>
<td>Tracer Communication Bridge (Comm3 &amp; Comm4): BMTB Frame Mount</td>
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<td>Tracer Communication Bridge (Comm3 &amp; Comm4): Tracer 100 to BMTB Retrofit Kit</td>
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<td>334512</td>
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<td>Tracer Communication Bridge (Comm3 &amp; Comm4): BMTB with Enclosure 120VAC</td>
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### Trace Communications Bridges

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<tr>
<td>334512</td>
<td>X13790968010</td>
<td>WCS-SD BAA (Display Sensor)</td>
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<td>WCS-SB BAA (Base Sensor)</td>
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### Wireless Controls

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<td>334512</td>
<td>501897940100</td>
<td>Metal Enclosure, UC210</td>
<td>1251</td>
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## Building Automation Systems (BAS) Training Seminars
### Trane University Course Listing

<table>
<thead>
<tr>
<th>SIN Number</th>
<th>Course Number</th>
<th>Course Name</th>
<th>Course Length</th>
<th>GSA Price</th>
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</thead>
<tbody>
<tr>
<td>334512</td>
<td>BSC01</td>
<td>Tracer Summit System Operation</td>
<td>3.5 days</td>
<td>$1,550.00</td>
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<tr>
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<td>BSC02</td>
<td>Tracer Summit 101</td>
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<td>BSC03</td>
<td>Tracer Summit 102</td>
<td>4.5 days</td>
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<td>BSC04</td>
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<td>Tracer SC+ 102</td>
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<td>BSC08</td>
<td>TGP2 Application</td>
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<td>BSC09</td>
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<td>BSC10</td>
<td>Tracer Ensemble Installation</td>
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### Technical Service Training

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>TS01</td>
<td>Air Conditioning Service</td>
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<td>Commercial Systems Service</td>
<td>4.5 days</td>
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<td>TS03</td>
<td>Airside System Service</td>
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<td>$1,800.00</td>
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<td>334512</td>
<td>TS04</td>
<td>HVAC Electrical Troubleshooting</td>
<td>4.5 days</td>
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<td>334512</td>
<td>TS05</td>
<td>Chilled Water Systems Service</td>
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<td>334512</td>
<td>TS06</td>
<td>CenTraVac System Operations &amp; Maintenance</td>
<td>3.5 days</td>
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<td>CenTraVac Electronic Controls</td>
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<td>Precedent Voyager Rooftops (3-25 ton)</td>
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### Online Classes

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<th>Length</th>
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<td>TS19</td>
<td>IntelliPak Human Interface Navigation &amp; Status Menu</td>
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<td>TS20</td>
<td>ReliaTel Zone Sensor Testing</td>
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### Training Packages

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<th>SIN Number</th>
<th>Course Number</th>
<th>Course Name</th>
<th>Course Length</th>
<th>Price</th>
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<td>PTP01</td>
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## NOTES:
1. Building Automation System (BAS): Comprised of all of the components of a building control system that provides comfort, view-ability, operability and control of a commercial building’s mechanical and other systems.
2. Training Packages: Customer controls attendee list and pays Trane U.S. Inc. a fixed rate dependent upon number of days training requested and type of training listed above. Trane University supplies instructor, all equipment needed, and any teaching materials.
### Online Virtual Module Training Courses

<table>
<thead>
<tr>
<th>SIN Number</th>
<th>Course Number</th>
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<td>334512</td>
<td>VM1</td>
<td>Foundations of Chilled Water Systems</td>
<td>16 hours</td>
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<td>334512</td>
<td>VM2</td>
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<td>3 hours</td>
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<tr>
<td>334512</td>
<td>VM3</td>
<td>Tracer Ensemble: The Power of Dashboards and Reports</td>
<td>3 hours</td>
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<tr>
<td>334512</td>
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<td>Tracer Ensemble: User and System Customization for Optimal Performance</td>
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<td>Tracer Ensemble: Utilizing Data Logs, Managing Schedules</td>
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<td>$300.00</td>
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<td>VM12</td>
<td>ACRA/RTAE Chiller, Power Options and Compressor</td>
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<td>ACRA/RTAE Condenser Evaporator Construction Operation</td>
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<td>Air Conditioning Service - Refrigeration Components and Troubleshooting</td>
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<td>VM16</td>
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<td>25 Ton Air Cooled Chiller</td>
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<td>155 Ton Air Cooled Chiller</td>
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<td>250 Ton Air Cooled Chiller</td>
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<td>7.5/10 HP Pump</td>
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<td>15/20 HP Pump</td>
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<td>750 kV Transformer</td>
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<td>10 Ton DX (Direct Exchange Refrigerant) Vertical Tent Unit</td>
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<td>20 Ton DX (Direct Exchange Refrigerant) Vertical Tent Unit</td>
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<td>25 Ton DX/Voyager (Direct Exchange Refrigerant) Unit</td>
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<td>500 Ton Tower (mounted on 48 foot step-deck trailer)</td>
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<td>12&quot; Flex Duct [contains (4) 25 foot sections Black]</td>
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<td>2/0 Cable Box (4) 100' Sections of Electric Cable</td>
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<td>4/0 Cable Box (4) 100' Section of Electric Cable</td>
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<td>48 foot Flatbed Trailer</td>
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<td>140kW Generator - 16 hour run rate</td>
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<td>Product Code</td>
<td>GSA Monthly Rental Rate</td>
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<td>24H500</td>
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NOTES:

(1) The total monthly Rental Rate equals the GSA Monthly Rental Rate multiplied by both the Time of Year Multiplier and the Multi-Month Rental Multiplier.
(2) The **Time of Year Multiplier** is set out in the Table below.

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<th>FEB</th>
<th>MAR</th>
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<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
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</tr>
</tbody>
</table>

(3) The **Multi-Month Rental Multiplier** is set out in the Table below.

<table>
<thead>
<tr>
<th>Months</th>
<th>&lt; 2</th>
<th>3 - 6</th>
<th>&gt; 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplier</td>
<td>1</td>
<td>0.85</td>
<td>0.75</td>
</tr>
</tbody>
</table>

(4) The Time of Year and Multi-Month Rental Multipliers are not applied to the Rental Rate for Electric Cable.
(5) For rental periods that include partial months, the Rental Rates will be calculated as follows:

**First Month**

<table>
<thead>
<tr>
<th>Rate Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly Rate</td>
<td>1/3 Monthly Rate</td>
</tr>
<tr>
<td>Daily Rate</td>
<td>1/3 Weekly Rate</td>
</tr>
</tbody>
</table>

**Ending Month**

<table>
<thead>
<tr>
<th>Rate Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly Rate</td>
<td>1/3 Monthly Rate</td>
</tr>
<tr>
<td>Daily Rate</td>
<td>1/3 Weekly Rate</td>
</tr>
</tbody>
</table>

(6) **Freight Charges** - Equipment is to be shipped from and returned to Trane designated storage locations with outbound and return freight prepaid by Trane.
(7) **Transformers** - Lugs for transformers must be provided by others and are not included. Transformers kVA 300, 500, 750 are for 208, 240, 480, & 600 Volts. Transformers kVA 1,000 & 1,500 (and some 750's) are for 480, 600, 2400, & 4160 Volts.
(8) **Electric Cable** - The Time of Year and Multi-Month Rental Multipliers are not applied to the rental rate for Electric Cable. Each 2/0 awg or 4/0 awg cable box contains (4) 100-ft sections, (4) 15-ft male pigtails, and (4) 15-ft female pigtails. If pricing electrical cable boxes please note multiple runs per phase might be required depending on the actual unit chosen. Please call Trane Rental Services at 800-755-5115 for any electrical questions regarding Trane Rental cable boxes. Wiring is only provided for 460V side. If a transformer is required the wiring for the building side must be provided by others.
(9) **Chillers** – 300-ton Air-Cooled chiller pricing includes trailer and chiller is on trailer. 400-ton and 500-ton Air-Cooled chiller pricing includes trailer, pump, and 200-ft hose kit of 6-in hose. All Water-Cooled chillers are stored in Charlotte, NC and shipped with a Nitrogen holding change. Refrigerant will be shipped in cylinders on the trailer. The chiller will need to be charged at delivery and the refrigerant recovered before it is sent back.
(10) **Pumps** – Pumps do not have wiring. This must be provided by others.
(11) **Ancillary Items** – Items such as pumps, hose kits, transformers, trailers, and electrical cable can only be rented with a chiller or DX unit. Trane Rentals does not rent these items as stand-alone items.
(12) **Generator Freight Charges** – Generator freight is not included in the generator rental rates. Roundtrip freight for generators will be based on actual freight charges. An estimate of the freight charges can be provided at the time the rental agreement is executed.
(13) **Generator Fueling** – Is not included in the rental rates above and is the responsibility of the Customer.
(14) **GSA Monthly Rental Rate.** A Customer should contact Trane for information on pricing and equipment specifications and configurations for Rental products to ensure appropriate for the ordering office’s needs.
<table>
<thead>
<tr>
<th>SIN Number</th>
<th>Product Description</th>
<th>GSA Price for Standard License (Part Number)</th>
<th>GSA Price for Additional License/Seat (Part Number)</th>
<th>GSA Price for LAN/Site License (Part Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>334512</td>
<td>TRACE 3D Plus Load Design</td>
<td>$845.00 CDS-PKG-X</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>334512</td>
<td>TRACE 3D Plus Load Design – Limited</td>
<td>N/A</td>
<td>$145.00 CDS-PKG-X2</td>
<td>$1,195.00 CDS-PKG-X1</td>
</tr>
<tr>
<td>334512</td>
<td>TRACE 3D Plus Load Design - Enterprise</td>
<td>N/A</td>
<td>$245.00 CDS-PKG-X4</td>
<td>$2,495.00 CDS-PKG-X3</td>
</tr>
<tr>
<td>334512</td>
<td>TRACE 3D Plus Load Design – Global</td>
<td>N/A</td>
<td>Unlimited Included</td>
<td>$14,995.00 CDS-PKG-X5</td>
</tr>
<tr>
<td>334512</td>
<td>TRACE 3D Plus</td>
<td>$2,345.00 CDS-PKG-Y</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>334512</td>
<td>TRACE 3D Plus – Limited Enterprise</td>
<td>N/A</td>
<td>$545.00 CDS-PKG-Y2</td>
<td>$3,195.00 CDS-PKG-Y1</td>
</tr>
<tr>
<td>334512</td>
<td>TRACE 3D Plus - Enterprise</td>
<td>N/A</td>
<td>$645.00 CDS-PKG-Y4</td>
<td>$6,995.00 CDS-PKG-Y3</td>
</tr>
<tr>
<td>334512</td>
<td>TRACE 3D Plus – Global Enterprise</td>
<td>N/A</td>
<td>Unlimited Included</td>
<td>$39,995.00 CDS-PKG-Y5</td>
</tr>
<tr>
<td>334512</td>
<td>Academic License Seats</td>
<td>N/A</td>
<td>$40.00 CDS-PKG-ALS</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**NOTES:**
(1) CDS Software is subject to annual licensing fee billed at 29% of GSA Price. Payment of this fee entitles the license.
(2) SITE USERS for TRACE 700 family may install software on multiple, standalone computers at one specific location.
(3) LAN USERS for TRACE 700 family may install software on a LAN. Seats must be purchased for each user.
## Customer Direct Service (CDS) Training Seminars

<table>
<thead>
<tr>
<th>SIN</th>
<th>Course Number</th>
<th>Course Name</th>
<th>Product Code</th>
<th>Unit of Order</th>
<th>Description</th>
<th>GSA Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>334512</td>
<td>CDS-TRNGL0</td>
<td>TRACE 700, LEED®, and ASHRAE Standard 90.1-2007</td>
<td>616</td>
<td>Per Person</td>
<td>1 Day of training at Contractor Site.</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL1</td>
<td>System Analyzer™</td>
<td>616</td>
<td>Per Person</td>
<td>1 Day of training at Contractor Site.</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL2</td>
<td>TRACE 700 Load Design</td>
<td>616</td>
<td>Per Person</td>
<td>1 Day of training at Contractor Site.</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL3</td>
<td>TRACE 700 Energy and Economics</td>
<td>616</td>
<td>Per Person</td>
<td>1 Day of training at Contractor Site.</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL4</td>
<td>TRACE 700 Advanced Topics</td>
<td>616</td>
<td>Per Person</td>
<td>½ Day of training at Contractor Site.</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL5</td>
<td>TRACE 3D Plus Load Design</td>
<td>616</td>
<td>Per Person</td>
<td>1 Day of training at Contractor Site.</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL6</td>
<td>TRACE 3D Plus Energy and Economics</td>
<td>616</td>
<td>Per Person</td>
<td>1 Day of training at Contractor Site.</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL7</td>
<td>CDS Software Training – 2 days</td>
<td>616</td>
<td>Per Person</td>
<td>2 Days of training at Contractor Site - Single Student Multiple Day Discount</td>
<td>$650.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL8</td>
<td>CDS Software Training – 3 days</td>
<td>616</td>
<td>Per Person</td>
<td>3 Days of training at Contractor Site - Single Student Multiple Day Discount</td>
<td>$900.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL9</td>
<td>CDS Software Training – 4 days</td>
<td>616</td>
<td>Per Person</td>
<td>4 Days of training at Contractor Site - Single Student Multiple Day Discount</td>
<td>$1,100.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TRNGL10</td>
<td>CDS Software Training – 5 days</td>
<td>616</td>
<td>Per Person</td>
<td>5 Days of training at Contractor Site - Single Student Multiple Day Discount</td>
<td>$1,300.00</td>
</tr>
</tbody>
</table>

### NOTES:

1. Customer Direct Service (CDS): Software to assist the engineering community with building and HVAC system design and analysis. CDS sells software licenses, provides technical and engineering support, and training for that software.
2. The “GSA Price above for each add’l student for a course w/IFF” is applicable only at Trane’s La Crosse, WI location.
3. Cancellations must be received two weeks prior to class date by fax, mail or email. $200 fee for any cancellations by Customer within 2 weeks of the agreed training date. No Shows will be charged full class price. Trane reserves the right to cancel classes due to weather, illness, or any other reason. All students will be notified as early as possible and CDS’ liability will be limited to the return of registration fees.
## Customer Direct Service (CDS) Training Seminars

### Online Virtual Modules

<table>
<thead>
<tr>
<th>SIN</th>
<th>Course Number</th>
<th>Course Name</th>
<th>Product Code</th>
<th>Unit of Order</th>
<th>Description</th>
<th>GSA Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>334512</td>
<td>CDS-ELEARN-101SGL</td>
<td>TRACE 700 Load Design Single</td>
<td>616</td>
<td>Per Single Seat License</td>
<td>eLearning, Self-paced on-line training for TRACE 700 Load Design - single license</td>
<td>$199.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-ELEARN-101SITE</td>
<td>TRACE 700 Load Design Enterprise</td>
<td>616</td>
<td>Per Site Location License</td>
<td>eLearning, Self-paced on-line training for TRACE 700 Load Design - site license</td>
<td>$999.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-ELEARN-201SGL</td>
<td>TRACE 3D Plus Load Design Single</td>
<td>616</td>
<td>Per Single Seat License</td>
<td>eLearning, Self-paced on-line training for TRACE 3D Plus Load Design - single license</td>
<td>$199.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-ELEARN-201ENT</td>
<td>TRACE 3D Plus Load Design Enterprise</td>
<td>616</td>
<td>Per Site Location License</td>
<td>eLearning, Self-paced on-line training for TRACE 3D Plus Load Design - site license</td>
<td>$999.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-ELEARN-201GLB</td>
<td>TRACE 3D Plus Load Design Global</td>
<td>616</td>
<td>Global Location License</td>
<td>eLearning, Self-paced on-line training for TRACE 3D Plus Load Design - global license</td>
<td>$4,995.00</td>
</tr>
<tr>
<td>34512</td>
<td>CDS-ELEARN-202ENT</td>
<td>TRACE 3D Plus Energy and Economics Enterprise</td>
<td>616</td>
<td>Per Site Location License</td>
<td>eLearning, Self-paced on-line training for TRACE 3D Plus Energy and Economics - site license</td>
<td>$999.00</td>
</tr>
<tr>
<td>34512</td>
<td>CDS-ELEARN-8HR</td>
<td>CDS Software Training – 8 Hours</td>
<td>616</td>
<td>Per Person</td>
<td>eLearning, Instructor lead on-line training for CDS Software offerings for 8 hours</td>
<td>$350.00</td>
</tr>
<tr>
<td>34512</td>
<td>CDS-ELEARN-16HR</td>
<td>CDS Software Training – 16 Hours</td>
<td>616</td>
<td>Per Person</td>
<td>eLearning, Instructor lead on-line training for CDS Software offerings for 16 hours</td>
<td>$650.00</td>
</tr>
</tbody>
</table>
### Customer Direct Service (CDS) Training Seminars

#### Schedule at Customer's Location Site

<table>
<thead>
<tr>
<th>SIN</th>
<th>Course Name</th>
<th>Product Code</th>
<th>Unit of Order</th>
<th>Description</th>
<th>GSA Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>334512</td>
<td>CDS Onsite Training Attendee Fee</td>
<td>616</td>
<td>Per Person</td>
<td>1 Day of training at Customer Site. Fee is applicable for each person attending group training.</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS Base Training Fee 15</td>
<td>616</td>
<td>Per Course</td>
<td>Base Group customer site setup fee to train up to 15 people</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS Base Training Fee 30</td>
<td>616</td>
<td>Per Course</td>
<td>Base Group customer site setup fee to train 16-30 people</td>
<td>$1,750.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS Base Training Fee 45</td>
<td>616</td>
<td>Per Course</td>
<td>Base Group customer site setup reservation fee to train 31-45 people</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS Base Training Fee 60</td>
<td>616</td>
<td>Per Course</td>
<td>Base Group customer site setup reservation fee to train 46-60 people</td>
<td>$500.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS Base Training Fee 60+</td>
<td>616</td>
<td>Per Course</td>
<td>Base Group customer site setup reservation fee to train 60+ people</td>
<td>$350.00</td>
</tr>
<tr>
<td>334512</td>
<td>1-5 Computers Rental</td>
<td>616</td>
<td>Per Day</td>
<td>1-5 Computers Rental - for onsite training</td>
<td>$400.00</td>
</tr>
<tr>
<td>334512</td>
<td>6-10 Computers Rental</td>
<td>616</td>
<td>Per Day</td>
<td>6-10 Computers Rental - for onsite training</td>
<td>$550.00</td>
</tr>
<tr>
<td>334512</td>
<td>11-15 Computers Rental</td>
<td>616</td>
<td>Per Day</td>
<td>11-15 Computers Rental - for onsite training</td>
<td>$400</td>
</tr>
<tr>
<td>334512</td>
<td>16-20 Computers Rental</td>
<td>616</td>
<td>Per Day</td>
<td>16-20 Computers Rental - for onsite training</td>
<td>$500</td>
</tr>
</tbody>
</table>

**NOTES:**

1. Customer Site Training Classes: Same courses on schedule and the customer determines what they want CDS to provide at their location. Pricing outlined is based on number of days of training and number of attendee/students.
2. CDS will rent computers for use by the customer during on-site training.
3. **Cancellation Policy** – A $200 administrative cancellation fee will apply to any cancellations occurring within 2 weeks of the agreed upon training date by Customer.
4. For training provided at the customer's location, training shall be provided at the billing rate shown above. The customer shall pay for the trainer's travel and per diem expenses. Rates paid as a result of travel must comply with the Federal Travel Regulations or Joint Travel Regulations, as applicable, in effect on the date(s) the travel is performed.
## Customer Direct Service (CDS) Training Seminars

### Training & Software Purchased Together

**Contractor Site**

<table>
<thead>
<tr>
<th>SIN</th>
<th>Course Number</th>
<th>Course Name</th>
<th>Product Code</th>
<th>Description</th>
<th>GSA Price Training &amp; Software Together</th>
</tr>
</thead>
<tbody>
<tr>
<td>334512</td>
<td>CDS-TNG-SA</td>
<td>System Analyzer™</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 1 day in La Crosse WI at half price.</td>
<td>$1,170.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TNG-L3DP-STD</td>
<td>TRACE 3D Plus Load Design Standalone license and training</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 1 day in La Crosse WI at half price.</td>
<td>$1,020.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TNG-L3DP-LTDENT</td>
<td>TRACE 3D Plus Load Design Limited Enterprise license and training</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 1 day in La Crosse WI at half price.</td>
<td>$1,370.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TNG-L3DP-ENT</td>
<td>TRACE 3D Plus Load Design Enterprise license and training</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 1 day in La Crosse WI at half price.</td>
<td>$2,670.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TNG-L3DP-GLOBAL</td>
<td>TRACE 3D Plus Load Design Global license and training</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 1 day in La Crosse WI at half price.</td>
<td>$15,170.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TNG-T3DP-STD</td>
<td>TRACE 3D Plus Standalone license and training</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 2 days in La Crosse WI at half price.</td>
<td>$2,670.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TNG-T3DP-LTDENT</td>
<td>TRACE 3D Plus Limited Enterprise license and training</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 2 days in La Crosse WI at half price.</td>
<td>$3,520.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TNG-T3DP-ENT</td>
<td>TRACE 3D Plus Enterprise license and training</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 2 days in La Crosse WI at half price.</td>
<td>$7,320.00</td>
</tr>
<tr>
<td>334512</td>
<td>CDS-TNG-T3DP-GLOBAL</td>
<td>TRACE 3D Plus Global license and training</td>
<td>616</td>
<td>Software purchased at full price with training for 1 attendee 2 days in La Crosse WI at half price.</td>
<td>$40,320.00</td>
</tr>
</tbody>
</table>

### NOTES:

1. Packaged Pricing for the purchase of software and training together is available at Trane’s La Crosse, WI site.
2. At the end of the La Crosse training seminar, all participants will receive a coupon to save 15% off the regular listed software price. To receive this discount, all software orders must be accompanied by this coupon.
## EDUCATIONAL LITERATURE & MATERIALS

### AIR CONDITIONING CLINICS

**Purpose:** Scripted training presentations used to educate on the fundamentals of heating, ventilating, and air conditioning (HVAC). Each clinic includes a student workbook, with corresponding quiz questions/problems.

**Audience:** The content is technical in nature and the original intended audience was HVAC system designers and installing contractors who wanted to learn the basics of HVAC. However, in the past the audience has been extremely broad and has included HVAC system designers, installing contractors, architects, system operators, servicing technicians, and owners.

