Price Sheet
Educational Materials
Customer Version

Literature Order Number	**EM-ADV1**
Date	**April 2019**
Supersedes	**EM-ADV1 (October 2018)**
Stocking Location	**http://www.trane.com/bookstore**

The most current version of this price sheet can be found on the Trane Web site (http://www.trane.com/bookstore).

Minimum Order Policy
Minimum order amount is US$25. Orders that do not total US$25 will be billed at US$25.

Shipping/Delivery
Literature orders shipped within the United States are shipped UPS Ground and are typically delivered within 3 to 6 business days (depending on the destination). A US$10 shipping and handling fee is added to each order shipped within the United States. Literature orders shipped outside the United States are shipped UPS and are typically delivered within 4 to 7 business days (depending on the destination and local customs). A US$30 shipping and handling fee is added to each literature order shipped outside of the United States.

Return Policy
All literature returns must receive prior authorization by calling 608.787.4153. There will be a 15 percent restocking charge on all literature returned. Literature returns will only be accepted up to 90