**Definitions:** International System of Units (SI) and/or inch-pound units (IP). Dual units contain both IP/SI.

### FUNDAMENTALS SERIES

<table>
<thead>
<tr>
<th>SIN</th>
<th>Order Number</th>
<th>Title</th>
<th>Publication Date</th>
<th>Units</th>
<th>Abstract</th>
<th>GSA Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>334290</td>
<td>TRG-TRC001EN</td>
<td>Psychrometric Charting</td>
<td>2000</td>
<td>IP units only</td>
<td>Discussion of the properties of air and the use of the psychrometric chart. Topics include: sensible and latent heat, heat and moisture change, elements of the psychrometric chart, sensible heat ratio (SHR), determining required airflow (cfm) and refrigeration (tons), analyses of basic systems at full and part load (modulating coil, reheat, face-and-bypass, variable volume).</td>
<td>$16.00</td>
</tr>
<tr>
<td>334290</td>
<td>TRG-TRC002-EN</td>
<td>Cooling and Heating Load Estimating</td>
<td>2000</td>
<td>Dual units (IP/SI)</td>
<td>Presentation of cooling and heating load estimating procedures to used for accurate HVAC equipment selections. The clinic presents the ASHRAE Cooling Load Temperature Difference (CLTD), Solar Cooling Load Factor (SCL), and Cooling Load Factor (CLF) method. Topics include: human comfort, indoor and outdoor design conditions, cooling load estimation, conduction heat gain and loss, solar heat gain, internal heat gains, infiltration, ventilation, fan heat, heating load estimation, single-space psychrometric analysis (sensible heat ratio or SHR, supply airflow, supply air temperature, coil load), multiple-space psychrometric analysis (block load versus sum-of-peaks), plenum versus space loads, and benefits of computerized load analysis.</td>
<td>$16.00</td>
</tr>
<tr>
<td>334290</td>
<td>TRG-TRC003-EN</td>
<td>Refrigeration Cycle</td>
<td>1999</td>
<td>Dual units (IP/SI)</td>
<td>Presentation of the basic principles of the vapor-compression refrigeration cycle. Topics include: principles of heat transfer, sensible heat, latent heat of vaporization, refrigerants, mechanical refrigeration cycle components (compressor, condenser, evaporator, expansion device), and pressure–enthalpy (P-h) chart (superheat, subcooling, refrigeration effect, heat of compression).</td>
<td>$16.00</td>
</tr>
<tr>
<td>334290</td>
<td>TRG-TRC004-EN</td>
<td>Refrigeration Compressors</td>
<td>2000</td>
<td>Dual units (IP/SI)</td>
<td>Introduction of the common compressor types used in air-conditioning applications, including reciprocating, scroll, helical-rotary (screw), and centrifugal. Topics include: review of the basic refrigeration cycle, open, semi-hermetic, hermetic, types of compressors, principles of compressor operation, methods of compressor capacity control (cylinder unloaders, cycling, slide valve, inlet vanes, variable-speed), methods of system-level control (direct expansion versus chilled water, constant volume versus VAV), and preventing evaporator freeze-up (sensing suction temperature, hot gas bypass).</td>
<td>$16.00</td>
</tr>
<tr>
<td>334290</td>
<td>TRG-TRC005-EN</td>
<td>Refrigeration System Components</td>
<td>1998</td>
<td>Dual units (IP/SI)</td>
<td>Discussion of the components used in a vapor-compression refrigeration system. Topics include: review of the refrigeration cycle, condensers (air-cooled, water-cooled, evaporative) and their control, evaporators (finned-tube, shell-and-tube) and their control, thermostatic expansion valve, superheat and subcooling, solenoid valve, liquid line filter drier, moisture-indicating sight glass, suction line filter, hot gas muffler, shutoff valve, and access ports.</td>
<td>$16.00</td>
</tr>
<tr>
<td>334290</td>
<td>TRG-TRC006-EN</td>
<td>Refrigerant Piping</td>
<td>2002</td>
<td>Dual units (IP/SI)</td>
<td>Review of refrigeration system piping considerations, design guidelines, and sizing recommendations. Topics include: suction line, discharge (hot gas) line, liquid line, hot gas bypass line, traps, double risers, refrigeration accessories required, insulation.</td>
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<td>334290</td>
<td>TRG-TRC007-EN</td>
<td>Fundamentals of HVAC Acoustics (2001)</td>
<td>Dual units (IP/SI)</td>
<td>Discussion of the fundamental concepts of acoustics as it applies to buildings and HVAC systems. Topics include: sound wave, frequency, broadband sound, tones, octave bands, one-third octave bands, sound power and sound pressure, decibels, loudness, A-weighting, Noise Criteria (NC), Room Criteria (RC), sones, phons, acoustical analysis procedure, source-path-receiver model, computerized analysis tools, attenuation and regeneration, sound transmission, sound absorption, sound reflection, room effect, equipment sound rating, free field, reverberent field, semireverberent field, industry rating standards, reverberent room method, ARI Standard 260.</td>
<td>$16.00</td>
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<tr>
<td>334290</td>
<td>TRG-TRC010-EN</td>
<td>Centrifugal Water Chillers (1999)</td>
<td>Dual units (IP/SI)</td>
<td>Description of the components, operation, and application of a centrifugal water chiller. Topics include: centrifugal compressor, condenser, expansion device (orifice plates), economizer, evaporator, motor, starters, controls, the refrigeration cycle, purge system, compressor capacity control (surge, inlet vanes, multi-stage compressor, adjustable frequency drive or variable speed drive), maintenance considerations, and application considerations (condensing temperature control, constant or variable evaporator water flow, heat recovery, free cooling, short water loops, ARI Standard 550/590-1998).</td>
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<td>334290</td>
<td>TRG-TRC011-EN</td>
<td>Absorption Water Chillers (2000)</td>
<td>Dual units (IP/SI)</td>
<td>Discussion of the fundamentals of the absorption refrigeration cycle as it pertains to water chillers. Topics include: absorption refrigeration cycle (generator or concentrator, condenser, evaporator, absorber, heat exchanger), system fluids (water, lithium bromide), equilibrium chart, single-effect versus double-effect chillers, indirect-fired versus direct-fired chillers, chiller/heaters, capacity control methods (energy valve, AFD), causes of crystallization and methods of prevention, purge operation, general maintenance considerations (corrosion inhibitors), cooling-water temperature limitations, combination gas-and-electric plants, special considerations for direct-fired chillers, ASHRAE Standard 15, and ARI Standard 560.</td>
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<td>334290</td>
<td>TRG-TRC012-EN</td>
<td>Helical-Rotary Water Chillers (1999)</td>
<td>Dual units (IP/SI)</td>
<td>Presentation of the components, operation, and application of a helical-rotary (screw) water chiller. Topics include: helical-rotary compressor, oil separator, condenser (water-cooled and air-cooled), expansion device, liquid/vapor separator, evaporator, starter, controls, the refrigeration cycle, refrigerants, compressor capacity control, slide valve operation, maintenance considerations, and a brief list of application considerations (air-cooled or water-cooled condensing, condensing temperature control, constant or variable evaporator water flow, short water loops, ARI Standard 550/590-1998).</td>
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</table>
Coverage of fan system performance, types of fans, and methods of control. Topics include: static pressure vs. velocity pressure, fan performance curves, fan—system interaction, basic types of fans (forward curved - FC, backward inclined - BI, airfoil - AF, vaneaxial, and variable-pitch vaneaxial - VPVA), methods of fan control (riding the fan curve, discharge dampers, inlet vanes, variable speed, and variable-pitch blade control), and fan applications considerations (static pressure control, system effects, non-standard conditions – altitude, and equipment certification standards.).

SYSTEMS SERIES

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<td>334290</td>
<td>TRG-TRC014-EN</td>
<td>VAV Systems (2001)</td>
<td>Dual units (IP/SI)</td>
<td>Summary of the variable air volume (VAV) approach to air conditioning. Topics include: explanation of VAV, components of a VAV system, terminal unit types (cooling only, reheat, parallel and series fan powered, dual duct), terminal unit controllers (pneumatic, electronic, DDC), diffusers, supply duct design, interior vs. perimeter spaces, system control modes, fan modulation, static pressure control, and system applications considerations (system-level ventilation, freeze protection for coils, part-load space humidity control, building pressurization control.).</td>
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<td>334290</td>
<td>TRG-TRC015-EN</td>
<td>Water-Source Heat Pump Systems (2000)</td>
<td>Dual units (IP/SI)</td>
<td>Discussion of the water-source heat pump (WSHP) system. Topics include: operation and components of a heat pump, types of heat pumps, components of a WSHP system, system benefits and issues, system configurations (cooling tower/boiler, ground-coupled, types of ground heat exchangers, hybrid systems), system-level control issues, maintenance considerations, application considerations (ventilation, acoustics, space humidity control, condensate management, airside and waterside economizers, building pressurization, equipment rating standards.).</td>
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<td>334290</td>
<td>TRG-TRC016-EN</td>
<td>Chilled-Water Systems (2001)</td>
<td>Dual units (IP/SI)</td>
<td>Description of chilled-water systems. Topics include: vapor-compression and absorption chiller types, air-cooled vs. water-cooled condensers, packaged vs. split components, ASHRAE Standard 90.1-1999, equipment rating standards (ARI 550, 590, and 560), components of a chilled-water system, coil control (3-way valves, 2-way valves, face-and-bypass dampers), constant vs. variable evaporator flow, chiller plant design concepts (parallel, series, and primary-secondary or decoupled), combined energy (hybrid) plants, low-flow systems, variable-primary-flow systems, heat recovery, sidecar arrangement, free cooling (plate-and-frame heat exchanger, refrigerant migration), and chilled-water system control (chiller sequencing, swing chiller, failure recovery, system optimization, and system-level control).</td>
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<td>334290</td>
<td>TRG-TRC017-EN</td>
<td>HVAC System Control (2002)</td>
<td>Dual units (IP/SI)</td>
<td>Introduction to automatic control of HVAC equipment and systems. Topics include: control loops, types of control action (two position or on/off, floating, proportional, proportional-integral or PI, and proportional-integral-derivative or PID), pneumatic controls, analog-electric controls, microprocessor-based controls or DDC, unit-level control versus system-level control, example unit-level control loops for a VAV air handler (discharge-air temperature, ventilation, airside economizer, mixed-air temperature, static pressure, building pressurization), examples of system-level control (occupied versus unoccupied modes, morning warmup mode, changeover in a two-pipe system, water loop temperature control in a WSHP system), examples of system optimization strategies (fan-pressure optimization, optimum start, chilled-water reset, WSHP loop optimization), normally-open versus normally-closed actuators, common functions of a building automation system (responding to complaints, graphical user interface, time-of-day scheduling, centralized alarms and diagnostics, remote access, reports, preventive maintenance, integration with other systems, multiple-site support), network terminology, dedicated vs. shared networks, communication protocols, gateways, interoperability, BACnet, LonTalk, LonMark.</td>
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<td>334290</td>
<td>TRG-TRC018-EN</td>
<td>Introduction to HVAC Systems  (2004)</td>
<td>Dual units (IP/SI)</td>
<td>Introduction to HVAC systems that dissects the entire system into five subsystems, or “loops.” Topics include: requirements for occupant comfort, five &quot;loops&quot; (airside loop, chilled-water loop, refrigeration-equipment loop, heat-rejection loop, controls loop), factors that affect decision to choose a chilled-water versus a direct expansion (DX) system, packaged versus split systems, common HVAC system types, single-zone versus multiple-zone systems, constant-volume versus variable-air-volume systems, packaged terminal air conditioner (PTAC), single-zone packaged DX rooftop, DX split system, chilled-water terminal system (fan coils, classroom unit ventilators, blower coils), two-pipe versus four-pipe systems, water-source heat pump systems, dedicated outdoor-air systems, single-zone VAV, multizone system, three-deck multizone system, changeover-bypass system, multiple-zone VAV system, rooftop VAV system, self-contained DX VAV system, chilled-water VAV system, double-duct VAV system, and factors that impact the selection of the HVAC system.</td>
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<td>334290</td>
<td>TRG-TRC019-EN</td>
<td>Ice Storage Systems (2005)</td>
<td>Dual units (IP/SI)</td>
<td>This clinic focuses on glycol-based ice storage systems, which use an ice-chiller to cool a heat transfer fluid—often a mixture of water and antifreeze, such as glycol—to a temperature below the freezing point of water. This fluid is pumped through an ice storage tank, causing water inside the tank to freeze. Topics include: benefits of ice storage, on-peak versus off-peak, ice storage tank, full storage versus partial storage, ice-making chiller, heat transfer fluid, ethylene glycol versus propylene glycol, common system layouts (small versus large systems), retrofitting existing systems, control of ice storage systems (tactical control versus strategic control).</td>
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**BUNDLED SETS**

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<td>334290</td>
<td>1-43.186</td>
<td>Set of all Air Conditioning Clinic booklets</td>
<td>Set of all Air Conditioning Clinic booklets</td>
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| 334290 | 1-43.165           | "Air Conditioning Clinic" bundle | This bundle includes:  
- Set of all Air Conditioning Clinic booklets  
- Ductulator duct sizing calculator  
- Psychrometric Charts – pad of 25, standard altitude, I-P units | $215.00 |
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<tr>
<td>334290</td>
<td>SYS-APM001-EN</td>
<td>Multiple Chiller System Design and Control (2009)</td>
<td>Dual units (IP/SI)</td>
<td>Details basic multiple-machine chilled water systems. Topics include: components of a chilled water system, chillers in parallel, chillers in series, primary/secondary (decoupled) systems, effects of temperatures and flow, low flow system designs, distributed pumping, tertiary pumping, chiller plant controls, chilled water reset, chiller staging, variable-primary flow (VPF) systems, heat recovery, free cooling, sidestream arrangement, system design considerations, preferential loading, alternate energy sources, series-counterflow arrangement, redundancy, contingency planning, condenser water systems, and cooling tower control.</td>
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<td>334290</td>
<td>SYS-APM003-EN</td>
<td>Air-to-Air Energy Recovery in HVAC Systems (2008)</td>
<td>Dual units (IP/SI)</td>
<td>Discusses the various air-to-air energy recovery technologies and their application in HVAC systems. Topics include: why recover energy?, sensible- versus total-energy recovery, effectiveness, unbalanced airflow, outdoor-air preconditioning (or exhaust-air heat recovery), supply-air tempering (or reheat) in series or parallel, ASHRAE Standard 90.1, impact on first cost and operating cost, frost prevention methods, minimizing cross leakage, methods of capacity control, coil loops (or coil runaround loops), fixed-plate heat exchangers (or air-to-air heat exchangers), heat pipes, rotary heat exchangers (or heat wheels, enthalpy wheels, desiccant wheels), ARI Standard 1060, controlling energy recovery devices in dedicated outdoor-air systems and mixed-air systems (constant volume, VAV), economizer operation, active desiccant dehumidification systems, local versus centralized preconditioning.</td>
<td>$16.00</td>
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<tr>
<td>334290</td>
<td>SYS-APM004-EN</td>
<td>Dehumidification in HVAC Systems (2002)</td>
<td>Dual units (IP/SI)</td>
<td>Discusses the dehumidification performance of various, cold-coil commercial HVAC systems, particularly at part-load conditions. Topics include: why control humidity in buildings, sources of moisture, cold coil versus active desiccant dehumidification, full-load versus part-load conditions, ASHRAE weather data, dehumidification performance of constant-volume systems (impact of climate, impact of outdoor-air quantity, impact of packaged direct expansion DX equipment, impact of energy recovery, fan-speed adjustment, mixed-air bypass, return-air bypass, dual path air handlers, supply-air tempering or reheat), dehumidification performance of VAV systems (impact of minimum airflow settings, impact of supply-air temperature reset, supply-air tempering at VAV terminals, using colder supply-air temperatures), dedicated outdoor-air systems (neutral versus cold, to the space versus to other units, design procedures, general application considerations (humidity control during unoccupied periods, building pressure control, airside economizer control), psychrometric analyses, ASHRAE Standards 62 and 90.1.</td>
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<td>334290</td>
<td>SYS-APM005-EN</td>
<td>Waterside Heat Recovery in HVAC Systems (2003)</td>
<td>Dual units (IP/SI)</td>
<td>This manual focuses on waterside heat recovery. It describes concepts and mechanical implementation, and identifies system-level characteristics for effective operation and control. Topics include: why use heat recovery?, heat-recovery chiller types, system configurations and control modes, heat rejection control, common uses of recovered heat, and analysis methods.</td>
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<td>334290</td>
<td>SYS-APM007-EN</td>
<td>Rooftop VAV Systems (2012)</td>
<td>Dual units (IP/NI)</td>
<td>Discusses proper design and application of packaged rooftop, variable air volume (VAV) systems. Topics include: basic system operation, benefits and drawbacks of a rooftop VAV system, in-depth coverage of the components that make up the system (packaged rooftop unit, VAV terminal units, air distribution system, hot water heating system, controls), solutions to address common design challenges (zoning, ventilation, humidity control, energy efficiency, acoustics), several system variations (cold air distribution, single-zone VAV, air-to-air energy recovery), and common unit-level and system-level control functions (including system optimization strategies).</td>
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<td>334290</td>
<td>SYS-APM008-EN</td>
<td>Chilled-Water VAV Systems (2012)</td>
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<td>Discusses proper design and application of chilled-water, variable air volume (VAV) systems. Topics include: basic system operation, benefits and drawbacks of a chilled-water VAV system, in-depth coverage of the components that make up the system (VAV air-handling unit, VAV terminal units, air distribution system, chilled-water system, hot water heating system, controls), solutions to address common design challenges (zoning, ventilation, humidity control, energy efficiency, acoustics), several system variations (cold air distribution, single-zone VAV, air-to-air energy recovery, dual-duct VAV systems), and common unit-level and system-level control functions (including system optimization strategies).</td>
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<td>334290</td>
<td>SYS-APM009-EN</td>
<td>Central Geothermal Systems (2011)</td>
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<td>Discusses proper design and control of central geothermal bidirectional cascade systems that use borefields. Topics include system design considerations (borefield, ground water, water temperatures, chiller/heater selection, system piping, system design options (optimum efficiency design features, supplemental heat, auxiliary energy rejection, contingency cooling, chilled-water pump control), airside considerations (heating design, economizer control, freeze protection, ASHRAE Standard 90.1 compliance), system operation and control (heating only, cooling only and simultaneous heating and cooling).</td>
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<tr>
<td>334290</td>
<td>SYS-APM010-EN</td>
<td>Water-Source and Ground-Source Heat Pump Systems (2013)</td>
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<td>Discusses proper design and application of water-source (WSHP) and ground-source heat pump (GSHP) systems. Topics include: basic system operation; benefits and drawbacks of a WSHP system; in-depth coverage of the components that make up the system (water-source heat pumps, water distribution system, heat rejection and heat addition, dedicated outdoor-air system); solutions to address common design challenges (thermal zoning, ventilation, humidity control, energy efficiency, acoustics); several system variations (ground-coupled, surface-water, and ground-water heat pump systems, as well as several hybrid system configurations); and common unit-level and system-level control functions (including system optimization strategies).</td>
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<td>334290</td>
<td>ISS-APM001-EN</td>
<td>Acoustics in Air Conditioning (2006)</td>
<td>Dual units (IP/NI)</td>
<td>Discusses the fundamentals of sound to aid in the design of quiet HVAC systems. Topics include: definitions, frequency, octave bands, sound power vs. sound pressure, sound ratings (A-weighting, B-weighting, C-weighting, noise criteria - NC, room criteria – RC, sone, phone), sound measurement methods, equipment sound rating and industry standards (ARI, AMCA, ASHRAE), source-path-receiver, sound paths, attenuation, transmission loss, regenerated noise, room effect, and fan-generated noise.</td>
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<td>334290</td>
<td>APP-APM001-EN</td>
<td>Refrigerating Systems and Machinery Rooms: ASHRAE Standard 15 (2012)</td>
<td>Dual units (IP/NI)</td>
<td>Details ASHRAE Standard 15-2010 as it relates to water-chiller refrigeration systems that require machinery (or mechanical or equipment) rooms. Topics include: ASHRAE Standard 34, refrigerants, refrigerant safety classifications, standards vs. guidelines, ASHRAE Standard 15, machinery room, ventilation for machinery rooms, pressure relief piping, refrigerant monitors, equipment room design specification, indirect open-spray systems, MER, SCBA, and ANSI Standards.</td>
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<td>334290</td>
<td>AM-SYS-6</td>
<td>Variable Air Volume Duct Design (1981)</td>
<td>IP Units only</td>
<td>Covers information pertaining to variable volume duct design with special attention given to the static regain method. Topics include: computerized duct design, round vs. rectangular ductwork, duct heat gain, fitting efficiency, duct design rules, typical duct layout errors, high-velocity duct fittings, and static pressure sensor location.</td>
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<td>334290</td>
<td>SYS-AM-7</td>
<td>Water Source Heat Pump System Design (1994)</td>
<td>IP Units only</td>
<td>Describes the water source heat pump system, including design, selection, installation, and controls. Topics include: components, basic operation, system design, control recommendations, typical system operation parameters, boiler, cooling tower and pump selection, piping design recommendations, water regulating valve and variable speed pumping, hybrid systems, condensate drain lines, freeze protection.</td>
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<td>334290</td>
<td>AM-SYS-9</td>
<td>Self-Contained/VAV System Design (1984)</td>
<td>IP Units only</td>
<td>Discusses the various aspects of self-contained/VAV system applications and to provide suggestions that will help the designer make the best possible design decisions when applying this equipment. Topics include: system components, VAV terminal unit types, equipment selection, zoning, interior vs. perimeter zones, cooling tower and condenser water pump and piping, freeze protection, system control, airside economizer, waterside economizer, building pressurization, system-level controls, and system optimization.</td>
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<tr>
<td>334290</td>
<td>SYS-AM-10</td>
<td>Ice Storage Systems (1987)</td>
<td>IP Units only</td>
<td>Intended to aid designers in the design of ice storage systems using ethylene glycol. Topics include: types of thermal storage (chilled water, ice, eutectic salts), full storage vs. partial storage, ice storage selection and capacity, chiller selection, ice storage system design and control. NOTE: See also the &quot;Ice Storage Systems&quot; series of Engineered Systems Clinics (ISS-CLC-1, 2, 3, 4).</td>
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<tr>
<td>334290</td>
<td>SYS-AM-13</td>
<td>Absorption Chiller System Design (1999)</td>
<td>Dual units (IP/SI)</td>
<td>Helps designers correctly apply absorption chillers into systems. Topics include: absorption refrigeration cycle, types of absorption chillers, gas cooling with absorption, economic analysis, chiller control, chiller plant design and control (heat recovery, thermal storage, heating applications), installation (exhaust stack, ASHRAE Standard 15, combustion air), and maintenance considerations.</td>
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<td>334290</td>
<td>SYS-AM-15</td>
<td>Managing Building Moisture (2010)</td>
<td>IP Units only</td>
<td>This manual helps HVAC system designers identify and quantify moisture sources in buildings. It also presents moisture-management techniques related to the building envelope, the occupied space and the mechanical-equipment room. Topics include: indoor air quality (IAQ), comfort, moisture sources, condensation, building envelope, dehumidification, equipment room moisture, ventilation air, moisture and equipment, drain pans, condensate traps, insulation, infiltration, vapor-pressure diffusion, design and control strategies, humid climates, and humidity control.</td>
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<tr>
<td>334290</td>
<td>AM-CON-10</td>
<td>Hot Gas Bypass Control (1982)</td>
<td>IP Units only</td>
<td>Explains the hot gas bypass (HGBP) system by discussing what it is, why and when it should be used, how it is properly applied, and how to size/adjust a HGBP valve. Includes: hot gas bypass to evaporator inlet, hot gas bypass to suction line.</td>
<td>$1.25</td>
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<td>334290</td>
<td>AM-CON-17</td>
<td>Building Pressurization Control (1982)</td>
<td>IP Units only</td>
<td>Reviews several key definitions and outlines these space pressure control systems: natural relief, barometric relief, constant volume return fan, constant volume exhaust fan, powered barometric relief, coordinated exhaust/supply fan control, coordinated return/supply fan control, volume reset of return fan, direct pressurization control, and sequenced control of multiple exhaust fans. Points out system performance characteristics and suggests control applications. Includes a general discussion, design considerations, system alternatives, and recommended equipment for the application.</td>
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<td>334290</td>
<td>ICS-AM-4</td>
<td>Control of Ice Storage Systems (1988)</td>
<td>IP Units only</td>
<td>Reviews ice storage controls as a part of a Trane Integrated Comfort system. Topics include: operating modes, control sequence development, demand-limiting vs. time-of-use, data gathering and monitoring and ice inventory, control of system components (chiller, pump, blending valve, bypass valve), system control and monitoring, load profiles, ice inventory, and points lists.</td>
<td>$5.00</td>
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<tr>
<td>334290</td>
<td>ED-FAN</td>
<td>Fans and Their Application in Air Conditioning (1982)</td>
<td>IP Units only</td>
<td>Provides a detailed overview of fan fundamentals intended to help system designers understand their performance, selection, application and control. Topics include: terminology, testing, fan performance curve, system resistance curve, fan surge, fan paralleling, types of fans (forward curved, backward inclined, radial, tubular, axial, fan laws, industry standards (AMCA), inlet and discharge conditions, transitions, drive and bearing losses, fan modulation devices (scroll volume damper, inlet and discharge dampers, inlet vanes, speed modulation, blade pitch variation), parallel and series operation, draw-thru vs. blow-thru, supply fans in systems, return fans, motors and controls, types of motor starters, power transmission, sound and vibration control, selection, specification, installation, maintenance, troubleshooting, and field measurement methods.</td>
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**ENGINEERS NEWSLETTER LIVE DVDS**

**Purpose:** Engineers Newsletter Live is a series of programs focused on the design and control of heating, ventilating, and air conditioning (HVAC) systems. The content of each program is objective, technical and educational in nature. The series is produced and presented by the Trane Applications Engineering team.

**Audience:** The intended audience for these programs is HVAC system designers. However, depending on the topic, the program may also be of interest to others in the industry. Asterisks designate programs accredited for continuing education by American Institute of Architects (AIA) and United States Green Building Council (USGBC). Assessment is required for credit please visit www.trane.com/continuingeducation to submit the associated quiz for continuing education credit.

**Length/Language/Units:** Each program is 90 minutes long, in English, with I-P units displayed only.

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<tr>
<td>334290</td>
<td>The Low Dollar Chiller Plant (August, 1999)</td>
<td>90 min</td>
<td>English</td>
<td>I-P</td>
<td>Gain an understanding of low-flow chiller system designs that will result in reduced capital, energy, and installed costs. Topics include: low flow, cooling tower performance, chilled-water coil performance, chiller-tower optimization, series chillers, variable-primary-flow systems.</td>
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<td>334290</td>
<td>Specifying Quality Sound (March, 2000)</td>
<td>90 min</td>
<td>English</td>
<td>I-P</td>
<td>Provides an understanding of how product sound data is developed and how to performance optimize an air-handling unit. Topics include: space sound level targets (NC, RC), acoustical analysis, source-path-receiver method, ARI 260, cost effective noise control ideas (fan types, air handler casing, wall construction, return air path, silencers).</td>
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<td>334290</td>
<td>Lowering Supply Air Temperatures (May, 2000)</td>
<td>90 min</td>
<td>English</td>
<td>I-P</td>
<td>This program explores the impact on system first cost and operating costs when lower air temperature principles are applied using modern-day equipment and technologies. The common concerns associated with low-temperature air systems are discussed along with strategies to address these issues. Topics include: cold air, chilled-water coil performance, fan-powered VAV boxes, vapor retarder, building pressurization, diffuser selection.</td>
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<td>334290</td>
<td>Advanced System Control Strategies (June, 2000)</td>
<td>90 min</td>
<td>English</td>
<td>I-P</td>
<td>This program discusses key air-handling system control issues like building pressure control, system ventilation control, damper control, and various reset strategies. Advanced control ideas related to the impact of energy recovery within systems is also covered. All of these topics are discussed with an eye toward compliance with ASHRAE Standards 62 and 90.1, while maintaining comfort and minimizing system operating and lifecycle costs. Topics include: ventilation reset, dual versus single damper mixing boxes, fan-pressure optimization, optimized damper control, building pressurization control, control of air-to-air energy recovery (economizer, capacity modulation).</td>
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<td>334290</td>
<td>APP-CMC005-EN</td>
<td>Building Moisture and Humidity Management (August, 2000)</td>
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<td>Provides a better understanding of the issue of building moisture control and the part-load dehumidification performance of various constant-volume system configurations. Other topics include: ASHRAE weather data, sensible- (peak dry bulb) and latent-design (peak dew point) conditions, psychrometric analysis (full load and part load), impact of total energy recovery, mixed-air bypass, return-air bypass, split dehumidification unit (SDU), supply air tempering (reheat), ASHRAE Standard 90.1.</td>
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<td>334290</td>
<td>APP-CMC006-EN</td>
<td>Air-to-Air Energy Recovery (October, 2000)</td>
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<td>Addresses the available energy-recovery technologies; how they are applied in various systems; whether or not the investment is worth the return; and what works best and why. Topics include: sensible- versus total-energy recovery, effectiveness, balanced versus unbalanced airflows, coil loops, heat pipes, fixed-plate heat exchangers, sensible wheels (heat wheels), total-energy wheels (enthalpy wheels), psychrometric analysis (cooling and heating), equipment downsizing, frost prevention, capacity modulation, VAV systems, constant-volume systems, dedicated outdoor-air systems (cold and neutral), control modes for all these systems, ASHRAE Standard 90.1.</td>
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<td>334290</td>
<td>APP-CMC007-EN</td>
<td>Geothermal Heat Pump Systems (May, 2001)</td>
<td>IP Units only</td>
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<td>By watching the program, viewers will understand the critical factors in the success of geothermal heat pump systems, consider the advantages and disadvantages, understand the economic considerations, and system variations. Topics include: conventional boiler-cooling tower WSHP system, geothermal heat pump system design process (site evaluation, loop sizing, life-cycle cost evaluation), types of geothermal heat exchangers (vertical, horizontal, spiral or slinky), surface water systems, ground temperatures, GLHEPRO loop design software, hybrid systems, ARI/ASHRAE/ISO Standard 13256-1, ASHRAE Standard 90.1.</td>
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<td>334290</td>
<td>APP-CMC008-EN</td>
<td>Dedicated Outdoor-Air Systems (September 2001)</td>
<td>IP Units only</td>
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<td>By watching the program, viewers will learn when separate conditioning of ventilation air is best applied; understand the pros and cons of dedicated outdoor-air ventilation systems in comparison to other system types; and understand the code requirements. Other topics include: system configurations (neutral-to-space, cold-to-space, neutral-to-units, cold-to-units), neutral versus cold air, system design procedures, system optimization ideas, application considerations (recovered heat for reheat, after-hours humidity control, building pressurization, economizer operation, outdoor-air preconditioning with air-to-air energy recovery) and ASHRAE Standard 90.1.</td>
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<td>334290</td>
<td>APP-CMC009-EN</td>
<td>Split System Refrigerant Piping Design (December 2001)</td>
<td>IP Units only</td>
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<td>A lower-cost and more reliable system is achieved by applying the “new rules” for sizing refrigerant lines with R-22 Trane scroll compressor split systems. The manufacturer should size the line whenever possible, but since some of the techniques presented in this program wouldn’t have been considered good practice in the past, it’s important to understand why. The purpose of this ENL is to learn how Trane has refocused the piping practices to achieve a less-costly and more reliable operating system; discover the traits of effective refrigerant piping; understand when to use the various line-sizing tools; and learn when and when not to use hot gas bypass.</td>
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<td>334290</td>
<td>APP-CMC012-EN</td>
<td>Coil Fundamentals (February, 2002)</td>
<td>IP Units only</td>
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<td>This ENL reviews the basic principles of heat transfer and how they’re exploited in coil technology. Topics include: how chilled-water coil selections affect the entire system, how to properly apply DX coils in cooling applications, the advantages and disadvantages of face-split, row-split, and intertwined refrigerant coil arrangements, and how to avoid freeze-ups and operational problems in steam systems.</td>
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<td>APP-CMC013-EN</td>
<td>Commercial Building Pressurization (April, 2002)</td>
<td>IP Units only</td>
<td>This ENL reviews the basic principles of building pressure control in commercial buildings. Topics include: why control building pressure, (impact of overly positive or overly negative building pressure, what impacts building pressure? (intermittent local exhaust fan operation, airside economizer, stack effect, wind), natural relief, barometric relief (local in the space, or central at the unit), central relief fan (control options), central return fan (control options), and pressure sensor (indoor and outdoor) location and selection.</td>
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<td>APP-CMC014-EN</td>
<td>Underfloor Air Distribution (February, 2003)</td>
<td>IP Units only</td>
<td>This ENL program discusses the benefits and issues associated with underfloor air distribution (UFAD) systems and common system configurations. Topics include: potential benefits and potential problems, floor options, type of floor diffusers, types of terminal equipment, common system configurations, and control considerations (economizer, dehumidification, heating, plenum pressure control).</td>
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<td>334290</td>
<td>APP-CMC015-EN</td>
<td>Variable-Primary-Flow Chilled-Water Systems (May, 2003)</td>
<td>IP Units only</td>
<td>This ENL program discusses variable-primary-flow (VPF) chilled-water systems. Topics include: comparison of a primary-secondary (decoupled) system to a variable-primary-flow system, advantages of VPF systems, proper selection of chillers for VPF applications, control sequence of operation, impact of VPF on plant design (series chillers, retrofit projects, manifolded or dedicated pumps, different type and size of chillers), and ASHRAE Standard 90.1 requirements.</td>
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<td>334290</td>
<td>APP-CMC016-EN</td>
<td>High Performance Schools (October, 2003)</td>
<td>IP Units only</td>
<td>This program briefly reviews common attributes of High Performance School initiatives. Topics include: government initiatives, elements of High Performance School programs, indoor air quality, contaminant source control (location of outdoor air intakes), ventilation (calculating design ventilation rates, demand-controlled ventilation), building moisture control (moisture sources, methods for minimizing moisture problems), improving dehumidification performance of HVAC system (chilled-water terminal systems, single-zone DX systems, central VAV air-handling systems), acoustics in classrooms (ANSI/AS1 Standard 12.60, reverberation time, absorption, background sound), lowering background sound of HVAC system (acoustical analysis, attenuation options), challenges of financing educational priorities (capital versus operating budgets, potential sources of funding, life-cycle cost analysis).</td>
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<td>334290</td>
<td>APP-CMC017-EN</td>
<td>HVAC and LEED (February, 2004)</td>
<td>IP Units only</td>
<td>This program provides an overview of the U.S. Green Building Council's &quot;Leadership in Energy and Environmental Design&quot; (LEED) Green Building Rating System, with specific focus placed on how it relates to HVAC systems.</td>
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<td>APP-CMC018-EN</td>
<td>Improving Dehumidification in Restaurants and Retail Stores (May, 2004)</td>
<td>IP Units only</td>
<td>This program discusses why humidity control is important for restaurants and retail stores (dry goods and wet goods), demonstrates how the constant-volume direct expansion (DX) equipment that is commonly used in these building types may not dehumidify adequately at part load, proposes some system designs that can offer enhanced humidity control, and discusses how ventilation requirements affect system design.</td>
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<td>334290</td>
<td>APP-CMC019-EN</td>
<td>Small Chilled-Water Systems – Design and Application (September, 2004)</td>
<td>IP Units only</td>
<td>This program discusses which small-capacity applications favor chilled water, and explains how to simplify the design, control, and operation of small chilled-water systems. For the purpose of this program, a “small” chilled-water system is less than 120 tons in capacity, and contains one or two air-cooled chillers.</td>
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<td>334290</td>
<td>APP-CMC020-EN</td>
<td>Cooling Towers and Condenser-Water Systems – Design and Operation (January, 2005)</td>
<td>IP Units only</td>
<td>Proper design of a chilled water system can greatly affect its energy use and life-cycle costs. Fine-tuning the design and operation can go a long way toward minimizing energy costs—but it also requires a good understanding of how the system components affect each other. This ENL examines cooling tower–chiller interaction at various conditions, and discusses techniques to minimize initial and/or operating costs.</td>
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<td>334290</td>
<td>APP-CMC022-EN</td>
<td>Energy Analysis – LEED™ Modeling (May, 2005)</td>
<td>IP Units only</td>
<td>Energy models are a critical requirement in the U.S. Green Building Council’s LEED-NC rating system. Under Energy &amp; Atmosphere (EA) Credit 1, a prospective LEED building can earn up to 10 points if the project team can demonstrate optimized energy performance. The greater the reduction in energy cost, the more points may be awarded. This program will discuss methods of building design and operation to reduce energy costs (including daylighting, HVAC design parameters, and control options) and how to earn EA Credit 1 points by effectively modeling energy-saving designs.</td>
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<td>334290</td>
<td>APP-CMC023-EN</td>
<td>ASHRAE Standard 62.1-2004: Ventilation Requirements (September, 2005)</td>
<td>IP Units only</td>
<td>In the 2004 version of ASHRAE Standard 62.1, the entire Ventilation Rate Procedure (VRP) has been revamped. This procedure is used to determine the minimum ventilation requirements for commercial, institutional, and high-rise residential buildings. The new VRP changes the requirements for breathing-zone and system-intake ventilation airflow by better accounting for the “additivity” of contaminants from different sources (people vs. building). It also details system ventilation efficiency for multiple-zone systems. This ENL takes a detailed look at the design and operation of various ventilation systems and their compliance with the new requirements.</td>
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<td>334290</td>
<td>APP-CMC024-EN</td>
<td>CO2-Based Demand-Controlled Ventilation (November, 2005)</td>
<td>IP Units only</td>
<td>The mobility of a building’s occupants poses a ventilation challenge…to bring enough outdoor air into the building to help assure good indoor air quality without wasting energy by bringing in (and conditioning) too much. This ENL discusses the use of carbon-dioxide (CO2) sensors to vary outdoor airflow based on actual demand. It also considers the related requirements for compliance with ASHRAE Standard 62.1-2004.</td>
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<td>334290</td>
<td>APP-CMC025-EN</td>
<td>Variable-Speed Drives and Their Effect on HVAC System Components (February, 2006)</td>
<td>IP Units only</td>
<td>Variable-speed drives (VSDs) can save energy, but the savings may not equal “the cube of the speed” in every case. This ENL looks at how VSDs affect the performance of pumps, cooling-tower fans, air-handler fans, and chillers, and discusses the differences in VSD control in each of these applications.</td>
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<td>334290</td>
<td>APP-CMC026-EN</td>
<td>HVAC Systems and Airside Economizers (May, 2006)</td>
<td>IP Units only</td>
<td>Airside economizers can lower annual energy costs by using outdoor air to help satisfy the building cooling load. This ENL discusses their use and control in constant- and variable-volume airside systems. It also considers the implications of the energy-use requirements in ASHRAE Standard 90.1 for airside economizing.</td>
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<td>334290</td>
<td>APP-CMC027-EN</td>
<td>HVAC Design for Places of Assembly (September, 2006)</td>
<td>IP Units only</td>
<td>Places of assembly such as auditoriums, gymnasiums and houses of worship create design and operational challenges for HVAC systems. Loads and ventilation requirements due to the number of people in the space are a challenge for any HVAC system. However, these issues can be overcome with proper system knowledge, design and operation.</td>
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<td>334290</td>
<td>APP-CMC028-EN</td>
<td>Energy-Saving Strategies for Rooftop VAV Systems (November, 2006)</td>
<td>IP Units only</td>
<td>Rooftop variable-air-volume (VAV) systems are used to provide comfort in a wide range of building types and climates. This ENL discusses HVAC system design and operating strategies that can save energy in these systems. Topics include: high efficiency equipment, air-to-air energy recovery, relief fan vs. return fan, evaporative condensing, hot gas bypass, hot gas reheate, maintenance program, fan-powered VAV, single-zone VAV, airside economizer, fan-pressure optimization, optimum start, optimum stop, supply-air-temperature reset, ventilation optimization (demand-controlled ventilation, ventilation reset), TRACE 700.</td>
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<td>334290</td>
<td>APP-CMC029-EN</td>
<td>Waterside Heat Recovery (February, 2007)</td>
<td>IP Units only</td>
<td>Green building initiatives, coupled with changes in building codes and standards, have renewed interest in applications that recover condenser heat from water-cooled chillers. This ENL describes how waterside energy recovery works, what is necessary for implementation, and identifies system-level characteristics for effective operation and control.</td>
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<td>APP-CMC030-EN</td>
<td>Improving Dehumidification in HVAC Systems (September, 2007)</td>
<td>IP Units only</td>
<td>Managing humidity should be a key design consideration in any HVAC application. This ENL will discuss the challenge of dehumidifying at part load, for both chilled-water and cycling compressor systems, and describe ways to improve the dehumidification performance of commonly-used HVAC systems. Topics include: modulating chilled water coil, cycling compressors, impact of ventilation, impact of oversizing, total-energy recovery, cool-reheat (hot gas reheat, condenser water heat recovery), face-and-bypass dampers (mixed-air bypass, return-air bypass), reduce airflow (multi-speed fan, VAV, single-zone VAV), dual paths (dedicated outdoor-air system, split dehumidification unit or SDU), desiccants (CDQ), and TRACE 700 humidity modeling and reports.</td>
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<td>APP-CMC031-EN</td>
<td>LEED® Case Studies (November, 2007)</td>
<td>IP Units only</td>
<td>As of the program date, the number of LEED certified buildings stands at over 800, with more than 6,500 additional buildings in the pipeline for certification. With USGBC’s aggressive goal of having 100,000 certified buildings by 2010 there is no doubt this will be a major impact on the built environment. Sustainable design, construction, and operation will be increasingly requested by building owners. This ENL will provide an in-depth review of LEED certified projects in a variety of building types and geographic locations. Unlike the previous LEED-related programs, this ENL provides interviews with various project stakeholders to review LEED credits that were obtained for each project, the original design intent, challenges and lessons learned.</td>
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<td>334290</td>
<td>APP-CMC032-EN</td>
<td>Energy-Saving Strategies for LEED® and the Energy Policy Act* (May, 2008)</td>
<td>IP Units only</td>
<td>According to the U.S. Green Building Council (USGBC), buildings account for 36 percent of the energy used in the United States. This ENL program discusses energy-saving strategies to implement for various HVAC system types, and quantifies the impact of each toward achieving LEED points under the “Optimize Energy Performance” credit. It includes a detailed review of an energy modeling study conducted to demonstrate the potential energy cost savings (for various strategies, climate zones, and HVAC system types) for achieving LEED points and demonstrates how these same strategies can help the building owner qualify for tax deductions through the Energy Policy Act. The presentation provides design engineers with a better understanding of the “big picture” of building energy use, including the impact of the building envelope, lighting, plug loads, and processes and covers common mistakes made when modeling for LEED points.</td>
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<td>APP-CMC033-EN</td>
<td>Small Chilled-Water Systems – only Part II (September, 2008)</td>
<td>IP Units only</td>
<td>More than 80 percent of new buildings in the U.S. are less than 25,000 square feet and almost all buildings are less than 200,000 square feet. This program identifies challenges and opportunities for chilled-water systems in these buildings from 20 to 500 tons. In addition, many low-rise buildings seeking LEED certification have traditionally not been strong candidates for chilled-water systems. If they are 150,000 square feet or less, their baseline for achieving LEED points under EAc1 will not be a chilled-water system. However, these applications may find it easier to beat their baseline and earn more points if they consider a chilled-water system.</td>
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<td>APP-CMC034-EN</td>
<td>ASHRAE Standards 62.1 and 90.1, and VAV Systems* (November, 2008)</td>
<td>IP Units only</td>
<td>Many designers want to comply with both Standard 62.1 and Standard 90.1. Requirements from both standards have been incorporated into many building codes, and the minimum requirements of both standards must be met as prerequisites to LEED certification. In attempting to comply with the ventilation requirements of Standard 62.1 AND the energy-limiting requirements of Standard 90.1, some designers have concluded that it's next to impossible to do so using traditional VAV systems. While in some specific cases these designers might be right, in most cases they are not right. In this program, the immediate past Chair of SSPC 62.1 (Dennis Stanke), the immediate past Chair of SSPC 90.1 (Mick Schwedler), and the one of the authors of the VAV-related sections in the User Manuals for both standards (Steve Taylor), discuss the potentially conflicting requirements and design choices.</td>
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<td>APP-CMC035-EN</td>
<td>LEED® 2009 Modeling and Energy Analysis* (March, 2009)</td>
<td>IP Units only</td>
<td>USGBC's LEED 2009 green building certification program was released in January this year. This presentation will cover the major changes in LEED 2009 and how they impact the HVAC practitioner. Chair of SSPC 90.1, Mick Schwedler, Scott Hintz of the Trane CDS support group and Chris Hsieh cover new regional credits, re-weighting of credit points, changes to the LEED AP credentialing and maintenance program, new modeling features that can help gain LEED points and much more.</td>
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<td>APP-CMC036-EN</td>
<td>Ice Storage System Design and Application* (May, 2009)</td>
<td>IP Units only</td>
<td>Thermal storage, specifically ice storage, is not only an easy way to store energy but it is reemerging as a valuable energy and energy cost saving technology for building owners. This presentation provides a bit of theory and application, then demonstrates the design steps for a small ice storage system from layout to operation and control. Presenters discuss how to make it affordable, expose hidden costs that may raise ROI, and identify and address the most common stumbling blocks.</td>
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<td>APP-CMC037-EN</td>
<td>Air-Handling Systems, Energy, and IAQ* (November, 2009)</td>
<td>IP Units only</td>
<td>Air-handling systems are key elements for building comfort and air quality, but they use energy. How much energy? The answer depends on system configuration and control strategies. This program presents various design and control strategies that can help reduce energy use, along with some interesting new technologies for improving indoor air quality (IAQ).</td>
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<td>APP-CMC038-EN</td>
<td>Fans In Air-Handling Systems* (March 2010)</td>
<td>IP Units only</td>
<td>Fans used in air-handling systems often have significant impact on energy use and acoustics. How much of an impact depends on how a fan is selected, installed and operated. Presentation covers fan performance curves and fan laws, different fan types (fan blade shape, housed vs. plenum fans, direct-drive plenum fans, fan arrays), how a fan interacts with various types of systems, considerations when selecting a fan (efficiency, acoustics, footprint) and ASHRAE Standard 90.1 fan power limitations. The discussion will help you determine the best fan selection based on the requirements of your specific application.</td>
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<td>APP-CMC039-EN</td>
<td>Central Geothermal Systems* (May 2010)</td>
<td>IP Units only</td>
<td>Most designers are familiar with heat pump systems, using small, &quot;geothermal&quot; heat pumps, distributed throughout the building, that are coupled with a ground source heat exchanger. Project teams are also considering central geothermal systems consisting of one or two chillers coupled with a closed, geothermal loop which exchanges heat with the earth. These systems offer premium energy efficiency, with the additional benefit of centralized maintenance, acoustic advantages, and flexibility.</td>
<td>$30.00</td>
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</tbody>
</table>
ASHRAE Standard 90.1-2010 was published in November 2010 with an aggressive goal of 30 percent energy-cost savings over the 2004 version of the standard. Trane experts on the 90.1 committee share their insights on the new requirements and implementation. This program discusses the major change with specific emphasis on mechanical-related system design, control and modeling, mechanical updates, including equipment efficiencies, design requirements for waterside, airside and ventilation, control updates for system design and operation, modeling changes for Appendix G baseline definitions and proposed buildings and summaries for lighting, envelope and other changes.

Existing chilled-water systems provide the capability to cool buildings efficiently. Yet there are often ways that these existing systems can be upgraded and improved to increase efficiency and better serve building occupants. In this presentation we discuss chiller retrofits and replacement; explore different design parameters (flow rates and temperatures) and the opportunities they offer existing systems; examine use of variable flow in existing systems; and consider controls to optimize and reduce system energy use.

Variable-air-volume (VAV) systems have been used to provide comfort in a wide range of building types and climates. This ENL will discuss design and control strategies that can significantly reduce energy use and ensure proper ventilation in VAV systems. Topics include: ventilation system design and control, optimized VAV system controls, cold air distribution, other energy-saving strategies, and dehumidification enhancements.

Previous ENLs have discussed system design and control considerations for dedicated outdoor-air systems. This ENL will shift the discussion to the various types of equipment used for dedicated OA conditioning, from packaged DX units to split DX systems to air handlers and water chillers.

More and more building owners and municipalities want a standard for buildings which exceed minimum building codes. ASHRAE Standard 189.1-2011 Design of High-Performance Green Buildings addresses this demand. It’s a mandatory-language code-intended standard with provisions related to building sites, water use, energy efficiency, general environmental impact, and indoor environmental quality. This ENL presents an overview of the standard and provides some insight regarding its potential impact on future building codes and building designs.

This ENL discusses HVAC system design and control strategies that can save energy in water-source heat pump (WSPH) and ground-source heat pump (GSHP) systems. Topics include the latest technologies being used in heat pumps, design and control of the water distribution loop and dedicated outdoor-air system, ground-source systems, and a review of the requirements in ASHRAE Standard 90.1 that apply to WSPH/GSHP systems.

With the increased focus on reducing energy use in buildings, more projects are considering the use of air-to-air energy recovery. And energy codes are evolving to require energy recovery in more applications. This ENL will discuss the various technologies used for air-to-air energy recovery and the importance of properly controlling these devices in various systems types.

The 2010 version of ASHRAE Standard 62.1 will likely be the basis for the next version of the International Mechanical Code, and it is expected to be a prerequisite for version 4 of the LEED Green Building Rating System. This ENL provides an update of the 2010 version of the standard, and focus on the Ventilation Rate Procedure for calculating zone and system ventilation airflow.
<table>
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<tr>
<th>SIN</th>
<th>Order Number</th>
<th>Title</th>
<th>IP or DUAL Units</th>
<th>Abstract</th>
<th>GSA Price</th>
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<tr>
<td>334290</td>
<td>APP-CMC048-EN</td>
<td>Single-Zone VAV Systems (April 2013)</td>
<td>IP Units only</td>
<td>Recent changes to ASHRAE Standard 90.1 require single-zone VAV systems in some applications. This ENL reviews these new requirements, discusses the benefits of single-zone VAV systems (energy savings, better part-load dehumidification, and lower part-load sound levels), identifies common applications for this system, and discusses ways to address application-related challenges (air distribution, demand-controlled ventilation, and building pressure control). In addition, we review a case study of a retrofit project where a constant-volume rooftop unit was replaced with a single-zone VAV unit.</td>
<td>$30.00</td>
</tr>
<tr>
<td>334290</td>
<td>APP-CMC049-EN</td>
<td>All-Variable-Speed Chilled-Water Plants (October 2013)</td>
<td>IP Units only</td>
<td>Variable frequency drives (VFDs) are being used on all chilled-water system components (fans, pumps, and chillers), and for good reason. When systems are properly designed and controlled, they offer the opportunity for significant energy savings as well as improved operation. With these new opportunities come new complexities. This ENL discusses all-variable-speed chilled-water system design and control. Discussion will include individual component and system performance as well as system design options and control.</td>
<td>$30.00</td>
</tr>
<tr>
<td>334290</td>
<td>APP-CMC050-EN</td>
<td>LEED v4 (March 2014)</td>
<td>IP Units only</td>
<td>LEED continues to thrive with more than 1.6 million square feet of space certified every day. In this ENL, Trane applications engineers will discuss changes in the latest version of LEED and how they impact HVAC practitioners.</td>
<td>$30.00</td>
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<tr>
<td>334290</td>
<td>APP-CMC051-EN</td>
<td>Applying Variable Refrigerant Flow (May 2014)</td>
<td>IP Units only</td>
<td>This program discusses some of the challenges of applying a variable refrigerant flow (VRF) system, such as complying with ASHRAE Standards 15 and 90.1, meeting the ventilation requirements of ASHRAE Standard 62.1, and zoning to maximize the benefit of heat recovery. In addition, we review the current state of modeling VRF in energy simulation software.</td>
<td>$30.00</td>
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<tr>
<td>334290</td>
<td>APP-CMC052-EN</td>
<td>Chilled Water Terminal Systems (Oct 2014)</td>
<td>IP Units only</td>
<td>Trane applications engineers discuss system design and control strategies for various types of chilled-water terminal systems, including fan-coils, chilled beams, and radiant cooling. Topics include: types of terminal equipment, variable-speed terminal fan operation, dedicated OA system design, chilled-water system design, and complying with ASHRAE 90.1 requirements</td>
<td>$30.00</td>
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<tr>
<td>334290</td>
<td>APP-CMC053-EN</td>
<td>Variable-Speed Compressors On Chillers (Mar 2015)</td>
<td>IP Units only</td>
<td>Trane applications engineers discuss the operational, performance and application differences for centrifugal (dynamic compression) and helical-rotary (positive displacement) compressors. Discussion includes an overview of how variable-speed drives affect chilled-water system components, physics of centrifugal compressor chillers and screw compressor chillers, applications that benefit from each technology, importance of proper life-cycle analysis and application considerations to leave the viewer with an understanding of which technologies bring real value to different system applications.</td>
<td>$30.00</td>
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<tr>
<td>334290</td>
<td>APP-CMC054-EN</td>
<td>Coils Selection and Optimization (May 2015)</td>
<td>IP Units only</td>
<td>Trane engineers discuss the application, selection, and optimization of both chilled-water and hot-water coils. Topics include a discussion about the impact of both water and air velocities on coil performance, a review of example selections for chilled-water and hot-water coils to demonstrate the tradeoffs of cost, pressure drop, and capacity, and an overview of various methods to prevent water coils from freezing during cold weather.</td>
<td>$30.00</td>
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<tr>
<td>334290</td>
<td>APP-CMC055-EN</td>
<td>Evaluating Sound Data (May 2015)</td>
<td>IP Units only</td>
<td>Sound data is the foundation of acoustical analysis and it is often used for comparing equipment from different manufacturers. Unfortunately not all manufacturers present sound data in the same format. In this ENL, Trane Applications Engineers focus on clarifying sound data terms and weighting methods so that the differences in sound data presentation are apparent. Examples of the common mistakes made when comparing chillers, air-handlers, VAV units, and fan coils are discussed.</td>
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### HVAC SYSTEM DESIGN TOOLS

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<tr>
<td>334290</td>
<td>APP-CMC056-EN</td>
<td>Chilled-Water System Design Trends (October 2015)</td>
<td>IP Units only</td>
<td>Improved technology and controls for chilled-water systems over the past several years enable these types of systems to do more and save more. This ENL reviews recent advancements in technology and trends due to these developments, system strategies that can take advantage of the latest technology and when various system strategies should be used. Consideration will be given to: variable primary, primary secondary, constant flow, series chillers, chilled water reset, pump pressure optimization, flow rates and turndown, heat exchanger types, and the components of air- and water-cooled systems.</td>
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<td>334290</td>
<td>94.24</td>
<td>Ductulator® (1998)</td>
<td>Dual units (IP/SI)</td>
<td>Hand held rotating calculator used for sizing supply and return duct systems using the equal friction design method. Includes scales for friction loss per unit length, air volume, air velocity, round duct diameter, and rectangular duct diameters. One side uses I-P units, the other side uses SI units. Includes a protective sleeve with ASHRAE recommended design air velocities for system components/applications.</td>
<td>$10.00</td>
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<td>1-43.190</td>
<td>Psychrometric Chart (1983)</td>
<td>I-P Units</td>
<td>Chart used for determining properties of moist air and analyzing air conditioning processes.</td>
<td>$7.50</td>
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<td>334290</td>
<td>1-43.191</td>
<td>Psychrometric Chart (1983)</td>
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<td>Psychrometric Chart (1983)</td>
<td>I-P Units</td>
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<td>1-43.196</td>
<td>Psychrometric Chart (1983)</td>
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<td>334290</td>
<td>1-43.197</td>
<td>Psychrometric Chart (1983) - standard altitude (101 kPa) - (1) 11” x 17” laminated chart</td>
<td>SI Units</td>
<td>Chart used for determining properties of moist air and analyzing air conditioning processes.</td>
<td>$15.00</td>
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<tr>
<td>334290</td>
<td>OSA 214 E</td>
<td>Psychrometric Chart (1996) - standard altitude (101 kPa) - 8.5” x 11” pad of 25 sheets - SI units - Includes “coil curves”</td>
<td>SI Units</td>
<td>Chart used for determining properties of moist air and analyzing air conditioning processes.</td>
<td>$7.50</td>
</tr>
<tr>
<td>334290</td>
<td>1-43.198</td>
<td>Equilibrium Chart I-P Units for Lithium Bromide Solutions (1983) - (1) 11” x 17” laminated chart</td>
<td>I-P Units</td>
<td>Chart used for determining properties of a lithium bromide solution used in the absorption refrigeration cycle.</td>
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| 334290, 238910, ANCILLARY, 561210FAC, 541690E | S020                     | HVAC Field Technician              | Non-Exempt                      | Functional Description: Responsible for retrofit and repair of environmental-comfort systems, utilizing knowledge of air conditioning theory, pipe fitting, and mechanical layouts.  
Minimum Experience: Typically requires 5 years of related experience.  
Minimum Education: Associate's degree or equivalent from a Technical/Trade School with a certificate in Heating, Ventilation, and Air Conditioning and five (5) years related experience; or seven (7) years related experience; or equivalent combination of education and experience. | $170.39 | $207.75 | $207.24  | $159.47   |
| 334290, 238910, ANCILLARY, 561210FAC, 541690E | S021                     | HVAC Field Technical – Apprentice  | Non-Exempt                      | Functional Description: Assists HVAC Field Technicians in the installation and repair of environmental control systems, utilizing knowledge of refrigeration theory, control systems, pipe fitting, and structural layouts.  
Minimum Experience: Typically requires 6 months of related experience.  
Minimum Education: Associate’s degree or equivalent from two-year college or technical school with a certificate in Heating, Ventilation, and Air Conditioning; or six months to one-year related experience and/or training; or equivalent combination of education and experience. | $147.96 | $178.94 | $164.90  | $147.09   |
| 334290, 238910, ANCILLARY, 561210FAC, 541690E | S022                     | HVAC Field Technician – Team Leader| Non-Exempt                      | Functional Description: Performs and directs HVAC Field Technicians who accomplish the repair/retrofit/replacement installation of environment comfort systems, utilizing knowledge of air conditioning theory, pipe fitting and mechanical layouts.  
Minimum Experience: Typically requires 5 years of related experience.  
Minimum Education: Associate’s degree or equivalent from two-year college or technical school with a certificate in Heating, Ventilation, and Air Conditioning; and five (5) years HVAC experience, or equivalent combination of education and experience. Must have knowledge of various HVAC products, systems, electronics, and pneumatic controls. | $213.53 | $217.73 | $242.64  | $191.33   |
| 334290, 238910, ANCILLARY, 561210FAC, 541690E | S049                     | HVAC Field Technician – Senior     | Non-Exempt                      | Functional Description: Applies training, knowledge and experience of HVAC systems at a Journeymen level HVAC Service Technician. Performs all work in the service and maintenance field on all major types of equipment, and is responsible for retrofit and repair of environmental-comfort systems, utilizing knowledge of air conditioning theory, pipe fitting, and mechanical layouts.  
Minimum Experience: Typically requires 7 years of related experience.  
Minimum Education: Associate’s degree (A.A.) or equivalent from a technical / trade school with a certificate in Heating, Ventilation, and Air Conditioning and seven (7) years related experience; or ten (1) years related experience; or equivalent combination of education and experience. | $196.14 | $210.55 | $216.25  | $175.74   |
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<th>Description</th>
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<td><strong>Functional Description:</strong></td>
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<td><strong>Central</strong></td>
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<td><strong>Northeast</strong></td>
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<td><strong>Southeast</strong></td>
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<tr>
<td>334290</td>
<td>S118</td>
<td>Project Administrator – Service</td>
<td>Non-Exempt</td>
<td>Possesses project documentation, materials, job costing, status monitoring, invoicing, and administrative closeout of a service project. This position is required to closely interact with the Project Manager and assigned project staff to ensure the timely completion of services scope of work. <strong>Minimum Experience:</strong> Typically requires 6 months of related experience. <strong>Minimum Education:</strong> One-year certificate from college or technical school; or six (6) months to two (2) years or related experience and/or training; or equivalent combination of education and experience. Familiarity with the operation of Energy Management Systems, HVAC Systems, and/or Temperature Controls preferred.</td>
<td>$142.64</td>
</tr>
<tr>
<td>334290</td>
<td>S154</td>
<td>Service Helper</td>
<td>Non-Exempt</td>
<td>Assists HVAC Field Technicians in routine maintenance and inspections on existing systems. <strong>Minimum Experience:</strong> Typically requires 1 year of related experience involving building trades or operation and service to buildings or HVAC. <strong>Minimum Education:</strong> High School Diploma or GED.</td>
<td>$145.11</td>
</tr>
<tr>
<td>334290</td>
<td>S082</td>
<td>Project Engineer II – Controls</td>
<td>Exempt</td>
<td>Performs hardware and software design activities for building automation systems. Applies engineering principles and practices for work on assigned projects. Designs cost effective control solutions to meet project requirements. Works directly on the project team to assist the Project Manager with project commissioning. <strong>Minimum Experience:</strong> Typically requires 3-6 years of related experience. <strong>Minimum Education:</strong> Bachelor’s degree in Engineering and 3-4 years experience; or Associate’s degree or equivalent from two-year college or technical school in electrical engineering and a certificate in HVAC or AAS and BAS in electrical engineering and 5-6 years related experience; or equivalent combination of education and experience.</td>
<td>$304.98</td>
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<tr>
<td>334290</td>
<td>S083</td>
<td>Project Engineer II – Energy</td>
<td>Exempt</td>
<td>Performs technical analysis, review, measurement, and verification of financially guaranteed projects. Provides technical analysis and review for performance monitoring or contracts, and applies engineering principles and practices on assigned projects. <strong>Minimum Experience:</strong> Typically requires 3 years of related experience. <strong>Minimum Education:</strong> Bachelor’s degree in Engineering and three (3) years experience; or equivalent combination of education and experience. Knowledge and experience with HVAC, control, electrical systems and proficiency with energy analysis tools such as TRACE and system analyzer. Working knowledge of cost and savings studies incorporating energy conservation measures.</td>
<td>$308.91</td>
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| 334290,    | 238910, ANCILLARY, | Project Engineer      | Exempt                           | **Functional Description:** Performs complex planning, estimating and design activities for the layout of equipment, commercial and industrial facilities. Determines the scope of projects, estimates cost, designs and documents HVAC and electrical systems and procure components. Works directly on the project team to assist the Project Manager with project commissioning.  
**Minimum Experience:** Typically requires 3-6 years of related experience.  
**Minimum Education:** Bachelor’s degree in Engineering and 3-4 years related experience; or Associate’s degree (A.A.) or equivalent from two-year college or technical school in electrical engineering and a certificate in HVAC or AAS and BAS in electrical engineering and 5-6 years related experience; or equivalent combination of education and experience. | $308.91    |
| 561210FAC, | 541690E          | II – Systems          |                                  |                                                                                     | $224.46    |
| 541690E     |                  |                      |                                  |                                                                                     | $265.02    |
|             |                  |                      |                                  |                                                                                     | $218.43    |
| 334290,    | 238910, ANCILLARY, | Project Manager       | Exempt                           | **Functional Description:** Manages all aspects of HVAC control projects, from beginning to end, with direct responsibility for project execution while leading a team, or teams, to accomplish specific objectives in a given time frame and with available resources. Responsible for the administration, implementation, and management of HVAC control projects. Ensures assigned projects’ scope of work, schedule, and budget are achieved.  
**Minimum Experience:** Typically requires 2-6 years of related experience.  
**Minimum Education:** Bachelor’s degree in Electrical or Mechanical Engineering or Construction Management with a minimum of two (2) years of project management, controls, HVAC or related experience, or a minimum of six (6) years of project management, controls, HVAC or related experience; or an equivalent combination of education and experience. | $247.15    |
| 561210FAC, | 541690E          | – Controls            |                                  |                                                                                     | $232.62    |
|             |                  |                      |                                  |                                                                                     | $211.22    |
|             |                  |                      |                                  |                                                                                     | $216.61    |
| 334290,    | 238910, ANCILLARY, | Project Manager       | Exempt                           | **Functional Description:** Manages all aspects of HVAC contract projects, from beginning to end, with direct responsibility for project execution while leading a team, or teams, to accomplish specific objectives in a given time frame and with available resources. Responsible for the administration, implementation, and management of control projects. Accountable for assigned projects’ scope of work, schedule, and budget.  
**Minimum Experience:** Typically requires 2-6 years of related experience.  
**Minimum Education:** Bachelor’s degree in Electrical or Mechanical Engineering or Construction Management with a minimum of two (2) years of project management, HVAC (systems, equipment, installation or service) or related experience, or a minimum of six (6) years or project management, HVAC (systems, equipment, installation, or service) or related experience; or an equivalent combination of education and experience. | $264.03    |
| 561210FAC, | 541690E          | – Contracts           |                                  |                                                                                     | $219.70    |
|             |                  |                      |                                  |                                                                                     | $230.83    |
|             |                  |                      |                                  |                                                                                     | $217.29    |

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<th>Description</th>
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<td></td>
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<td>Exempt</td>
<td></td>
<td>Functional Description: Performs hardware and software design activities for building automation systems. Applies engineering principles and practices for work on assigned projects. Designs cost effective control solutions to meet project requirements. Works directly with the project team to assist with project commissioning. Directs and assists other project engineers on the team related to opportunities and obstacles in managing the engineering workload. Possesses a familiarity with the concepts of new construction, renovation/retrofit; performance contracting, and service project management. Minimum Experience: Typically requires 2-4 years of related experience. Minimum Education: Bachelor's degree in engineering and two (2) to three (3) years experience; or Associate's degree or equivalent from two-year college or technical school in electrical engineering and a certificate in HVAC or AAS and BAS in electrical engineering and three (3) to four (4) years related experience; or equivalent combination of education and experience.</td>
<td>$308.91</td>
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<tr>
<td></td>
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<td>Non-Exempt</td>
<td></td>
<td>Functional Description: Responsible for project set-up, document control, data entry, billing, contract monitoring, and administrative closeout of each project. This position is required to closely interact with the Project Manager and assigned project staff to assist with the timely completion of each project. Minimum Experience: Typically requires 6 months of related experience. Minimum Education: One-year certificate from college or technical school; or six (6) months of related experience and/or training; or equivalent combination of education and experience. Familiarity with the operation of Energy Management Systems, HVAC Systems and/or Temperature Controls preferred.</td>
<td>$136.23</td>
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<td>Non-Exempt</td>
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<td>Functional Description: Responsible for creating computer aided design (CAD) drawings using standard CAD digitizing techniques and skills. Also responsible for the system graphics required to support automation systems design. Minimum Experience: Typically requires 6 months of related experience. Minimum Education: Associate's degree from college or technical school in Computer-Aided Design or Drafting; or at least six (6) months related experience and/or training; or equivalent combination of education and experience. Working knowledge of AutoCAD or other computer aided design, Microsoft Office software required.</td>
<td>$146.21</td>
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<tr>
<td></td>
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<td>Non-Exempt</td>
<td></td>
<td>Functional Description: Performs more complex commissioning, diagnosis, and repair of environmental-control systems, utilizing knowledge of electronics, direct digital control, airflow, hydronics, refrigeration theory, and control techniques. Minimum Experience: Typically requires 6 months of related experience. Minimum Education: Associate's degree or equivalent from two-year college or technical school or six (6) months experience in control systems; or equivalent combination of education and experience.</td>
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<td>334290,</td>
<td>S152</td>
<td>Controls Technician – Entry Level</td>
<td>Non-Exempt</td>
<td>Functional Description: Performs and assists under direction complex commissioning, diagnosis, and repair of environmental-control systems, utilizing knowledge of electronics, direct digital control, airflow, hydronics, refrigeration theory, and control techniques. Performs these tasks on simple control projects. Minimum Experience: Typically requires 6 months of related experience. Minimum Education: Associate's degree or equivalent from two-year college or technical school or six (6) months experience in control systems; or equivalent combination of education and experience.</td>
<td>$191.43  $152.71  $179.80  $183.21</td>
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<tr>
<td>238910,</td>
<td>S167</td>
<td>Project Engineer I – Systems</td>
<td>Non-Exempt</td>
<td>Functional Description: Project development - Performs planning, estimating and design activities for the layout of equipment, commercial and industrial facilities. Assists in determining the scope of projects, estimates cost, designs and documents HVAC and electrical systems and procures components. Works directly on the project team to assist the Project Manager with project commissioning. Minimum Experience: Typically requires 4-5 years of related experience. Minimum Education: Associate’s degree or equivalent from two-year college or technical school in electrical engineering and a certificate in HVAC or AAS and BAS in electrical engineering and 4-5 years related experience; or equivalent combination of education and experience.</td>
<td>$127.10  $148.53  $179.80  $158.54</td>
</tr>
<tr>
<td>238910,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>561210FAC,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>541690E</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>238910,</td>
<td>S168</td>
<td>Project Engineer I – Energy</td>
<td>Non-Exempt</td>
<td>Functional Description: Project development - Provides technical analysis and review for performance monitoring on contracts. Applies knowledge of technology and applications on assigned projects. Minimum Experience: Typically requires 5-6 years of related experience. Minimum Education: Knowledge and 5-6 years experience with HVAC, control, electrical systems and proficiency with energy analysis tools such as TRACE and system analyzer. Working knowledge of cost and savings studies incorporating energy conversation measures.</td>
<td>$127.10  $148.53  $179.80  $158.54</td>
</tr>
<tr>
<td>561210FAC,</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>541690E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>238910,</td>
<td>S169</td>
<td>Project Engineer I – Controls</td>
<td>Non-Exempt</td>
<td>Functional Description: Project development which includes applying engineering principles and practices on assigned projects. Designs cost effective control solutions to meet project requirements. Works directly on the project team to assist with project commissioning. Minimum Experience: Typically requires 4-5 years of related experience. Minimum Education: Associate’s degree or equivalent from two-year college or technical school in electrical engineering and a certificate in HVAC or AAS and BAS in electrical engineering and 4-5 years related experience; or equivalent combination of education and experience.</td>
<td>$127.10  $148.53  $179.80  $158.54</td>
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<tr>
<td>561210FAC,</td>
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<tr>
<td>541690E</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Labor Categories under SIN 334290, 561210FAC, 541690E, Ancillary Services, and SIN 238910 Installation Involving Construction**

The rates shown above are for labor services performed during standard work hours and are the GSA ceiling rates (maximum price) for the region. These rates are adjusted to the Trane Commercial Sales Office (CSO) within the region where the work will be performed. An overtime premium is not charged for exempt overtime labor services (See Service Contract Act Exempt / Non-Exempt listing). That is not the case for non-exempt positions.

**Overtime Rates.** For NE labor services performed after the standard workday (typically 5:00pm), the published rates in appendices do not apply and this Standard-Time (ST) rate should be multiplied by 1.5 to obtain the Over-Time (OT) rate for applicable NE job descriptions. Saturday after noon (12pm), Sunday and holiday work is at Premium-Time (PT). It is typically double-time (standard rate is multiplied by 2.0). These premium rates are charged unless it is established up front that there will be a work week change, for example, the workweek for services will be Sunday to Thursday. This must be negotiated and agreed to by both parties up front. Also, some work on Saturdays may be considered. **West** = States of Arizona, Alaska, California, Colorado, Hawaii, Idaho, Montana, New Mexico, Nevada, Oklahoma, Oregon, Texas, Utah, Washington, Wyoming. **OCONUS Central** = States of Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin. **Northeast** = States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia. **Washington DC Southeast** = States of Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia

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### GSA Pricing of Labor – GSA Hourly Billing Rates (Davis Bacon Act)

<table>
<thead>
<tr>
<th>SIN</th>
<th>Reference Number</th>
<th>Labor Category</th>
<th>Wage Determination</th>
<th>GSA Price</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>West</td>
</tr>
<tr>
<td>238910, ANCRA</td>
<td>DB01</td>
<td>Acoustical Installer</td>
<td>Davis Bacon Act</td>
<td>$106.20</td>
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<tr>
<td>238910, ANCRA</td>
<td>DB02</td>
<td>Carpenters</td>
<td>Davis Bacon Act</td>
<td>$103.24</td>
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<td>238910, ANCRA</td>
<td>DB03</td>
<td>Mason/Concrete Finisher</td>
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<td>Glazier</td>
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<td>DB08</td>
<td>Ironworker – Reinforcing</td>
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<td>238910, ANCRA</td>
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<td>Ironworker - Structural</td>
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<td>238910, ANCRA</td>
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<td>Painters</td>
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<td>DB13</td>
<td>Plasterer Tender</td>
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<tr>
<td>238910, ANCRA</td>
<td>DB14</td>
<td>Plumbers &amp; Pipefitters</td>
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<td>$150.17</td>
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<td>Welders – Building</td>
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</tbody>
</table>

### Davis Bacon Act Labor Categories under SIN 238910, ANCRA Installation Involving Construction

The rates shown above are for labor services performed during standard work hours and are the GSA ceiling rates (maximum price) for the region. These rates are adjusted to the Trane Commercial Sales Office (CSO) within the region where the work will be performed. Since all of these labor categories are listed on the Davis-Bacon Act wage determinations, an overtime premium will be charged for these services. An overtime premium is not charged for exempt overtime labor services (See Service Contract Act Exempt / Non-Exempt listing). That is not the case for non-exempt positions.

**Overtime Rates.** If the labor categories listed in this price list are performed after the standard eight (8) hour workday, the rates above do not apply, and this Standard-Time (ST) rate should be multiplied by 1.5 to obtain the Over-Time (OT) rate for the applicable labor category. Holiday work is at Premium-Time (PT). It is double-time (standard rate is multiplied by 2.0). These premium rates are charged unless it is established up front that there will be a work week charge, for example, the work week will be Sunday to Thursday. This must be negotiated and agreed to by both parties up front and must be compliant with DBA provisions.

- **West** = States of Arizona, Alaska, California, Colorado, Hawaii, Idaho, Montana, New Mexico, Nevada, Oklahoma, Oregon, Texas, Utah, Washington, Wyoming, OCONUS.
- **Central** = States of Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin.
- **Northeast** = States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia.
- **Southeast** = States of Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia.

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At Trane Supply, we have the parts and the knowledge to support all of your HVAC needs, no matter what system you are working on. You can rely on us to deliver a solution to meet your needs, and to help you be more productive, profitable, and knowledgeable.

Along with our technical expertise, we focus on providing customers with the best availability of OEM parts for Trane equipment, including remanufactured OEM compressors, as well as ancillary parts and supplies needed to support your entire job, from start to finish.

Contact Trane Parts Supply:
1-855-250-3660
partsnationalaccounts@trane.com
www.tranesupply.com

On-line access to contract ordering information, terms and conditions, up-to-date pricing, and the option to create an electronic delivery order is available through GSA Advantage!, a menu driven database system. The INTERNET address for GSA Advantage! is:
www.gsaadvantage.gov
### Synexis Indoor Air Quality (IAQ) Products

<table>
<thead>
<tr>
<th>SIN Number</th>
<th>MFR Part#</th>
<th>Product Name</th>
<th>Unit of Issue</th>
<th>GSA Price</th>
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<tbody>
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<td>334512</td>
<td>TR-DC3406</td>
<td>Synexis Blade</td>
<td>EA</td>
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<td>334512</td>
<td>TR-E1004</td>
<td>Sentry UV Replacement Bulb (T8 Bulb)</td>
<td>EA</td>
<td>$176.05</td>
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<tr>
<td>334512</td>
<td>TR-E1006</td>
<td>U Replacement Bulb (7&quot; T5 bulb)</td>
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<td>TR-M1082</td>
<td>Sphere Wire Stand</td>
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<td>TR-M7007</td>
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<td>TR-M7008</td>
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<td>334512</td>
<td>TR-PR9403-WH</td>
<td>Synexis Sentry (stand only) Unit - White</td>
<td>EA</td>
<td>$3,148.94</td>
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TRACE 3D Plus Load Design (CDS-PKG-X)

| Length: N/A | Software Type: Design Tools | Software Cost: See Schedule | Licensing Option: Single/Site/Ent/Global | Recommended search: N/A |

**Purchase Now! Trane C.D.S. Software**

**Software Description**
TRACE 3D Plus Load software is a separate program incorporating the load and system portion of the design process. In other words, it contains the functionality of TRACE 3D Plus minus the energy and economic portions of the program. Use this program to complete complex building load calculations for virtually any building. TRACE 3D Plus Load Design provides all of the options and modeling capabilities you expect in a comprehensive load analysis tool, combined with a whole new level of usability that makes load design easy.

**Features**
TRACE 3D Plus Load Design modeling and features include:
- Load Phase
- Day/Hour/Zone Calculations
- Assignment of Loads
- System cooling Supply-Air Dry Bulb (SADBC)
- Design Calculation Summary

**Licensing Description**
SINGLE. “Standalone” Provides a single annual license to use the “Software”. The software may be installed and used on a single computer or supported interface device which can be directly accessed by only one user at a time, and which is not accessible to users on other computers.

SITE. “Limited Enterprise” This license comes with one Seat and provides a single annual base license to install the software at any company location on any company or supported interface device based on the number of Seats that have been purchased.

ENTERPRISE. “Enterprise” Requires the purchase of TRACE 3D Plus Enterprise Concurrent Seats (no seats included) and a TRACE 3D Plus license server installed on the company computer network. Provides a single annual base license to install the software at any company location on any company computer or supported interface device. Use of the software for each computer the software is installed upon is limited to the quantity of purchased Enterprise Concurrent Seats.

GLOBAL. “Global Enterprise” Provides an annual license to install and use the software at any company location on any company computer or supported interface device. Unlimited Seats.

**Prerequisites**
None.
TRACE 3D Plus (CDS-PKG-Y)

<table>
<thead>
<tr>
<th>Length:</th>
<th>Software Type: Design Tools</th>
<th>Software Cost: See Schedule</th>
<th>Licensing Option: Single/Site/Ent/Global</th>
<th>Recommended search: N/A</th>
</tr>
</thead>
</table>

Software Description
TRACE® 3D Plus is a next generation building design and analysis software program that delivers faster, more accurate results through a seamless workflow that closely aligns with today’s building process. The latest HVAC systems and controls can be modeled quickly, precisely and with the intricacies of today’s many building applications. TRACE 3D Plus is built on the U.S. Department of Energy’s EnergyPlus engine and enhanced with Trane’s industry leading expertise to help designers validate and interpret projects with confidence and clarity. All of these new features plus a more robust support experience to get you up and running quickly. TRACE 3D Plus allows you to move from project plan to load design to energy and economic analysis all through the same project file and interface. Import 3D models directly from CAD using Green Building XML (gbXML), or import floor plans and trace over using the draw tools. Easily create and validate your architectural design and HVAC systems in 2D or 3D.

Features
TRACE 3D Plus advantages include:
- Faster modeling process with visually dynamic workflows
- Create schedules faster with graphical plotting and drag-and-drop features
- Use pre-configured building themes and thousands of pre-loaded and scalable libraries and templates
- Schematically configure systems and plants easily with built-in systems validation and intelligence

Licensing Description
SINGLE. “Standalone” Provides a single annual license to use the “Software”. The software may be installed and used on a single computer or supported interface device which can be directly accessed by only one user at a time, and which is not accessible to users on other computers.

SITE. “Limited Enterprise” This license comes with one Seat and provides a single annual base license to install the software at any company location on any company or supported interface device based on the number of Seats that have been purchased.

ENTERPRISE. “Enterprise” Requires the purchase of TRACE 3D Plus Enterprise Concurrent Seats (no seats included) and a TRACE 3D Plus license server installed on the company computer network. Provides a single annual base license to install the software at any company location on any company computer or supported interface device. Use of the software for each computer the software is installed upon is limited to the quantity of purchased Enterprise Concurrent Seats.

GLOBAL. “Global Enterprise” Provides an annual license to install and use the software at any company location on any company computer or supported interface device. Unlimited Seats.

Prerequisites
None.

Purchase Now! Trane C.D.S. Software
Tracer® Summit™ System Operation (BSC01)

| Length: 3.5 days | Day and time: Day 1-3: 8 a.m.–4:30 p.m.; Day 4: 8:00–11:30 a.m. | Course Cost: See Schedule | Continuing Education Units: 2.5 | Recommended search: System Operation |

Register Now! Trane Education Center

Course Description
In this course students will learn to perform common and advanced operations with their installed Tracer Summit building management system. This highly interactive basic course includes presentations and hands-on workshops where students practice using the common applications of a Tracer Summit building management system and learn how to monitor and control building mechanical systems.

Specific Course Objectives
Upon completion of this course, participants should be able to:
- Create and modify schedules/holidays and exceptions.
- Create, modify and plot graphs of trends.
- Respond, route and print alarms.
- Create and modify users and passwords.
- Create and modify basic graphics.
- Monitor chiller plant control.
- Apply knowledge of schedules, area, and variable air systems applications to controls building air systems.

Who Should Attend
Tracer Summit System Operations is intended for Trane service technicians and Tracer Summit system owners, building engineers and operators.

Prerequisites
None

Pre-Work
None
## Tracer Summit 101 (BSC02)

<table>
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<th>Length:</th>
<th>Day and time:</th>
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<td>See Schedule</td>
<td>3.2</td>
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</tbody>
</table>

Register Now! Trane Education Center

### Course Description
Summit 101 is an installation course intended for BAS personnel and Applied Systems Contractors who will be responsible for engineering, installing, and commissioning Tracer Summit projects. Skills taught in the installation workshops are intended for those who will install Tracer Summit hardware and configure applications.

### Specific Course Objectives
By the end of this course, you will be able to cover topics such as:
- Basic understanding of the Tracer Summit Software.
- Site configuration
- BCU installation
- Ethernet LANs
- BACnet®/IP LANs
- BCU comm links
- Interfacing LonTalk®
- Generic LonTalk® Devices (GLDs)
- Point configuration
- Alarm and message routing
- Graphics
- Time of Day schedules
- Introduction to the area application
- Introduction to Comm4 Variable Air Systems (VAS) application
- LonTalk VAS
- Site backup and restore

### Who Should Attend
The class is designed primarily for beginning users. The information in this class provides basic information critical for understanding subsequent Tracer applications.

### Prerequisites
Student must receive Trane University approval prior to registration.

### Pre-Work
None.
**Tracer Summit 102 (BSC03)**

<table>
<thead>
<tr>
<th>Length</th>
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<tbody>
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</tr>
<tr>
<td>Course Cost</td>
<td>See Schedule</td>
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<td>Continuing Education Units</td>
<td>3.2</td>
</tr>
<tr>
<td>Recommended search</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Register Now! Trane Education Center

**Course Description**
Students are introduced to the standard Tracer applications included with the Tracer Summit software through lecture and extensive hands-on workshops. In addition to the standard Tracer applications, the course also covers the custom programming language (CPL) used in Tracer Summit. Our programs use a variety of assessment methods to measure learning, from pre and post tests, to classroom activities, quizzes, and workshops.

**Specific Course Objectives**
By the end of this course, you will be able to:
- Set up and operate area control.
- Set up and operate Variable Air Systems (VAS) [Comm4 and LonTalk®].
- Set up and operate Chiller Plant Control (CPS)
- Write programs using CPL.

**Who Should Attend**
The class is designed primarily for advanced users. The information in this class provides a deeper dive into information critical for understanding subsequent Tracer applications.

**Prerequisites**
Student must receive Trane University approval prior to registration. In order to attend Tracer Summit 102, students must have completed Tracer Summit 101.

**Pre-Work**
None.
Tracer® Synchrony™ Operation (BSC04)

Length: 2.5 days

Day and time:
Day 1-2: 8 a.m.–4:30 p.m.;
Day 3: 8:00–11:30 a.m.

Course Cost: See Schedule

Continuing Education Units: 1.8

Recommended search: Synchrony Operation

Register Now! Trane Education Center

Course Description
In the Tracer Synchrony Operation course, students learn to operate and modify an installed Tracer SC+ system using the Synchrony interface. This highly interactive course includes presentations, demonstrations and hands-on workshops where students practice using the software applications integral to a Tracer SC+ building management system.

Specific Course Objectives
Upon completion of this course, participants should be able to:
- Determine the need for and sequence of operation of various types of HVAC equipment.
- Describe the different levels of control in a building automation system and how they relate to equipment.
- Monitor and control building mechanical systems.
- Utilize contract documentation to identify control components and locations.
- Create new user accounts and control their level of access within Tracer Synchrony.
- Navigate the Tracer Synchrony user interface.
- Create and modify custom time-of-day schedules.
- Apply knowledge of schedules, area, and variable air system applications to control building air systems.
- Respond to hot and cold calls by applying troubleshooting strategies.
- Respond to alarm conditions.
- Generate and view data logs and reports.
- Back up your Tracer SC+.

Who Should Attend
Tracer Synchrony Operation is intended for Trane service technicians and Tracer SC/SC+ system owners, building engineers and operators.

Prerequisites
Introduction to the Tracer SC System e-learning module is recommended but not required.

Pre-Work
None

[Image: Log in to Tracer Synchrony]

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Tracer® Synchrony™ Advanced Operation (BSC05)

Length: 3 days
Day and time: Day 1–3: 8 a.m.–4:30 p.m.
Course Cost: See Schedule
Continuing Education Units: 2.1
Recommended search: Advanced Operation

Register Now! Trane Education Center

Course Description
The Tracer Synchrony Advanced Operation course builds on the knowledge and skills learned in the TracerSC/Synchrony Operation course. This course will enable learners to expand their skillset to complete a variety of advanced operations, control strategies and energy saving methods to get the most value out of their Tracer SC+ building control system.

Specific Course Objectives
Upon completion of this course, participants should be able to:

• Define and apply coordinated control methods using spaces, Area, VAS and schedules.
• Create an area using the area application and understand the different configuration options.
• Create HVAC, analog and binary schedules.
• Set up and modify data logs with advanced configurations.
• Use Tracer TU™ to backup, restore and upgrade firmware for Trane unit controllers.
• Configure alarming for binary and analog points.
• Create custom alarm categories and notification classes.
• Route alarm categories to users.
• Work with Tracer Graphical Editor (TGE) to modify and publish Graphics to the SC+.

Who Should Attend
Tracer Synchrony Advanced Operation is intended for Tracer SC/SC+ system owners, operators and building engineers who have previously completed the Tracer SC/Tracer Synchrony Operation course and want to go deeper.

Prerequisites

• Tracer® Synchrony™ Operation

Tracer Synchrony Advanced Operation is an advanced operations course. Students must also be proficient at using a personal computer and familiar with using a web browser.

Pre-Work
None
Tracer SC+ 101 (BSC06)

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<tr>
<td>SC+101</td>
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Course Description

The Tracer SC+101 class will walk through a complete standard Tracer® SC+/Synchrony™ setup and commissioning process.

Specific Course Objectives

Upon completion of this course, participants should be able to:

- Commission and troubleshoot LonTalk®, BACnet® and Air-Fi® protocols
- Configure and commission Unit Controllers (UC210, UC400, UC600) using standard configurations and PPS (PPS Configurator)
- Perform initial SC+ setup/licensing
- Install UC into Tracer SC+ using both standard and custom equipment templates (multi-equipment templates, custom keys and key conversion)
- Create and configure points to include: point service, referencing for global applications and standard application use
- Setup and configure area control
- Setup and configure Variable Air systems (VAS) control
- Setup and configure schedules
- Create and edit custom graphics
- Setup user Roles and Profiles
- Backup and Restore the Tracer SC+

Who Should Attend

Tracer SC+ 101 is intended for Trane Control Service technicians and Applied Systems Contractors whose primary function will be to install new sites.

Prerequisites

None.

Pre-Work

Student must be pre-approved by Trane University for this course offering.

Pre-work for this course includes:

- LonTalk® Fundamentals Self-paced Learning
- BACnet® Fundamentals Self-paced Learning
- Introduction to IP Networking e-learning
- Air-Fi® Wireless Fundamentals e-learning

All pre-work must be completed prior to coming to class. Students will be tested on this material the first day.
Tracer SC+ 102 (BSC07)

Course Description
The Tracer SC+ 102 class is designed to take a student through the built-in applications within Tracer® Synchrony™. The class also introduces the student to some TGP2 programming, Offsite Facility Definition and Alarm Notification.

Specific Course Objectives
Upon completion of this course, participants should be able to:
- Configure a site using the Offsite Facility Definition in Tracer® TU.
- Apply Area Control and its operating modes to its members and member types
- Configure and setup Variable Air Systems: Changeover Bypass
- Apply the Tracer® SC Chiller Plant Control application.
- Introduction to TGP2 programming

Who Should Attend
Tracer SC+ 102 is intended for Trane controls systems installer-programmers and controls system service technicians.

Who Should Attend

Prerequisites
Tracer SC+ 101

Pre-Work
Student must be pre-approved by Trane University for this course offering.
Pre-work for this course includes:
- Modbus Fundamentals e-learning
- Introduction to Chilled Water Systems e-learning
- TGP2 Fundamentals

All pre-work must be completed prior to coming to class. Students will be tested on this material the first day.
TGP2 Applications (BSC08)

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**Course Description**

This course equips participants with the ability to create and implement standard and custom configurations as well as program Trane’s Tracer® BACnet devices. Course scope includes device configuration, TGP2 program creation and the use of Pre-Package Solutions Configurator for the Tracer® UC400/600 and Tracer® SC+ (other devices will be supported as they are released). The class includes hands-on workshops so students can learn best practices, create, test and debug their programs under the supervision of experienced programmers.

**Specific Course Objectives**

Upon completion of this course, participants should be able to:

- Identify the need for a TGP2 program.
- Convert a TGP program to a TGP2 program.
- Create point configurations from a job submittal.
- Identify appropriate TGP2 blocks for programming functions.
- Create TGP2 programs from a sequence of operation for Tracer UC products.
- Use Pre-Packaged Solutions configurations and programs.
- Implement TGP2 for custom applications such as air handler, boiler and pump controls.
- Implement TGP2 programming inaa Tracer SC+.
- Integrate a programmable Tracer UC into a Tracer SC+

**Who Should Attend**

TGP2 Applications is intended for ASC and Trane installer/programmers that are familiar with Tracer SC/SC+, Trane BACnet unit controllers and Tracer® TU service tool.

**Prerequisites**

Completion of Trane University’s Tracer SC+ 101 or equivalent familiarity with setup and programming of Tracer SC/SC+ and Tracer UC400 is recommended but not required. Experience with MPS80 TGP may also be helpful.

**Pre-Work**

Student must be pre-approved by Trane University for this course offering.
Tracer® Ensemble™ Operation (BSC09)

**Course Description**
Tracer Ensemble Operation is specifically designed for building operators and administrators to become more efficient with their Tracer Ensemble software which is a Web-enabled service and monitoring tool for multiple building facilities. Tracer Ensemble allows building operators and administrators access to Tracer Ensemble from the local network or the Internet to monitor and control their building system. Students will have the opportunity to work with the Tracer Ensemble software to become more familiar with common tasks.

**Who Should Attend**
Tracer Ensemble Operation is intended for building operators and owners with Tracer Ensemble.

**Prerequisites**
This is an operations-level class. Students must have an operating-level understanding of personal computers and the Windows operating system. Students must possess knowledge of Tracer® Summit™ or Tracer® SC/Synchrony™ depending upon which system is installed in their facility.

**Specific Course Objectives**
Upon completion of this course, participants should be able to:
- Create user roles and user profiles
- Navigate Tracer Ensemble Buildings
- Design dashboards
- Use override control to manipulate building systems
- Make changes to building schedules
- Manage building alarms
- Log data
- Create custom reports
- Set up Tenant Services
- Use Critical Control to limit access in Tracer Ensemble

**Pre-Work**
None
Tracer Ensemble Installation (BSC14)

Course Description
This course provides participants with the understanding of Tracer Ensemble software which is a web-enabled service and monitoring tool for multiple building facilities. After Tracer Ensemble is installed and configured, building operators and administrators can access the Tracer Ensemble from the local network or the internet to monitor and control the building system.

Specific Course Objectives
Upon completion of this course, participants should be able to:
- Understand options for Server installation
- Set up internet information services.
- Install Tracer Ensemble
- Manage graphics, users, and tenants, as well as, status and overrides.
- Work with schedules.
- Process alarms.
- Configure and use Data Logs.
- Global application.
- Configure critical controls.
- Design dashboards.

Who Should Attend
Tracer Ensemble Installation is intended for installation and service technicians that will be installing and working with Tracer Ensemble customers.

Prerequisites
Students must possess knowledge of Tracer® SC/SC+/UC and how a site is configured. Students should have a basic knowledge of networking, operating systems and Microsoft browser technology. Suggested Trane University classes prior to taking Tracer Ensemble Installation are Tracer SC+ 101 and Introduction to Computer Networking (e-learning).

Pre-Work
Student must be pre-approved by Trane University for this course offering.
Air Conditioning Service (TS01)

Length: 4.5 days
Day and time: Mon–Thu: 8 am–4:30 pm
Fri: 8–11 am
Course Cost: See Schedule
Continuing Education Units: 3.2
Recommended search: Air Conditioning Service

Course Description
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, sub-cooling, piping, evacuation and recharging techniques.
This course is 45–50 percent lab intensive. Packaged rooftop units, 2 to 5 tons, are used in the lab sessions. A separate course is available to help develop electrical troubleshooting skills.

Specific Course Objectives
Upon completion of this course, participants should be able to:
- Draw and explain basic system theory.
- Identify the four basic parts of the refrigeration system and how they work.
- 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 sub-cooling using classroom methods.
- Demonstrate refrigerant recovery procedures.

Lab Safety
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend
This course is well suited for entry-level air conditioning and/or HVAC maintenance mechanics, service technicians and industrial or facility maintenance technicians. An electrician with new responsibilities in air conditioning maintenance and service will also benefit.

Qualifications
The student should have some basic mechanical and electrical background in addition to an aptitude and interest for work with HVAC equipment.
Commercial Systems Service (TS02)

Length: 4.5 days  Day and time: Mon–Thu: 8 am–4:30 pm  Fri: 8–11 am  Course Cost: See Schedule  Continuing Education Units: 3.2  Recommended search: Commercial Systems

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course description
This course exposes the student to commercial unit and systems operation, set-up, and troubleshooting. This course is delivered through a combination of classroom activities, interactive workshops, and hands-on lab exercises using Trane commercial unitary and applied equipment. The course emphasizes a systematic approach to commercial HVAC system service and troubleshooting.

Specific Course Objectives
Upon completion of this course, participants should be able to:

- Interpret temperature and pressure readings on an operating refrigeration system.
- Troubleshoot common refrigeration system issues.
- Measure airflow using appropriate airflow instruments.
- Apply airflow fundamentals to unit operation.
- Perform combustion analysis and determine combustion efficiency.
- Compare air mixtures using the psychrometric chart.
- Set up an economizer using appropriate mixed air formulas.
- Describe building systems used in commercial HVAC applications.

Lab Safety
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend
This course is ideal for dealer, contractor or owner maintenance technicians progressing from residential to light commercial service who have experience in HVAC.

Prerequisites
We recommend attendees meet one of the following:
- Completion of a vocational or technical program in air conditioning/refrigeration
- At least 1.5 years practical experience
- Completion of one of the following Trane University courses
  - Air Conditioning Service
  - HVAC Electrical Troubleshooting

Qualifications
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/Ohm Meter
- Electronic Temperature Meter
- Clamp-on ammeter
- Temperature/Pressure Relationships
- Metering Devices
- Basic trade math
Airside System Service (TS03)

Course Description
This course covers the operation and setup of a commercial VAV system from the standpoint of the service technician. Shutoff VAV, Bypass VAV and Single Zone VAV will be discussed in the class, although Shutoff VAV (traditional VAV) will be the primary focus. The concepts discussed will apply to new system startup as well as existing buildings. The course also discusses the different fan types used in commercial HVAC units.

The lab exercises are designed around several working VAV systems in our La Crosse, Wisconsin, training lab. This includes IntelliPak® Commercial Self-Contained (CSC) and rooftop units (RTU) with various types of VariTrane® VAV boxes. During the lab exercises, students will use the various tools and software needed to setup and commission (or re-commission) a VAV system. Attendees will learn to recognize important parameters within building plans in order to commission the building as the design engineer intended. The plans used will include the equipment schedule, sequence of operation, airflow requirements, and ventilation.

The course includes systems used in all geographic regions.

Specific Course Objectives
Upon completion of this course, participants should be able to:

- Verify system airflow using multiple methods.
- Interpret fan curve data from the various fan types such as forward curve, airfoil, and direct drive pleume.
- Set up and verify proper system air with the fan types used in our lab.

- Describe the capabilities and the limitations of the building control system from a service technician standpoint.
- Using a Rover service tool, analyze air delivery on multiple VAV systems.
- Describe the difference between Single Zone VAV systems and Multiple Zone VAV systems.
- Go through the procedure required to establish the supply pressure setpoint on a VAV system.

Lab Safety
Student participation in any hands-on portion of this course will include ladder safety and use of proper fall protection. It is expected the student will adhere to all other safety requirements as they arise.

Who Should Attend
This course is ideal for advanced service, controls, and maintenance technicians, as well as service contractors. Existing Building Systems personnel and others involved with system commissioning or with ensuring that an HVAC system is operating correctly and efficiently would benefit from this course.

Qualifications
Participants attending this course must have strong HVAC skills or an understanding of engineered building systems. They should also understand the importance of compliance with today’s energy efficiency requirements.
HVAC Electrical Troubleshooting (TS04)

Length: 4.5 days
Day and time: Mon–Thu: 8 am–4:30 pm
Fri: 8–11 am
Course Cost: See Schedule
Continuing Education Units: 3.2
Recommended search: Electrical

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Course Description
This course is intended to improve a technician’s ability and confidence when troubleshooting electrical problems on 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
Upon completion of this course, participants should be able to:
• Define and use fundamental electrical terms, laws and formulas for understanding what electricity is and what it does.
• Discuss the basics of series, parallel and series-parallel circuits.
• Identify the proper usage of meters required to troubleshoot electricity.
• Increase confidence and ability in reading complex wiring diagrams.
• Discuss the control logic and sequence of unit operation.
• Discuss safeties and component operation in Trane equipment.
• Recognize characteristics of single- and three-phase motors and their associated control components.
• Discuss the principal maintenance requirements for longer operating life of electrical components.
• Practice systematic methods of electrical troubleshooting for all major HVAC products.

Lab Safety
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend
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.

Qualifications
Students should have some basic mechanical and electrical background in addition to an aptitude and interest for work with HVAC equipment.
Chilled Water Systems Service (TS05)

Length: 3.5 days
Day and time: Tue–Thu: 8 am–4:30 pm
Fri: 8–11 am
Course Cost: See Schedule
Continuing Education Units: 2.5
Recommended search: Chilled Water

Course Description
This course is intended to provide attendees with a "systems" approach to maintaining and diagnosing problems involving chilled water piping systems from a service perspective. It will show technicians and supervisors how Trane utilizes water flows to obtain efficient chiller operation. The course will also discuss water system conditions that can be detrimental to efficient operation and possibly damaging to system components. Students will take flow measurements in a laboratory setting, using recommended tools and techniques to determine chilled water system performance. Chilled water system types such as decoupled loop, variable primary flow and others will be discussed.

Specific Course Objectives
Upon completion of this course, participants should be able to:
• Demonstrate an understanding of the water principles as applied to a chilled water system.
• Calculate the loop size in a chilled water system in order to understand and prevent short loop issues.
• Measure and verify flow on a simple chilled water system using a variable frequency drive.
• Calculate water flow in a system using various methods.
• Given the necessary tools, service literature and personal protective equipment (PPE); properly log multiple chillers in our hands-on lab.
• Using operating pumps, calculate flow and then plot changes of flow using a balancing valve.
• Calculate unit capacity on a chiller by using proper tools and methods.

Lab Safety
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend
This course is intended for plant engineers, maintenance supervisors, operating engineers, HVAC service technicians, and maintenance technicians who need an improved understanding of chilled water system control and maintenance requirements and techniques.

Qualifications
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 "systems" thinking.
CenTraVac® System Operation and Maintenance (TS06)

Length: 3.5 days

Day and time:
Tue–Thu: 8 am–4:30 pm
Fri: 8–11 am

Course Cost: See Schedule

Continuing Education Units: 2.5

Recommended search: CenTraVac System

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Course Description

This course will familiarize owner maintenance supervisors and technicians with Trane CenTraVac CVHE/F/G/L/S and new CVHM centrifugal chiller operation and maintenance requirements. It will assist them understanding chilled water systems and load-based chiller dynamics. The course will help technicians troubleshoot and will help chiller owners decide if work can be done in-house or not. Technicians can particularly benefit from coverage on diagnosing and maintaining machine design performance, and learn what can occur if operating outside of these parameters. We will discuss the addition of the new refrigerant options: R514A and R1233zd, and the changes that were made to the chillers. 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 does not include hands-on maintenance training.

Specific Course Objectives

Upon completion of this course, participants should be able to:
1. Describe Trane centrifugal chiller operation and chilled water system theory.
2. Observe chiller construction process.
3. Use operating logs to recognize normal operation and how abnormal influences affect chiller operation and performance.
4. Recognize problems that reduce efficiency and damage equipment.
5. Identify system components and their role in the system.
6. Identify system differences related to the new refrigerant options.
7. Identify chilled water piping designs.

Who Should Attend

Our target is individuals responsible for the operation and preventative maintenance of Trane CenTraVac chillers (CVHE/F/G/L/S/M). This course will benefit technicians, supervisors or engineers who make planning decisions to support centrifugal chiller maintenance.

Qualifications

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 individuals from widely varied backgrounds and does not require in-depth HVAC knowledge.

Plant Tour Requirement

Leather shoes which give good protection and long trousers are required. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.
CenTraVac® Electronic Controls (TS07)

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</tbody>
</table>

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**Course Description**
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 2001 and the present. Earlier-model control systems are not discussed in depth. This course covers Tracer™ CH530 and Tracer AdaptiView™ control system in use at this time.

This is a controls technology class only. Centrifugal operation and maintenance understanding is necessary for this course.

**Specific Course Objectives**
Upon completion of this course, participants should be able to:
- Operate all the controls covered by this course, including systems interface.
- Describe operating logic for Tracer CH530 and Tracer AdaptiView control platforms.
- Use control information for routine operational troubleshooting.
- Use menu-driven diagnostics.
- Perform trouble analysis on controls and determine necessary field repairs or replacement action.

**Lab Safety**
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

**Who Should Attend**
This course is for technicians who regularly work with Trane CenTraVac CV/HE/F/G/I and duplex chillers.

**Qualifications**
Technicians must be comfortable with electrical controls, electrical meters such as digital volt-ohm meters and understand refrigeration and centrifugal chiller control requirements. It is helpful if technicians have experience with other HVAC electronic control systems or have attended Trane University’s HVAC Electrical Troubleshooting course. Familiarity with basic computing skills, file management and internet downloading procedures is also desirable.
CenTraVac® Mechanical Overhaul Service (TS08)

Length: 3.5 days
Day and time: Tues–Thur: 8 am–4:30 pm
Fri: 8–11 am
Course Cost: See Schedule
Continuing Education Units: 2.5
Recommended search: Mechanical

Course Description
This course will broaden any technician’s level of service and overhaul expertise. It will help them gain confidence and experience in 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.

Specific Course Objectives
Upon completion of this course, participants should be able to:

- Identify various Trane centrifugal chillers and variations in mechanical components.
- Be familiar with documented factory service information available to support Trane centrifugal chillers.
- Properly maintain and repair chillers with varying lubrication and cooling system designs.
- Properly overhaul a CVHE/F/G/L CenTraVac chiller compressor and motor, using factory-recommended procedures.
- Properly inspect compressor and motor components for compliance to factory specifications.

Lab Safety
Students are required to wear steel-tipped footwear, safety glasses and gloves to participate in mechanical lab service procedures. Appropriate work clothes should be worn to disassemble a chiller.

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

Qualifications
In order to attend this course, a student must meet the following qualifications:

- Previous heavy refrigeration service experience
- Skills with close tolerance measuring instruments
- Experience with shop rigging of components heavier than 150 lbs

Plant Tour Requirement
Leather shoes which give good protection and long trousers are required. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.
Single-Stage Absorption Chillers (TS09)

Length: 4.5 days
Day and time: Mon–Thu: 8 am–4:30 pm, Fri: 8–11 am
Course Cost: See Schedule
Continuing Education Units: 3.2
Recommended search: Absorption

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Course Description

This course is a thorough and comprehensive presentation on the foundational understanding of absorption chillers and their refrigeration cycle. Topics include a detailed view of absorption chiller components, instruction in the theory of absorption chiller operation and in the lithium bromide chemical cycle, the chemistry of inhibitors, overview of capacity control system operation, crystallization causes and effects, purge system operation, and performance and operator logging recommendations.

This course utilizes an 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.

Specific Course Objectives

Upon completion of this course, participants should be able to:

* Describe absorption chiller construction.
* Recognize major absorber components and describe their functions.
* Discuss the characteristics of lithium bromide in relation to charging and inhibitors.
* Use an Equilibrium Chart to determine system conditions.
* Describe the sequence of control operation (pneumatics and electric).
* Demonstrate how Trane's UCP2™ Adaptive Control™ technology has been applied to absorption chillers.

Lab Safety

Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend

This course is for technicians who desire a comprehensive understanding of the theory of absorption refrigeration systems.

Qualifications

The student should have a working knowledge of pneumatic, electrical, heat transfer, steam and mechanical systems.
# RTAA Rotary Chillers (TS10)

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**Course Description**

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.

This course is primarily classroom oriented.

**Specific Course Objectives**

Upon completion of this course, participants should be able to:

- Describe the theory of helical rotary chiller operation.
- Discuss chiller components and the interrelationships.
- Describe the capabilities of individual chiller designs.
- Read unit wiring and interconnecting diagrams.
- Describe control start sequence and operating logic.
- Discuss system control methods available for building automation.
- Use control information for routine operational troubleshooting.
- Complete routine maintenance requirements for helical-rotary chillers.
- Discuss the limits to field service methods

### Inherent to Helical Compressor Designs

- Apply proper service techniques with refrigerant handling and component repairs.

### Lab Safety

Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

### Who Should Attend

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

### Qualifications

Technicians must have solid electrical skills equal to Trane University’s HVAC Electrical Troubleshooting course standards. 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.
RTAC Rotary Chillers (TS11)

Length: 3 days
Day and time: Tue–Thu: 8 am–4:30 pm
Course Cost: See Schedule
Continuing Education Units: 2.1
Recommended search: RTAC

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Course Description
This course covers operation, diagnostics, and maintenance for Trane's RTAC rotary chillers, the Tracer™ CH530 micro electronic control system and covers refrigeration system components. The operational characteristics of the GP2 compressor, Falling Film evaporator, and E-coil design condenser are given emphasis. Additional coverage provided for chiller operation using ANSI® Trane wiring diagrams with emphasis on understanding the Adaptive control system logic. Tracer CH530 control architecture and components are discussed. This course is primarily classroom oriented.

Specific Course Objectives
Upon completion of this course, participants should be able to:
- Discuss the operating characteristics of 140 to 500 ton Trane RTAC rotary chiller machines.
- Identify components and their interrelationship to each other
- Describe GP2 compressor construction, operation and checkout.
- Describe Falling Film evaporator construction and operation.
- Discuss the Tracer CH530 control architecture and operating logic.
- Explain the field maintenance of the Trane RTAC rotary chiller.

Lab Safety
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTAC rotary chillers.

Qualifications
Technicians must have solid electrical skills equal to Trane University’s HVAC Electrical Troubleshooting course standards. Service experience with other types of liquid chillers and/or the Trane UCP1 and UCP2™ chiller control system would be helpful, but are not required. Familiarity with basic computing skills, file management and internet downloading procedures is also desirable.
RTAE/ACRA Rotary Chillers (TS12)

Course Description

This course covers the operation of Trane RTAE/ACRA rotary chillers. Coverage includes chiller refrigeration system components, construction and operation. Emphasis will be placed on the operational characteristics of the GP4 and GP4 with VVI compressor, CHIL evaporator, transverse condenser, and the AFD3 and PowerFlex 755 cooling circuits. Additional coverage will be provided on the RTAE/ACRA UC800 control platform with TD7 AdaptiView™ display, chiller logging and maintenance requirements. This course is primarily classroom oriented.

Specific Course Objectives

Upon completion of this course, participants should be able to:

- Describe the operating characteristics of a RTAE/ACRA rotary chiller.
- Identify RTAE/ACRA rotary chiller construction and the physical relationship of components.
- Describe GP4 and GP4 with VVI compressor operation.
- Describe the CHIL evaporator construction and operation.
- Discuss the Trane UC800 control platform and operating logic.
- Perform the field service, maintenance of RTAE/ACRA rotary chillers.
- Identify how the AFD3 and PF755 Drive works as it relates to RTAE/ACRA rotary chillers.

Lab Safety

Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend

This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane's RTAE/ACRA rotary chillers.

Qualifications

The student must have solid electrical skills equal to Trane University's HVAC Electrical Troubleshooting course standards. Service experience with other types of liquid chillers and/or the Trace™ CH530 chiller control system would be helpful but are not required.
RTHD Rotary Chillers (TS13)

Course Description
This course covers the operation and maintenance of Trane’s RTHD helical rotary chiller with Tracer™ CH530 and UC800 control platforms. Coverage includes discussion on the CH530 and UC800 micro electronic controls in addition to refrigeration system components and operational logging. Emphasis will be placed on chiller sequence of operation, construction of refrigeration system components and the chiller’s Adaptive Control™ system logic. This course is primarily classroom oriented.

Specific Course Objectives
Upon completion of this course, participants should be able to:
- Describe the operating characteristics of Trane RTHD helical rotary chillers.
- Explain the differences between Tracer CH530 and UC800 control platforms.
- Discuss the service and maintenance of Trane’s RTHD rotary chillers.
- Describe Trane’s RTHD rotary chiller compressor operation with and without TR200 VFD.

Who Should Attend
This course is intended for contractor and in-plant HVAC service technicians who will work regularly with Trane Series R chillers.

Qualifications
The technician must have solid electrical skills equal to Trane University’s HVAC Electrical Troubleshooting course standards. Service experience with other types of liquid chillers and/or Trane’s UCP1 and UCP2™ is helpful but not required. Familiarity with basic computing skills, file management and internet downloading procedures is also desirable.
RTWD Rotary Chillers (TS14)

Course Description
This course provides an in-depth understanding of the controls, maintenance and troubleshooting of Trane's RTWD helical rotary chiller with Tracer™ CH530. The course also provides insight into compressor design, unit operation, unit performance and service diagnosis. This course is primarily classroom oriented.

Specific Course Objectives
- Describe the theory of operation of Trane's RTWD.
- Discuss the RTWD platform service procedures, maintenance and troubleshooting.
- Discuss the CH530 control system.
- Explain how the GP2 compressor operates.
- Describe gas pump operation.
- Discuss the problems associated with oil loss.
- Describe oil return.

Who Should Attend
This course is intended for contractor and in-plant HVAC service technicians who will work regularly with Trane Series R chillers.

Qualifications
The student must have solid electrical skills equal to Trane University's HVAC Electrical Troubleshooting course standards. Service experience with other types of liquid chillers and/or Trane's UCP1™ and UCP2™ is helpful but not required. Familiarity with basic computing skills, file management and internet downloading procedures is also desirable.
Precend® Voyager™ Rooftops (3–25 Ton Units) (TS15)

Length: 3.5 days
Day and time: Tue–Thu: 8 am–4:30 pm
Fri: 8–11 am
Course Cost: See Schedule
Continuing Education Units: 2.5
Recommended search: Precedent OR Voyager

Register Now! Trane Education Center

Course Description
This course is designed to provide commercial service technicians in-depth comprehensive coverage of the Trane Precend and Voyager rooftops with ReiaTel™ controls. Students will be exposed in detail to the mechanical, electrical and control systems of these units and will become knowledgeable in the start-up, maintenance and troubleshooting requirements of these products. This course will also cover updates for each of these units including fans, compressors and refrigerant.

Specific Course Objectives
Upon completion of this course, participants should be able to:

- Explain CV, SZVAV, MZVAV, and eFlex unit operation and proper airflow adjustment.
- Demonstrate the ability to read and follow a RelaTel™ schematic.
- Demonstrate proper gas heating checkout and troubleshooting.
- Demonstrate the ability to test and troubleshoot Zone Sensor modules.
- Apply proper techniques to service, diagnose and troubleshoot Precend and Voyager rooftops with ReiaTel controls.
- Explain the operation of the ReiaTel economizer with CO2 and DCV control.

LabSafety
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend
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 Precend and Voyager rooftops.

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

Plant Tour Requirement
Classes held in Clarksville TN: Leather shoes which give good protection and long trousers are required for plant tours. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.
IntelliPak® I & II Rooftop Units (TS16)

Course Description
The course focuses on operation, start-up and maintenance of 20 to 130 ton IntelliPak I and 90 to 162 ton IntelliPak II rooftop units. Proper service techniques will be discussed to include correct maintenance procedures and intervals. Factory recommended installation and start-up procedures will also be discussed. Students will also learn the service and checkout procedures for the mechanical cooling and heating systems related to IntelliPak.

Specific Course Objectives
Upon completion of this course, participants should be able to:
- Using IntelliPak terminology, discuss rooftop unit functions.
- Demonstrate circuit board level troubleshooting by using an IntelliPak wiring diagram.
- Practice configuration and setup of a unit using an IntelliPak Human Interface.
- Demonstrate the proper setup procedure for cooling and heating.
- Discuss and demonstrate pressure transducer troubleshooting.
- Describe the basic IntelliPak sequences of operation.
- Describe scroll compressor construction and operation.
- Diagnose and troubleshoot IntelliPak binary and analog inputs and outputs.
- Test and verify modulating dehumidification.
- Demonstrate an understanding of CV, SIZAV, and VAV airflow properties.

Lab Safety
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend
This course is intended for rooftop service technicians who have a good understanding of both constant volume and variable air volume rooftop units and systems and need additional knowledge regarding startup and maintenance procedures of Trane IntelliPak rooftop units.

Qualifications
Students must have a good understanding of both the refrigeration and combustion cycles and understand airflow dynamics. Students should also 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 and long trousers are required for plant tours. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.
IntelliPak® with Symbio™ 800 (TS18)

Course description
The IntelliPak with Symbio 800 program provides the technical knowledge and skills required to start-up, service and troubleshoot IntelliPak units with Symbio 800 controls. The course is intended to familiarize technicians with the new IntelliPak with Symbio 800 controls rooftop unit. This course will cover new product information with an emphasis on the Symbio 800 control platform.

This course is intended for new IntelliPak units with Symbio 800 controls. This course does not cover legacy IntelliPak topics.

Specific course objectives
Upon completion of this course, participants should be able to:

- Explain sequence of operations for Constant Volume (CV), Single Zone VAV (SZVAV) and Multiple Zone VAV (MZVAV) units.
- Perform LLID binding using Tracer TU and TD7 display.
- Interpret electrical wiring schematics for Symbio 800 controls.
- Verify and adjust units’ airflow using product literature.
- Identify system components that make up the Symbio 800 control platform.
- Demonstrate unit configuration using model number, literature and Tracer TU software.
- Describe gas fired burner operation for staged and modulating heat.

Lab safety
Instructor provided PPE is required for the hands-on workshops of this course. The proper clothing should also be worn: long pants, long sleeves of 100% cotton and closed toes shoes.

Who should attend
This course is intended for rooftop service technicians who have a good understanding of both constant volume and variable air volume rooftop units and systems and need additional knowledge regarding startup and maintenance procedures of Trane IntelliPak rooftop units with Symbio 800 controls.

Qualifications
Students must have a good understanding of both the refrigeration and combustion cycles. Students should be able to follow electrical ladder diagram logic and be familiar with commercial rooftop sequence of operation. Basic PC skills and use of software is a plus but not required.
CVH/M Chiller Operation (TS22)

Length: 3.5 days
Day and time: Tues–Thu: 8 am–4:30 pm
Fri: 8–11 am

Course Cost: See Schedule
Continuing Education Units: 2.5
Recommended search: CVHS

Register Now! Trane Education Center

Course Description
This course is for the experienced centrifugal service technician or facility personnel who want to familiarize themselves more with Trane’s CVHS/M Centrifugal Chiller operation and maintenance requirements. The course provides insight into chiller construction, use of chiller control platform and overall sequence of operation. In addition, proper unit disassembly and motor replacement will be performed in a lab environment along with the factory mounted adaptive frequency drive.

Specific Course Objectives
Upon completion of this course, participants should be able to:

- Discuss the operating characteristics of the CVHS/M Chiller.
- Operate the Tracer AdaptiView™/TU control platform applied to this chiller.
- Identify CVHS/M chiller components and discuss their role in the system.
- Perform proper disassembly of the unit and motor replacement.
- Demonstrate an understanding of the AFDN/AFD3 operation and maintenance guidelines.
- Discuss the operational characteristics of the Earthwise™ purge as it applies to the CVHS/M chiller.

Lab Safety
Students are required to wear steel-tipped footwear, safety glasses and gloves to participate in mechanical lab service procedures. Appropriate work clothes should be worn to disassemble a chiller.

Who Should Attend
This course is designed for technicians and mechanics who have experience with other HVAC chiller products and are experienced in working with other Trane centrifugal products.

Prerequisites
We highly recommend attendees take Trane University’s CenTraVac System Operation and Maintenance course prior to attending or have two or more years of service exposure to centrifugal equipment.

Qualifications
In order to attend this course, a student must meet the following qualifications:

- Previous heavy refrigeration service experience
- Skills with close tolerance measuring instruments
- Experience with shop rigging of components heavier than 150lbs

Plant Tour Requirement
Leather shoes which give good protection and long trousers are required for plant tours. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.
IntelliPak® with Symbio™ 800 (TS23)

Length: 3.5 days
Day and time: Tues–Thur: 8 am–4:30 pm
Fri: 8–11 am
Course Cost: SeeSchedule
Continuing Education Units: 2.5
Recommended search: Symbio

Course description
The IntelliPak with Symbio 800 program provides the technical knowledge and skills required to start-up, service and troubleshoot IntelliPak units with Symbio 800 controls. The course is intended to familiarize technicians with the new IntelliPak with Symbio 800 controls rooftop unit. This course will cover new product information with an emphasis on the Symbio 800 control platform.

This course is intended for new IntelliPak units with Symbio 800 controls. This course does not cover legacy IntelliPak topics.

Specific course objectives
Upon completion of this course, participants should be able to:

- Explain sequence of operations for Constant Volume (CV), Single Zone VAV (SZVAV) and Multiple Zone VAV (MZVAV) units.

- Perform LLID binding using Tracer TU and TD7 display.

- Interpret electrical wiring schematics for Symbio 800 controls.

- Verify and adjust units’ airflow using product literature.

- Identify system components that make up the Symbio 800 control platform.

- Demonstrate unit configuration using model number, literature and Tracer TU software.

- Describe gas fired burner operation for staged and modulating heat.

Labsafety
Instructor provided PPE is required for the hands-on workshops of this course. The proper clothing should also be worn: long pants, long sleeves of 100% cotton and closed toes shoes.

Who should attend
This course is intended for rooftop service technicians who have a good understanding of both constant volume and variable air volume rooftop units and systems and need additional knowledge regarding startup and maintenance procedures of Trane IntelliPak rooftop units with Symbio 800 controls.

Qualifications
Students must have a good understanding of both the refrigeration and combustion cycles. Students should be able to follow electrical ladder diagram logic and be familiar with commercial rooftop sequence of operation. Basic PC skills and use of software is a plus but not required.
ProSpace VRF Service and Operation (TS24)

Length: 3 days  
Day and time: 8 a.m. – 4:30 p.m.  
Course Cost: See Schedule  
Continuing Education Units: 3.2  
Recommended search: N/A

Register Now! Trane Education Center

Course Description
The Trane ProSpace VRF Service and Operation Course is designed to provide the service technician with the knowledge and skills to properly service, troubleshoot and maintain a VRF system. Trane ProSpace VRF training will be delivered through a combination of classroom and hands on activities.

Our programs use a variety of assessment methods to measure learning, from pre and post tests, to classroom activities, quizzes, and workshops.

Specific Course Objectives
By the end of this course, you will be able to:
- Explain the features and functions of the Trane ProSpace VRF system.
- Identify the proper installation procedures for the Trane ProSpace VRF system.
- Describe the Trane ProSpace VRF system sequence of operation.
- Perform proper start-up and checkout of the Trane ProSpace VRF system.
- Perform proper maintenance on the Trane ProSpace VRF system.
- Perform proper maintenance on the Trane ProSpace VRF system.

Who Should Attend
The class is designed primarily for all user levels. The information in this class provides a deeper dive into information critical for understanding VRF Systems.

Prerequisites
Student must receive Trane University approval prior to registration.

Pre-Work
None.
RTAF Rotary Chillers (TS25)

Length: 3 days
Day and time: 8 am–4:30 pm
Course Cost: See Schedule
Continuing Education Units: 2.1
Recommended search: RTAF

Course Description
This course is designed to teach service technicians the components of Trane's RTAF Sintesis unit and how to maintain it. Identification and troubleshooting using diagnostics is emphasized. Compressor and unit control operation are also covered. After completion, the technician should be able to verify proper unit operation and performance. This course is primarily classroom oriented.

Specific Course Objectives
Upon completion of this course, participants should be able to:

- Identify the tonnages, components and physical differences of the compressors in a RTAF Sintesis chiller.

- Explain the operation of the capacity control of the Helical Rotary compressor.

- Explain the diagnostic, troubleshooting and repair procedures on the capacity control for the Helical Rotary compressor.

- Identify the components, oil management process and maintenance of a RTAF Sintesis chiller.

- Explain the unit control operation of the RTAF Sintesis chiller.

- Explain the components, operation and troubleshooting of a RTAF Sintesis chiller Microchannel condenser.

- Identify the EEV and evaporator components in a RTAF Sintesis chiller.

Lab Safety
Instructor provided PPE is required for the hands-on live circuit portion of this course. The proper clothing should also be worn: long pants and long sleeves of 100% cotton.

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTAF rotary chillers.

Qualifications
The student must have solid electrical skills equal to Trane University's HVAC Electrical Troubleshooting course standards. Service experience with other types of liquid chillers and/or the Tracer™ CH530 chiller control system would be helpful but are not required.

Plant Tour Requirement
Classes held in Pueblo, CO will include a Plant Tour. Leather shoes which give good protection and long trousers are required for plant tours. Neither sandals nor clogs-top shoes are permitted in manufacturing areas.
Online Classes

**IntelliPak® Human Interface Navigation and Status Menu (TS19)**

<table>
<thead>
<tr>
<th>Length:</th>
<th>Course Cost:</th>
<th>Register here:</th>
<th>Recommended search:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hour</td>
<td>See Schedule</td>
<td>Trane Education Center</td>
<td>Intelipak Human</td>
</tr>
</tbody>
</table>

Course Description
The IntelliPak Human Interface Navigation and Status Menu program walks a service technician through basic navigation and status screens for IntelliPak Rooftop Units 20 to 162 tons.

Specific Course Objectives
Upon completion of this course, participants should be able to:

- Effectively navigate the Intellipak Human Interface

**ReliaTel™ Zone Sensor Testing (TS20)**

<table>
<thead>
<tr>
<th>Length:</th>
<th>Course Cost:</th>
<th>Register here:</th>
<th>Recommended search:</th>
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</thead>
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<tr>
<td>30 Minutes</td>
<td>See Schedule</td>
<td>Trane Education Center</td>
<td>RelaTel</td>
</tr>
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</table>

Course Description
This course is designed to provide Trane service technicians with in-depth information on RelaTel Zone Sensor Module testing and troubleshooting.

Specific Course Objectives
Upon completion of this course, participants should be able to:

- Discuss the basic operation of a Zone sensor.
- Demonstrate how to properly test the Zone Sensor Module.
- Troubleshoot the Zone Sensor Module
Training Packages

**Building Systems and Controls Private Class (BSC010, BSC011, BSC012, BSC013)**

<table>
<thead>
<tr>
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</thead>
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<tr>
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</table>

**Course Description**

Trane University can provide private training if you are unable to attend one of our scheduled classes. Customer controls attendee list and pays Trane a fixed rate dependent upon the number of days training requested and selects a custom course schedule of training courses offered. Trane University supplies instructor, all equipment needed, and any teaching materials. This track focuses on Building Systems and Controls.

**Specific Course Objectives**

Focusing on system design and optimization valuable for:

- Facility owners and management
- Engineers

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**Technical Service Private Class (TS021, TS022, TS023)**

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<tr>
<th>Length:</th>
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<th>Continuing Education Units:</th>
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<tr>
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</table>

**Course Description**

Trane University can provide private training if you are unable to attend one of our scheduled classes. Customer controls attendee list and pays Trane a fixed rate dependent upon the number of days training requested and selects a custom course schedule of training courses offered. Trane University supplies instructor, all equipment needed, and any teaching materials. This track focuses on Technical Services.

**Specific Course Objectives**

Focusing on operation, maintenance, and troubleshooting, was developed for:

- HVAC service and maintenance technicians
- Maintenance supervisors
- Mechanical contractors
Training Packages

Gold Training Package (GTP02)
Gold Plus Training Package (GTP03)
Platinum Training Package (PTP01)

| Length: | Custom | Day and time: | 8 a.m. – 4:30 p.m. | Course Cost: | See Schedule | Continuing Education Units: | N/A | Recommended search: |

Registered Now! Trane Education Center

Course Description
Trane University Training Packages are designed to help you save money when you send one or more people to a class or several classes. This program works by pre-paying for training credits, each credit is equivalent to one dollar, which can reduce your cost by up to 40%.

Training Package Levels
There are three levels of training packages:

- **GOLD Training Package** - Most Popular!
  - Includes 7,800 credits
  - Package cost: See Schedule
  - Up to 4 courses for the price of 3
  - Gold credits are valid for one year

- **GOLD PLUS Training Package**
  - Includes 11,700 credits
  - Package cost: See Schedule
  - Up to 6 courses for the price of 4
  - Gold credits are valid for one year

- **PLATINUM Training Package**
  - Includes 47,500 credits
  - Package Cost: See Schedule
  - Up to 25 courses for the price of 15
  - Platinum credits are valid for two years

Who Should Attend
Training Packages are designed primarily for users that want to purchase multiple training courses as a packaged deal.

Prerequisites
None.

Pre-Work
None.

Login to the Trane Education Center to purchase a training package. We will contact you within 24 hours to provide your Package code, your credits can be applied immediately. For your convenience, we track the credits your company uses and send periodic updates showing your available credits.
Foundations of Chilled Water Systems (VM1)

Course Description
This course provides an in depth exploration of the chilled water systems found in many commercial buildings. Attendee will gain a working knowledge of how the components of a chilled water system interact and how they influence the overall operating cost of the system. With that knowledge the student will be able to answer three basic questions as they relate to a chilled water system:
- Why does water flow?
- Where does water go?
- How much will it cost?

Who Should Attend
Design engineers, contractors, estimators, technicians, account managers and anyone who has a desire to learn how chilled water systems function in a building.

Prerequisites
You will need a scientific calculator to help you with the homework assignments. An option to be a TI 30XS II.

Pre-Work
There is pre-work for this class. You must read Trane AC Clinic Chilled-Water Systems (TRG-TRC016-EN).

Specific Course Objectives
At the end of this class students will:
- Identify the various components and what purpose they serve in a chilled water system. This will include the pump, the chiller and the various types of valves found throughout the system.
- Explain the relationship between head and pressure.
- Calculate the pressure losses associated with each component.
- Calculate the design flow and design head of the chilled water system.
- Balance a chilled water system.
- Interrogate a pump curve to identify the performance characteristics of a pump.
- Calculate the required pump horsepower at various loads.
- Illustrate riding the pump curve.
- Apply the three pump affinity laws to explain how flow rate, system head and pump horsepower vary as a function of system design ΔT.
- Explain the difference between constant and variable flow chilled water systems.
- Describe the decoupled loop and variable primary flow chilled water systems.
- Calculate various temperatures, ΔTs and flow rates within the decoupled loop and variable primary flow systems.
- Explain how varying the design ΔT impacts the operating cost of the entire HVAC system.
Tracer Ensemble: Tenant Services and Work Order Management (VM2)

<table>
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<tr>
<th>Length:</th>
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<td>Virtual Module</td>
<td>See Schedule</td>
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<td>N/A</td>
</tr>
</tbody>
</table>

Register Now! Trane Education Center

Course Description
Trane University presents a Tracer Ensemble Virtual module. This module will showcase the licensed add on features, Tenant Services and Work Order Management.

Who Should Attend
This course is intended for owner/operators with Tracer Ensemble systems.

Prerequisites
None.

Pre-Work
None.

Specific Course Objectives
At the end of this class students will:
- Understand Tenant Services within Tracer Ensemble
- Understand Work Order Management in Tracer Ensemble
Tracer Ensemble: The Power of Dashboards and Reports (VM3)

Length: 3 Hours  
Day and time: Virtual Module  
Course Cost: See Schedule  
Continuing Education Units: N/A  
Recommended search: N/A

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Course Description
Trane University presents a Tracer Ensemble Virtual module. In this module students will learn how to create, manage, standard and custom reports. Also learn how to create, manage and utilize Dashboards (licensed add on feature).

Specific Course Objectives
At the end of this class students will:
• Understand Reports within Tracer Ensemble
• Understand Dashboards in Tracer Ensemble

Who Should Attend
This course is intended for Tracer Ensemble systems owner/operators.

Prerequisites
None.

Pre-Work
None.
Tracer Ensemble: User and System Customization for Optimal Performance (VM4)

<table>
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<tr>
<th>Length:</th>
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<td>Virtual Module</td>
<td>See Schedule</td>
<td>N/A</td>
<td>N/A</td>
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</table>

Register Now! Trane Education Center

Course Description
Trane University presents a Tracer Ensemble Virtual module. This module will showcase user and system customizations that can be made with any current Ensemble System to optimize navigation, display, and user experience.

Specific Course Objectives
At the end of this class students will:
- Understand Reports within Tracer Ensemble
- Understand Dashboards in Tracer Ensemble

Who Should Attend
This course is intended for owner/operators with Tracer Ensemble systems.

Prerequisites
None.

Pre-Work
None.
### Tracer Ensemble: Utilizing Data Logs, Managing Schedules (VM5)

<table>
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<th>Length:</th>
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<tr>
<td>3 Hours</td>
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#### Course Description
This module is designed for higher level Tracer Ensemble users to utilize different Global Features available with Ensemble to help Display and manage multiple buildings at once. This is a showcase of how users can manage data logs and Schedules within Tracer Ensemble.

#### Specific Course Objectives
At the end of this class students will:
- Understand Global Features within Tracer Ensemble that will manage multiple buildings simultaneously.

#### Who Should Attend
Tracer Ensemble Owner/Operators with a higher level of experience using Tracer Ensemble.

#### Prerequisites
None.

#### Pre-Work
None.
Tracer Ensemble: Utilizing Global Features (VM6)

Course Description
Trane University presents a Tracer Ensemble Virtual module. This module is designed for higher level Tracer Ensemble users to utilize different Global Features available with Ensemble to help Display and manage multiple buildings at once.

Specific Course Objectives
At the end of this class students will:
- Understand Glob Features within Tracer Ensemble that will manage multiple building simultaneously.

Who Should Attend
Tracer Ensemble Owner/Operators with a higher level of experience using Tracer Ensemble

Prerequisites
None.

Pre-Work
None.
## Tracer Synchrony: Area and VAS (VM7)

<table>
<thead>
<tr>
<th>Length:</th>
<th>Course Cost:</th>
<th>Continuing Education Units:</th>
<th>Recommended search:</th>
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</thead>
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<tr>
<td>3 Hours</td>
<td>Virtual Module</td>
<td>See Schedule</td>
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</tbody>
</table>

**Register Now! Trane Education Center**

**Course Description**
Trane University presents a Tracer Synchrony Virtual module. This course is designed to explain how Area and VAS applications work within Tracer Synchrony.

**Who Should Attend**
Tracer Synchrony owner/operators

**Specific Course Objectives**
At the end of this class students will:
- Understand Area and VAS applications in Tracer Synchrony.

**Prerequisites**
None.

**Pre-Work**
None.
<table>
<thead>
<tr>
<th><strong>Tracer Synchrony: Status and Graphic Customization (VM8)</strong></th>
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<tr>
<td><strong>Length:</strong> 3 Hours</td>
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<td><strong>Day and time:</strong> Virtual Module</td>
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<td><strong>Course Cost:</strong> See Schedule</td>
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<td><strong>Continuing Education Units:</strong> N/A</td>
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<tr>
<td><strong>Recommended search:</strong> N/A</td>
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</tbody>
</table>

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**Course Description**
Trane University presents a Tracer Synchrony Virtual module. This course will showcase how to change the items displayed on equipment status pages and standard graphic page.

**Who Should Attend**
Tracer Synchrony owner/operators

**Prerequisites**
None.

**Specific Course Objectives**
At the end of this class students will:
- Understand how to customize status page for equipment
- Understand graphic tab in equipment

**Pre-Work**
None.
Tracer Synchrony: User and System Customization (VM9)

Length: 3 Hours

Day and time: Virtual Module

Course Cost: See Schedule

Continuing Education Units: N/A

Recommended search: N/A

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Course Description
Trane University presents a Tracer Synchrony Virtual module. This course showcases Admin features in TracerSynchrony.

Specific Course Objectives
At the end of this class students will:

- Understand how to create user roles and Admin features in Tracer Synchrony

Who Should Attend
Tracer Synchrony owner/operators

Prerequisites
None.

Pre-Work
None.
Tracer Synchrony: Utilizing Data Logs, Managing Schedules (VM10)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
Trane University presents a Tracer Synchrony Virtual module. This course showcase how users can manage data logs and schedules within Tracer Synchrony.

Specific Course Objectives
At the end of this class students will:
- Understand how to create Data Logs and maintain/manage schedules.

Who Should Attend
Tracer Synchrony owner/operators

Prerequisites
None.

Pre-Work
None.
ACRA/RTAE Chiller User Interface, Controls Hardware (VM11)

Length: 3 Hours  
Day and time: Virtual Module
Course Cost: See Schedule  
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
This course provides an in depth exploration of ACRA/RTAE user interface, controls hardware and sequence of operation.

Specific Course Objectives
At the end of this class students will:
- Better navigation of the hum interface, learn user set point options.
- Introduction to controls hardware.
  - Temp sensors
  - Pressure transducers
  - Panel boards
- Understand basic chiller operating sequences

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane's RTAE/ACRA rotary chillers.

Prerequisites
None.

Pre-Work
None.
## ACRA/RTAE Chiller, Power Options and Compressor (VM12)

<table>
<thead>
<tr>
<th>Length:</th>
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### Course Description
This course provides an in-depth exploration of the ACRA/RTAE user interface, controls hardware and sequence of operation.

### Specific Course Objectives
At the end of this class students will:
- Better navigation of the human interface, learn user set point options
- Introduction to controls hardware.
  - Temp sensors
  - Pressure transducers
  - Panel boards
- Understand basic chiller operating sequences

### Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane's RTAE/ACRA rotary chillers.

### Prerequisites
None.

### Pre-Work
None.
ACRA/RTAE Condenser Evaporator Construction Operation (VM13)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

Register Now! Trane Education Center

Course Description
This course provides an in-depth exploration of the ACRA/RTAE user interface, controls hardware and sequence of operation.

Specific Course Objectives
At the end of this class students will:
• Better navigation of the human interface, learn user set point options
• Introduction to controls hardware.
  o Temp sensors
  o Pressure transducers
  o Panel boards
• Understand basic chiller operating sequences

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trae’s RTAE/ACRA rotary chillers.

Prerequisites
None.

Pre-Work
None.
# Air Conditioning Service - Basic Refrigeration (VM14)

<table>
<thead>
<tr>
<th>Length:</th>
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</table>

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## Course Description
Trane University presents an AC Fundamental Virtual module. This module will cover the fundamentals of the refrigeration cycle as applied to air conditioning systems. Topics covered include; superheat, subcooling, enthalpy, and the fundamentals of heat transfer. The basic refrigeration cycle will be discussed in depth. Basic psychrometrics will be introduced.

## Specific Course Objectives
At the end of this class students will:
- Describe the four basic components that comprise the basic refrigeration system.
- Calculate superheat and subcooling and explain their importance.
- Explain the fundamentals of heat transfer.
- Define the four properties of air. Dry-Bulb, Wet-Bulb, Dew Point, and Enthalpy.

## Who Should Attend
This course is well suited for entry-level air conditioning and/or HVAC maintenance mechanics, service technicians and industrial or facility maintenance technicians. An electrician with new responsibilities in air conditioning maintenance and service will also benefit.

## Prerequisites
None.

## Pre-Work
None.
Air Conditioning Service - Refrigeration Components and Troubleshooting (VM15)

Length: 3 Hours  
Day and time: Virtual Module 
Course Cost: See Schedule  
Continuing Education Units: N/A  
Recommended search: N/A

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Course Description
This module covers the refrigeration system components in depth. Specifically metering devices, compressors and coils will be covered. An introduction to the basic tools required to test and troubleshoot air conditioning equipment will be presented.

Specific Course Objectives
At the end of this class students will:
• Describe the function of the metering device.
• Explain the difference between a fixed metering device and a TXV/EXV.
• Identify different compressor types and describe their operation.
• Troubleshoot common refrigeration related issues utilizing superheat and sub cooling.

Who Should Attend
This course is well suited for entry-level air conditioning and/or HVAC maintenance mechanics, service technicians and industrial or facility maintenance technicians. An electrician with new responsibilities in air conditioning maintenance and service will also benefit.

Prerequisites
None.

Pre-Work
None.
CenTraVac Controls (VM16)

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<td>Virtual Module</td>
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</table>

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Course Description
Identification of controls hardware and an introduction to the software used to control Trane centrifugal chillers.

Specific Course Objectives
At the end of this class students will:
- Be able to identify the control hardware used on Trane chillers
- Introduction to the software needed to communicate with the controls used on Trane centrifugal chillers
  - Tech View
  - Tracer TU

Who Should Attend
Our target is individuals responsible for the operation of Trane CenTraVac chillers (CVHE/F/G/L/S/M). This course will benefit technicians, supervisors or engineers who make planning decisions to support centrifugal chiller maintenance.

Prerequisites
None.

Pre-Work
None.
CenTraVac Human Interface (VM17)

Length: 3 Hours

Day and time: Virtual Module

Course Cost: See Schedule

Continuing Education Units: N/A

Recommended search: N/A

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Course Description
Trane University presents a CentraVac virtual module. This module offers Navigation of AdaptiView and Dyna
view

Specific Course Objectives
At the end of this class students will:
• Better understanding of the capabilities of the AdaptiView and dynaview screens on the CTV
• Changing set points
• Manual overrides
• Data graphing LLID binding

Who Should Attend
Our target is individuals responsible for the operation of Trane CenTraVac chillers (CVHE/F/G/L/S/M). This course will benefit technicians, supervisors or engineers who make planning decisions to support centrifugal chiller maintenance

Prerequisites
None.

Pre-Work
None.
CenTraVac Operation & Maintenance Capacity Control, Motor Cooling & Oil System (VM18)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
Trane University presents a CenTraVac virtual module. This module covers compressor capacity control, motor cooling and oil system.

Specific Course Objectives
At the end of this class students will:
- Understand compressor capacity control
- Describe how motor cooling is done
- Understand oil system supply and return

Who Should Attend
Our target is individuals responsible for the operation of Trane CenTraVac chillers (CVHE/F/G/L/S/M). This course will benefit technicians, supervisors or engineers who make planning decisions to support centrifugal chiller maintenance

Prerequisites
None.

Pre-Work
None.
CenTraVac Operation & Maintenance Components, Refrigeration Cycle (VM19)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
This module covers compressor capacity control, motor cooling and oil system.

Specific Course Objectives
At the end of this class students will:
• Understand compressor capacity control
• Describe how motor cooling is done
• Understand oil system supply and return.

Who Should Attend
Our target is individuals responsible for the operation of Trane CenTraVac chillers (CVHE/F/G/L/S/M). This course will benefit technicians, supervisors or engineers who make planning decisions to support centrifugal chiller maintenance.

Prerequisites
None.

Pre-Work
None.
CenTraVac Operation & Maintenance Troubleshooting Operation & Maintenance (VM20)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
This module covers service and maintenance.

Specific Course Objectives
At the end of this class students will:
• Learn preventive and predictive maintenance
• Learn to use design specs to properly troubleshoot chiller operating conditions

Who Should Attend
Our target is individuals responsible for the operation of Trane CenTraVac chillers (CVHE/F/G/L/S/M). This course will benefit technicians, supervisors or engineers who make planning decisions to support centrifugal chiller maintenance.

Prerequisites
None.

Pre-Work
None.
CenTraVac Purge (VM21)

Course Description
This module covers CenTraVac Purge operation and maintenance.

Specific Course Objectives
At the end of this class students will:
• Understand purge operation and its need for proper chiller operation.
• Troubleshoot and maintain purge

Who Should Attend
Our target is individuals responsible for the operation of Trane CenTraVac chillers (CVHE/F/G/L/S/M). This course will benefit technicians, supervisors or engineers who make planning decisions to support centrifugal chiller maintenance.

Prerequisites
None.

Pre-Work
None.
## CGAM/ACS Mechanical Components (VM22)

<table>
<thead>
<tr>
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### Course Description

This module covers the unit design and the available applications. The module discusses design specs, application selection, and the design operating points for the unit in various applications.

### Specific Course Objectives

- Know how to obtain design specs for unit
- Understand application selection process
- Understand units capabilities and design operating points

### Who Should Attend

This course is intended for technicians who will work regularly with Trane CGAM/ACSA scroll chillers and need additional knowledge regarding startup and maintenance procedures of CGAM/ACSA air-cooled chillers.

### Prerequisites

None.

### Pre-Work

None.
CGAM/ACS Unit Design and Selection (VM23)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
This module covers the unit design and the available applications. The module discusses design specs, application selection, and the design operating points for the unit in various applications.

Specific Course Objectives
At the end of this class students will:
- Know how to obtain design specs for unit
- Understand application selection process
- Understand units capabilities and design operating points

Who Should Attend
This course is intended for technicians who will work regularly with Trane CGAM/ACSA scroll chillers and need additional knowledge regarding startup and maintenance procedures of CGAM/ACSA air-cooled chillers.

Prerequisites
None.

Pre-Work
None.
### CGAM/ACS Unit Operation & Capacity Control (VM24)

<table>
<thead>
<tr>
<th>Length</th>
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#### Course Description
This module covers the chiller sequence of operation, and capacity controlled. It also discusses items that affect normal operation and capacity control.

#### Specific Course Objectives
At the end of this class students will:
- Know how to obtain design specs for unit
- Understand application selection process
- Understand units capabilities and design operating points

This course is intended for technicians who will work regularly with Trane CGAM/ACSA scroll chillers and need additional knowledge regarding startup and maintenance procedures of CGAM/ACSA air-cooled chillers.

#### Prerequisites
None.

#### Pre-Work
None.
# Chilled Water Systems - System Design Types (VM25)

<table>
<thead>
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<th>Length:</th>
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## Course Description
Trane University presents a Chilled Water Virtual module. This module will describe and identify system design types (variable Primary, decoupled loops, etc.). Discuss the operation and control for various systems. Identify requirements for different system designs (variable flow vs. Constant flow).

## Specific Course Objectives
- Identify system design types (variable Primary, decoupled loops, etc.)
- Understand the operation and control for various systems
- Identify requirements for different system designs (variable flow vs. Constant flow)

## Who Should Attend
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
None.

## Pre-Work
None.
Chilled Water Systems - System Operation (VM26)

Length: 3 Hours  
Day and time: Virtual Module  
Course Cost: See Schedule  
Continuing Education Units: N/A  
Recommended search: N/A

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Course Description
Trane University presents a Chilled Water Virtual module. This module will discuss the function of a chilled water system. Describe and define chilled water system terminology.

Specific Course Objectives
At the end of this class students will:
- understand the operation of a basic chilled water system
- identify various methods of measuring water flow
- understand water flow requirements in the system

Who Should Attend
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
None.

Pre-Work
None.
### Chilled Water Systems - System Principles (VM27)

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<td>Recommended search:</td>
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#### Course Description
Trane University presents a Chilled Water Virtual module. This module will discuss the function of a chilled water system. Describe and define chilled water system terminology.

#### Specific Course Objectives
- understand the function of a chilled water system
- understand chilled water system terminology

#### Who Should Attend
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
None.

#### Pre-Work
None.
HDWA/Agility Chiller - Chiller Power Options (VM28)

Length: 3 Hours

Day and time: Virtual Module

Course Cost: See Schedule

Continuing Education Units: N/A

Recommended search: N/A

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Course Description
Trane University presents a HDWA/Agility Chiller Virtual module. This module covers chiller power options, Danfoss Drive operation, UPS options, power electronics cooling, chiller components and control.

Specific Course Objectives
At the end of this class students will:
• Understand the power options for chiller selection
• Understand the Danfoss drive operation
• Maintain UPS for chiller
• Understand and maintain electronics cooling
• Discuss chiller components and there control

Who Should Attend
This class is intended for Trane HVAC and service technicians who will work regularly with the HDWA Agility Chiller.

Prerequisites
None.

Pre-Work
None.
HDWA/Agility Chiller – Introduction, Compressor Overview (VM29)

Course Description
Trane University presents a HDWA/Agility Chiller Virtual module. This module covers chiller introduction and compressor overview.

Specific Course Objectives
At the end of this class students will:
• Overview of the new chiller offering.
• Introduce new compressor, explain Mag bearing and associated electronics.

Who Should Attend
This class is intended for Trane HVAC and service technicians who will work regularly with the HDWA Agility Chiller.

Prerequisites
None.

Pre-Work
None.
HVAC Electrical - Basic Electricity (VM30)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
Trane University presents a HVAC Electrical module. This module covers basic electrical concepts for both AC and DC circuits. Ohms, Watts and Kirchhoff’s laws and how they apply to series and parallel circuits will be covered in depth. Other topics include use of multimeters, inductance, transformers, relays, and other component typically found in HVAC equipment will be discussed.

Specific Course Objectives
At the end of this class students will:
• Describe the difference between AC and DC current.
• Explain how voltage, current and resistance interact in various circuits.
• Describe series and parallel circuits and how they differ.
• Identify common electrical components found in HVAC equipment and describe their operation.

Who Should Attend
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
None.

Pre-Work
None.
HVAC Electrical - Electric Motors (VM31)

Length: 3 Hours  
Day and time: Virtual Module  
Course Cost: See Schedule  
Continuing Education Units: N/A  
Recommended search: N/A

Course Description
Trane University presents a HVAC Electrical Virtual Module. This module covers the fundamentals of electric motors. Motor construction including stators and rotors for inductive, permanent magnet motors will be discussed. The module will cover both three phase and single phase motors. There will also be discussion of motor starters and the use of capacitors on single phase motors. Motor testing and troubleshooting methods with an approach to predictive maintenance will be introduced.

Specific Course Objectives
At the end of this class students will:
• Describe the difference between ECM, three phase and single phase motors.
• Explain the fundamentals of motor operation.
• Discuss capacitors and their role in single phase motor operation.
• Perform Meg-Ohm testing and describe why this testing is performed.
• Identify different types of motor starters and their application.

Who Should Attend
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.

Prerequisites
None.

Pre-Work
None.
IntelliPak Airside and Transducer Troubleshooting (VM32)

Length: 3 Hours  Day and time: Virtual Module  Course Cost: See Schedule  Continuing Education Units: N/A  Recommended search: N/A

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Course Description
Trane University presents an IntelliPak Virtual module. This module will cover common airflow applications, including Constant Volume (CV), Single Zone Variable Air Volume (SZVAV) and Multiple Zone Variable Air Volume (MZVAV). Various fan types, their application and how to measure airflow are introduced. Proper set up and operation of the economizer will be discussed. Demand control ventilation (DCV) is also covered. Transducer operation and troubleshooting will be discussed.

Specific Course Objectives
At the end of this class students will:
• Discuss proper troubleshooting techniques for transducers.
• Explain how to measure and adjust airflow.
• Describe economizer operations and setup of minimum outside air.

Who Should Attend
This course is intended for rooftop service technicians who have a good understanding of both constant volume and variable air volume rooftop units and systems and need additional knowledge regarding startup and maintenance procedures of Trane IntelliPak rooftop units.

Prerequisites
None.

Pre-Work
None.
## IntelliPak Refrigeration/Mechanical/Dehumidification (VM33)

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### Course Description

This module will discuss the sequence of operation and service requirements of the refrigerant circuits with microchannel or tube and fin construction. We will take about refrigerant logging, pressure curves, compressor operation, compressor safety and head pressure control including low ambient operation. We will also explore the dehumidification option using hot gas reheat.

### Specific Course Objectives

At the end of this class students will:

- Describe condenser fan staging and low ambient control.
- Explain the operation of the refrigeration system safety.
- Describe how the unit utilizes modulating hot gas reheat for dehumidification.

### Who Should Attend

This course is intended for rooftop service technicians who have a good understanding of both constant volume and variable air volume rooftop units and systems and need additional knowledge regarding startup and maintenance procedures of Trane IntelliPak rooftop units.

### Prerequisites

None.

### Pre-Work

None.
IntelliPak w/Symbio 800 - Symbio 800 Controls (VM34)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
Trane University presents a rooftop Virtual module. This module will cover the IntelliPak with Symbio 800 controls rooftop unit. This will include an overview of the basic sequence of operation, various control boards and the expected voltage readings. We will also explore the model number and how that reflects the configuration of the unit and what components to expect. Human interface and WebUI navigation will be covered at a high level, including LLID binding from the Human interface.

Specific Course Objectives
At the end of this class students will:

• Determine unit options by performing a model number breakdown.
• Explain the sequence of operation for constant volume, single zone variable air volume and multiple zone variable air volume units during occupied and unoccupied modes.
• Identify the components that make up the Symbio 800 control platform.
• Using the human interface and WebUI, navigate through various unit menus and make adjustments as required.
• Perform LLID binding using the human interface.
• Set up operation of the unit service mode.

Who Should Attend
This course is intended for rooftop service technicians who have a good understanding of Trane IntelliPak rooftop units.

Prerequisites
None.

Pre-Work
None.
Intellipak with Symbio 800 - Airflow and Economizer (VM35)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
Trane University presents a rooftop Virtual module. This module covers Intellipak with Symbio 800 airflow and fan operation. Supply fan selection and set-up are covered. Identification of supply fan motor and impeller utilizing the model number description is discussed. Airflow measurement and adjustment using unit fan curves and programming. Location and operation of relief fans including StatiTrac and TRAQ fresh air measurement will also be discussed. Set-up and operation of the economizer including Demand Control Ventilation (DCV) will also be covered.

Who Should Attend
This course is intended for rooftop service technicians who have a good understanding of Trane Intellipak rooftop units.

Prerequisites
None.

Pre-Work
None.

Specific Course Objectives
At the end of this class students will:
• Identify fan types used for supply and relief operation.
• Perform airflow measurement utilizing the unit fan curves and a manometer.
• Explain economizer decisions utilizing dry-bulb, reference and/or comparative enthalpy.
• Describe economizer operation with and without DCV.
• Verify and troubleshoot airflow transducers.
IntelliPak with Symbio 800 - Refrigeration & Heat (VM36)

Length: 3 Hours  
Day and time: Virtual Module  
Course Cost: See Schedule  
Continuing Education Units: N/A  
Recommended search: N/A

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Course Description
Trane University presents a rooftop Virtual module. This module will discuss the sequence of operation and service requirements of the refrigerant circuits and heat options. We will discuss refrigerant logging, pressure curves, compressor operation, compressor safety and head pressure control including low ambient operation. Dehumidification option using hot gas reheat will be covered. In addition, Gas and electric heat operation and start-up will also be discussed.

Who Should Attend
This course is intended for rooftop service technicians who have a good understanding of Trane IntelliPak rooftop units.

Prerequisites
None.

Pre-Work
None.

Specific Course Objectives
At the end of this class students will:
- Describe condenser fan staging and low ambient control.
- Interpret refrigeration system operating envelope and how this affects system operation.
- Identify refrigeration system LLIDs and their use and operation in the system.
- Describe how the unit utilizes modulating hot gas reheat for dehumidification.
- Explain proper operation and set up of gas and electric heat. (Staged and modulating)
Legacy IntelliPak (VM37)

Course Description
This module will cover the legacy IntelliPak sequences of operation. This will include a discussion of the various control boards and expected voltage readings. Common sequences of operation based on unit configuration. We will also explore the model number and how that reflects the configuration of the unit and what components to expect. This course does not cover IntelliPak w/Symbio 800 controls.

Who Should Attend
This course is intended for rooftop service technicians.

Prerequisites
None.

Pre-Work
None.

Specific Course Objectives
At the end of this class students will:

- Discuss circuit board options and which boards to expect based on the unit configuration.
- Identify inputs and outputs and the voltages expected.
- Explain the sequence of operation for constant volume, single zone variable air volume and multiple zone variable air volume units.
# Legacy IntelliPak Controls/Sequence of Operation (VM38)

<table>
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<td>Virtual Module</td>
<td>See Schedule</td>
<td>N/A</td>
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</tr>
</tbody>
</table>

**Course Description**

This module will cover the legacy IntelliPak sequences of operation (does not cover IntelliPak w/Symbio 800 controls.) This will include a discussion of the various control boards and expected voltage readings. Common sequences of operation based on unit configuration. We will also explore the model number and how that reflects the configuration of the unit and what components to expect.

**Specific Course Objectives**

At the end of this class students will:

- Discuss circuit board options and which boards to expect based on the unit configuration.
- Identify inputs and outputs and the voltages expected.
- Explain the sequence of operation for constant volume, single zone variable air volume and multiple zone variable air volume units.

**Who Should Attend**

This course is intended for rooftop service technicians.

**Prerequisites**

None.

**Pre-Work**

None.

Register Now! Trane Education Center
## Legacy IntelliPak I & II Heat (VM39)

<table>
<thead>
<tr>
<th>Length:</th>
<th>Day and time:</th>
<th>Course Cost:</th>
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<td>Virtual Module</td>
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</tbody>
</table>

### Register Now! Trane Education Center

### Course Description
In this module we will discuss the various types of heating that are provided in Intellipak rooftops. We will discuss burner operation and proper setup of the direct fire burners, the modulating burners, hydronic (steam or hot water) and electric heat for Intellipak I and II.

### Specific Course Objectives
At the end of this class students will:
- Describe the different operations of the various staged and modulating burners.
- Explain the importance of combustion analysis and how it is used to properly setup a burner.
- Describe the difference between electric heat on Intellipak I and II.

### Who Should Attend
This course is intended for rooftop service technicians.

### Prerequisites
None.

### Pre-Work
None.
Precedent/Voyager - Airflow & Economizer Operation (VM40)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
This module will cover common airflow applications, including Constant Volume (CV), Single Zone Variable Air Volume (SZAV) and Multiple Zone Variable Air Volume (MZVAV). Various fan types, their application and how to measure airflow are introduced. Proper set up and operation of the economizer will be discussed. Demand control ventilation (DCV) and ventilation override modes (VOM) are also covered.

Specific Course Objectives
At the end of this class students will:
• Measure and adjust airflow across a variety of fan types.
• Determine and set minimum outside air damper position.
• Set up and describe the operation of the economizer with DCV using a CO2 sensor.

Who Should Attend
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.

Prerequisites
None.

Pre-Work
None.
Precedent/Voyager - ReliaTel Controls (VM41)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education
Units: N/A
Recommended search: N/A

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Course Description
In this module the ReliaTel controls platform will be covered in depth. ReliaTel controls are used exclusively on Trane Precedent and Voyager RTU’s as well as Odyssey split systems. This module will cover circuit boards, sequence of operations, schematics and common applications. This module will help build a foundation for further ReliaTel modules.

Specific Course Objectives
At the end of this class students will:
• Identify the circuit boards and their functions that are utilized in the ReliaTel control platform.
• Describe the basic sequence of operations for heating and cooling.
• Using the unit model number description, identify unit component and options.

Who Should Attend
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.

Prerequisites
None.

Pre-Work
None.
## Precedent/Voyager - ReliaTel Troubleshooting (VM42)

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<tr>
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### Course Description
This module will cover troubleshooting the ReliaTel control platform. This includes where to take various voltage measurements and how to interpret these readings, using the ReliaTel diagnostic manual. Additional troubleshooting tools will be discussed including Test mode and the TDS display.

### Specific Course Objectives
At the end of this class students will:
- Properly wire and troubleshoot various sensors.
- Using the diagnostic manual, interpret voltage or resistance readings and diagnostic indicators.
- Describe the use of Test mode.

### Who Should Attend
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.

### Prerequisites
None.

### Pre-Work
None.
Precendent/Voyager eFlex™ Operation (VM43)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
This module covers Trane eFlex unit components and sequence of operation.

Specific Course Objectives
At the end of this class students will:
- Describe what Trane Precendent/Voyager eFlex technology is
- Discuss the eFlex unit sequence of operation

Who Should Attend
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 Precendent and Voyager rooftops.

Prerequisites
None.

Pre-Work
None.
### Precedent/Voyager, Heating (VM44)

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<tr>
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**Course Description**
In this module the various types of heating including gas, electric, heat pump and duel fuel will be covered. Discuss proper set up and operation of the light commercial power burner (negative pressure burner) and Precedent in-shot burner. Modulating heat for Voyager and Precedent units with variable airflow are also covered.

**Specific Course Objectives**
At the end of this class students will:
- Measure and adjust manifold gas pressures for the various burners used in the Precedent and Voyager RTUs.
- Describe the sequence of operation for Precedent and Voyager II heat pumps.
- Explain the gas heating sequence of operation for all burner types.

**Who Should Attend**
This course is intended for commercial rooftop service technicians.

**Prerequisites**
None.

**Pre-Work**
None.
# RAUJ Unit Operation (VM45)

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<tr>
<th>Length:</th>
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Register Now! Trane Education Center

## Course Description
In this module we will provide the RAUJ Chiller unit operation.

## Specific Course Objectives
At the end of this class students will:
- Navigate through both of the chiller control panels
- Discuss controls modules inputs and outputs, sensor troubleshooting, and configuration setup

## Who Should Attend
This course is intended for contractors and in-plant HVAC service technicians who will work regularly with Trane RTAA air-cooled and RTWA water-cooled chillers.

## Prerequisites
None.

## Pre-Work
None.
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<tr>
<th>Length:</th>
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Register Now! Trane Education Center

**Course Description**

This module provides the controls overview for the RTAA Chiller.

**Specific Course Objectives**

At the end of this class students will:

- Cover the differences in the controls between the 70 – 125 RTAA and the 130 – 400 ton RTAA
- Navigate through both of the chiller control panels
- Discuss controls modules inputs and outputs, sensor troubleshooting, and configuration setup

**Who Should Attend**

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

**Prerequisites**

None.

**Pre-Work**

None.
## RTAA Operation (VM47)

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</table>

Register Now! Trane Education Center

### Course Description
In this module we will provide the RTAA Chiller mechanical overview of the chiller

### Specific Course Objectives
At the end of this class students will:
- Cover the differences in the controls between the 70 – 125 RTAA and the 130 – 400 ton RTAA
- Navigate through both of the chiller control panels
- Discuss controls modules inputs and outputs, sensor troubleshooting, and configuration setup

### Who Should Attend
This course is intended for contractors and in-plant HVAC service technicians who will work regularly with Trane RTAA air-cooled and RTWA water-cooled chillers.

#### Prerequisites
None.

#### Pre-Work
None.
### RTAC Chiller Mechanical Components (VM48)

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<th>Length:</th>
<th>3 Hours</th>
<th>Day and time:</th>
<th>Virtual Module</th>
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<th>Recommended search:</th>
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</table>

Register Now! Trane Education Center

**Course Description**
This module covers the mechanical component layout of the chiller and maintenance associated with chiller components as well as their function. As well as, refrigeration cycle as it applies to the unit and terminology associated with chiller applications.

**Specific Course Objectives**
At the end of this class students will:
- identify the mechanical component layout of the chiller
- understand maintenance associated with chiller components
- Understand the mechanical components and there function
- Understand refrigeration cycle as it applies to the unit

**Who Should Attend**
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTAC rotary chillers.

**Prerequisites**
None.

**Pre-Work**
None.
RTAC Chiller Operation and Capacity Control (VM49)

<table>
<thead>
<tr>
<th>Length:</th>
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Course Description
This module covers the chiller sequence of operation, and capacity controlled. It also discusses items that affect normal operation and capacity control.

Specific Course Objectives
At the end of this class students will:
- Understand sequence of operation for chiller
- Understand the capacity control function of the chiller

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTAC rotary chillers.

Prerequisites
None.

Pre-Work
None.
## RTAC Chiller Unit Design and Selection (VM50)

<table>
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<tr>
<th>Length:</th>
<th>Day and time:</th>
<th>Course Cost:</th>
<th>Continuing Education Units:</th>
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### Course Description

This module covers the unit design and the available applications. The module discusses design specs, application selection, and the design operating points for the unit in various applications.

### Specific Course Objectives

At the end of this class students will:
- Know how to obtain design specs for unit
- Understand application selection process
- Understand units capabilities and design operating points

### Who Should Attend

This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTAC rotary chillers.

### Prerequisites

None.

### Pre-Work

None.
## RTAF Chiller - Evaporator (VM51)

<table>
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</table>

Register Now! Trane Education Center

### Course Description
Trane University presents a centraVac virtual module. This module covers the Evaporator as it applies to the various screw chiller products: RTAF, ACRA, & RTAE. It also covers the construction, operation, and service of the Evaporator. Attendees for this module should be familiar with basic chiller operation and refrigeration cycle.

### Specific Course Objectives
- Identify the installation requirements for the Evaporator
- Understand the function of the evaporator
- Understand the service and maintenance associated with the evaporator

### Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTAF rotary chillers.

### Prerequisites
None.

### Pre-Work
None.
RTAF Chiller - Oil System (VM52)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
Trane University presents a RTAF virtual module. This module describes the oil system as it applies to the RTAF screw chillers. It also covers the operation and servicing of the oil system.

Specific Course Objectives
At the end of this class students will:

- Identify the oil system components as they apply to the various screw chillers
- Understand the oil system function
- Understand the oil flow protections and unit controls associated

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTAF rotary chillers.

Prerequisites
None.

Pre-Work
None.
## RTAF Chiller - Operation & Maintenance (VM53)

<table>
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<tr>
<th>Length:</th>
<th>Day and time:</th>
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<th>Continuing Education Units:</th>
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<td>Virtual Module</td>
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### Course Description
This module covers the chiller operation and maintenance associated with chiller components. It also covers the refrigeration cycle as it applies to the unit and terminology associated with chiller applications.

### Specific Course Objectives
At the end of this class students will:
- Understand the Operation of the chiller
- Understand maintenance associated with chiller components
- Understand refrigeration cycle as it applies to the unit
- Understand terminology associated with chiller applications

### Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTAF rotary chillers.

### Prerequisites
None.

### Pre-Work
None.
### RTHD Chiller - Evaporator (VM54)

<table>
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<th>Length:</th>
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</table>

#### Register Now! Trane Education Center

**Course Description**
This module covers the falling film style Evaporator as it applies to the various screw chiller products: RTHD. It also covers the construction, operation, and service of the falling film style Evaporator. Attendees for this module should be familiar with basic chiller operation and refrigeration cycle.

**Specific Course Objectives**
At the end of this class students will:
- Identify the installation requirements for the Evaporator
- Understand the function of the evaporator
- Understand the service and maintenance associated with the falling film evaporator

**Who Should Attend**
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTHD rotary chillers.

**Prerequisites**
None.

**Pre-Work**
None.
# RTHD Chiller - Oil System (VM55)

<table>
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## Course Description

This module describes the oil system as it applies to the RTHD screw chillers. It also covers the operation and servicing of the oil system.

## Specific Course Objectives

At the end of this class students will:
- Identify the oil system components as they apply to the various screw chillers
- Understand the oil system function
- Understand the oil flow protections and unit controls associated

## Who Should Attend

This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTHD rotary chillers.

## Prerequisites

None.

## Pre-Work

None.
RTHD Chiller - Operation & Maintenance (VM56)

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<th>Length:</th>
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Register Now! Trane Education Center

Course Description
This module covers the chiller operation and maintenance associated with chiller components. It also covers the refrigeration cycle as it applies to the unit and terminology associated with chiller applications.

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Trane RTHD rotary chillers.

Specific Course Objectives
At the end of this class students will:
- Understand the Operation of the chiller
- Understand maintenance associated with chiller components
- Understand refrigeration cycle as it applies to the unit
- Understand terminology associated with chiller applications

Prerequisites
None.

Pre-Work
None.
Single-Stage Absorption Chillers (VM57)

Length: 16 Hours  Day and time: Virtual Module  Course Cost: See Schedule  Continuing Education Units: N/A  Recommended search: N/A

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Course Description
This course is a thorough and comprehensive presentation on the foundational understanding of absorption chillers and their refrigeration cycle. Topics include a detailed view of absorption chiller components, instruction in the theory of absorption chiller operation and in the lithium bromide chemical cycle, the chemistry of inhibitors, overview of capacity control system operation, crystallization causes and effects, purge system operation, and performance and operator logging recommendations. This course utilizes an operational absorption chiller with UCP2 micro control.

Specific Course Objectives
At the end of this class students will:
- Describe absorption chiller construction.
- Recognize major absorber components and describe their functions.
- Discuss the characteristics of lithium bromide in relation to charging and inhibitors.
- Use an Equilibrium Chart to determine system conditions.
- Describe the sequence of control operation (pneumatics and electric).
- Demonstrate how Trane’s UCP2™ Adaptive Control™ technology has been applied to absorption chillers.

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with Single-Stage Absorption Chillers.

Prerequisites
Students should have a working knowledge of pneumatic, electrical, heat transfer, steam and mechanical systems.

Pre-Work
None.
### RTWD Chiller Operation & Maintenance (VM58)

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**Register Now! Trane Education Center**

**Course Description**
This module covers the chiller operation and maintenance associated with chiller components. It also covers the refrigeration cycle as it applies to the unit and terminology associated with chiller applications.

**Specific Course Objectives**
At the end of this class students will:
- Describe RTWD Chiller Operation
- Recognize maintenance associated with Chiller components
- Discuss the refrigeration cycle
- Have knowledge of Chiller Applications

**Who Should Attend**
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with RTWD Chillers.

**Prerequisites**
None.

**Pre-Work**
None.
RTWD Chiller Evaporator & Condenser (VM59)

Length: 3 Hours
Day and time: Virtual Module
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

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Course Description
This module covers the Evaporator & Condenser as it applies to the RTWD screw chiller product. It also covers the construction, operation, and service of the Evaporator & Condenser.

Specific Course Objectives
At the end of this class students will:
• Describe RTWD Chiller Evaporator & Condenser
• Have knowledge how construction, operation, and service of these items.

Who Should Attend
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with RTWD Chillers.

Prerequisites
Attendees for this module should be familiar with basic chiller operation and refrigeration cycle.

Pre-Work
None.
## RTWD Chiller Oil System (VM60)

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<td>Recommended search:</td>
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**Course Description**
This module describes the oil system as it applies to the RTWD screw chiller. It also covers the operation and servicing of the oil system.

**Specific Course Objectives**
At the end of this class students will:
- Describe RTWD Chiller oil system
- Have knowledge of the operation and servicing of such systems

**Who Should Attend**
This course is intended for owners, contractors and in-plant HVAC service technicians who will work regularly with RTWD Chillers.

**Prerequisites**
None.

**Pre-Work**
None.
TRACE 700, LEED®, and ASHRAE Standard 90.1-2007 (CDS-TRNGLO)

Length: 1 day  
Day and time: 8 a.m.–4:30 p.m.  
Course Cost: See Schedule  
Continuing Education Units: N/A  
Recommended search: N/A

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Course Description
Many know TRACE™ 700 software as the benchmark complete load, system, energy, and economic analysis program that compares the energy and economic impact of such building alternatives as architectural features, HVAC systems, building utilization or scheduling and economic options. TRACE™ 700 is tested in accordance with ASHRAE Standard 140, “Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs,” and it meets the requirements for simulation software set by ASHRAE Standard 90.1-2007/2010 and LEED. Trane C.D.S. offers an 8-hour class discussing how to utilize TRACE™ 700 for LEED Energy & Atmosphere Credit 1 analyses through the Performance Rating Method detailed in ASHRAE Standard 90.1-2007/2010. Trane C.D.S. provides a full day of training on TRACE 700, LEED®, and ASHRAE Standard 90.1-2007.

Who Should Attend
The class is designed primarily for advanced users.

Prerequisites
You must hold a valid license for the software. If you need to purchase software, take advantage of the software and training discount. Participants are expected to have previously attended TRACE 700 Load and TRACE 700 Energy & Economics courses prior to attending this course. If not, those taking the course should understand how to perform basic functions such as navigation, creating templates, creating custom library values, program methodology, and how to interpret results.

Pre-Work
None.

Specific Course Objectives
By the end of this course, you will be able to:

- Summarize United States Green Building Council (USGBC) and the LEEDv3 and LEEDv4 programs
- Identify various credits available through the LEED for New Construction rating system and how TRACE can aid in achieving various points
- Summarize goals of ASHRAE Standard 90.1
- Summarize details of HVAC related areas of ASHRAE Standard 90.1
- Summarize details of Appendix G – Performance Rating Method
- ASHRAE Standard 90.1 requirements and how they relate to TRACE™ 700
- Build a baseline building to satisfy LEED EA C1 through in-class exercises
- Define an unmet hours and understand how to reduce/eliminate them
- Understand LEED Automation and LEED submittals
System Analyzer (CDS-TRNGL1)

Length: 1 day
Day and time: 8 a.m.–4:30 p.m.
Course Cost: See Schedule
Continuing Education Units: N/A
Recommended search: N/A

Register Now! Trane Education Center

Course Description
System Analyzer is a comparative analysis tool for preliminary evaluations of HVAC systems based on energy and economic performance. Use it to quickly evaluate virtually an combination of air distribution systems(s) and cooling/heating equipment for a specific building type and weather location. Trane CDS offers 1 day class proving users with a better understanding of System Analyzer allowing them to more effectively use the program.

Specific Course Objectives
By the end of this course, you will be able to:
- Learn how to navigate the program and gain a better understanding of various input fields.
- Discover how the program uses inputs to determine energy consumption and life cycle costs.
- Understand program assumptions and how they relate to results.
- Learn how to create multiple alternatives to model various choices.
- Learn how to create custom library values for specific applications.
- Interpret results and learn how to read the various output reports.
- Practice using the program through in-class exercises.
- Discover various resources available to help licenses users.

Who Should Attend
The class is designed primarily for beginning users, but advanced users will find the class useful based on tips provided by the trainer.

Prerequisites
None.

Pre-Work
None.
TRACE 700 Load Design (CDS-TRNL2)

Course Description
TRACE 700 Load software is a separate program incorporating the load and system portion of TRACE 700. In other words, it contains the functionality of TRACE minus the energy and economic portions of the program. Use this program to complete complex building load calculations for virtually any building. Trane C.D.S. provides a full day of training on TRACE Load Design.

Specific Course Objectives
By the end of this course, you will be able to:
- Navigate the program and gain a better understanding of the various input fields.
- Understand how design weather is used to determine peak loads.
- Explain how TRACE™ calculates supply temperatures and airflow.
- Summarize the plenum heat balance calculations and how TRACE™ balances airflow.
- Explain how TRACE™ determines coil capacities and how to zone spaces.
- Utilize templates to reduce input time.
- Create multiple alternatives to model various choices.
- Create custom library values for items such as construction types, schedules, and shading plus others.
- Share files and understand the difference between a stand-alone and network installation.
- Summarize advanced features in the program (e.g. Modeling ASHRAE Standard 62.1, importing GBXML files, and various system types).
- Interpret results and learn how to read the various output reports.
- Practice using the program through in-class exercises.
- Interpret results and the various output reports.

Who Should Attend
The class is designed for all levels of users. The information in this class provides basic information critical for understanding TRACE 700 Software.

Prerequisites
None.

Pre-Work
None.
TRACE 700 Energy & Economics (CDS-TRNGL3)

Course Description
TRACE 700 software is the benchmark complete load, system, energy and economic analysis program that compares the energy and economic impact of such building alternatives as architectural features, HVAC systems, building utilization or scheduling and economic options. Trane C.D.S. provides a full day of training on TRACE Energy and Economics.

Specific Course Objectives
By the end of this course, you will be able to:
- Navigate the program and gain a better understanding of the various input fields.
- Summarize how weather is used to determine peak and off-peak loads.
- Summarize the various daytypes TRACE™ uses to calculate peak and off-peak loads.
- Understand how TRACE™ uses unloading curves to determine energy use.
- Create multiple alternatives to model various choices.
- Create custom library values to model various heating equipment.
- Summarize how TRACE™ calculates life-cycle costs and other economic parameters.
- Create custom utility rate structures.
- Identify advanced features in the program to include modeling ASHRAE Standard 62.1, importing GBXML files, and system control strategies.
- Interpret results and learn how to read the various output reports.
- Practice using the program through in-class exercises
- Identify various resources available to help licensed users

Who Should Attend
The class is designed primarily for intermediate users. The information in this class provides basic information critical for understanding subsequent C.D.S. TRACE courses (e.g. the TRACE 700, LEED, and ASHRAE Standard 90.1 and the Advanced Topics courses).

Prerequisites
You must hold a valid license for the software. If you need to purchase software, take advantage of the software and training discount. Participants are expected to have previously attended TRACE Load Design training, and if not, to be a proficient TRACE Load user.

Pre-Work
None.
TRACE 700 Advanced Topics (CDS-TRNGL4)

**Length:** 1/2 day

**Day and time:** 8 a.m.–12:00 p.m.

**Course Cost:** See Schedule

**Continuing Education Units:** N/A

**Recommended search:** N/A

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**Course Description**

TRACE 700 software is the benchmark complete load, system energy and economic analysis program that compares the energy and economic impact of such building alternatives as architectural features, HVAC systems, building utilization or scheduling and economic options. Trane C.D.S. provides a ½ day of training on TRACE Advanced Topics.

**Specific Course Objectives**

By the end of this course, topics covered include:

- Daylighting
- ASHRAE 62.1 Inputs and Reports
- Airflow Balancing
- Interpreting Outputs
- Air to Air Energy Recovery
- Dedicated OA
- Creating Libraries- schedules, equipment, constructions, etc.
- TES – Thermal energy storage
- Over/under Sizing
- Heat Recovery Chillers
- Waterside Free Cooling
- Cogeneration
- Cooling Tower Operation and Design
- District Energy Modeling
- Life Cycle Cost Analysis
- Geothermal HP Systems
- Terminal Fan Sizing (Parallel and Series)
- Detailed Psychometrics
- Underfloor Air Distribution
- Variable Refrigerant Flow Systems
- Active and Passive Chilled Beams

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**Who Should Attend**

The class is designed primarily for advanced users. The information in this class provides experienced level users with a deeper dive into the software. Please contact us if there is a specific topic you would like to cover.

**Prerequisites**

You must hold a valid license for the software. If you need to purchase software, take advantage of the software and training discount. Participants are expected to have previously attended TRACE 700 Load and TRACE 700 Energy & Economics courses prior to attending this course. If not, those taking the course should understand how to perform basic functions such as navigation, creating templates, creating custom library values, program methodology, and how to interpret results.

**Pre-Work**

None
# TRACE 3D Plus Load Design (CDS-TRNL5)

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**Course Description**

TRACE 3D Plus Load software is a separate program incorporating the load and system portion of the design process. In other words, it contains the functionality of TRACE 3D Plus minus the energy and economic portions of the program. Use this program to complete complex building load calculations for virtually any building. Trane C.D.S. provides a full day of training on Load Design.

**Who Should Attend**

This class is designed primarily for beginning users, but advanced users will gain a better understanding of program methodology and garner tips from the trainer. This class provides basic information critical for understanding subsequent C.D.S. TRACE 3D Plus Energy & Economics course and advanced topics.

**Prerequisites**

You must hold a valid license for the software. If you need to purchase software, take advantage of the software and training discount.

**Pre-Work**

We also request that you familiarize yourself with the software by completing the TRACE 3D Plus Load 101 tutorials prior to this class. Access the Getting Started Guide by navigating to ...

**Specific Course Objectives**

By the end of this course, you will be able to:

- Navigate the program and gain a better understanding of the various input fields.
- Practice using the drawing tools and creating a 3D model of your building.
- Understand how design weather is used to determine peak loads.
- Explain how TRACE™ 3D Plus calculates loads and airflows.
- Understand customization of system.
- Take a brief look at plant level load calculations.
- Utilize templates and themes to reduce input time.
- Create multiple alternatives to model various choices.
- Create custom library values for items such as construction types, schedules, and systems plus others.
- Share files and libraries.
- Interpret results and learn how to read the various output reports.
- Practice using the program through in-class exercises.
- Interpret results and the various output reports.
### TRACE 3D Plus Energy and Economics (CDS-TRNGL6)

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#### Course Description

TRACE 3D Plus software is the benchmark complete load, system, energy and economic analysis program that compares the energy and economic impact of such building alternatives as architectural features, HVAC systems, building utilization or scheduling and economic options. Trane C.D.S. provides a full day of training on TRACE Energy and Economics.

#### Specific Course Objectives

- Navigate the program and gain a better understanding of the various input fields.
- Expand on elements of the building and system sections that are specific to the energy calculations.
- Summarize how weather is used to determine peak and off-peak loads.
- Summarize the various daytypes TRACE™ uses to calculate peak and off-peak loads.
- Understand how TRACE™ uses unloading curves to determine energy use.
- Create multiple alternatives to model various choices.
- Create custom library values for cooling and heating equipment and plant configurations.
- Summarize how TRACE™ calculates life-cycle costs and other economic parameters.
- Create custom utility rate structures.
- Interpret results and learn how to read the various output reports.
- Practice using the program through in-class exercises.
- Identify various resources available to help licensed users.

#### Who Should Attend

The class is designed primarily for intermediate users. The information in this class provides basic information critical for understanding subsequent C.D.S. TRACE courses (e.g. the TRACE 700, LEED, and ASHRAE Standard 90.1 and the Advanced Topics courses).

#### Prerequisites

You must hold a valid license for the software. If you need to purchase software, take advantage of the software and training discount. Participants are expected to have previously attended TRACE Load Design training, and if not, to be a proficient TRACE Load user.

#### Pre-Work

We also request that you familiarize yourself with the software by completing the tutorials in the Getting Started Guide and watch the Energy 101 online training course prior to attending class. Access the Getting Started Guide by navigating to ...\Documents\Trane\TRACE 3D Plus\Documents\Help\Getting Started.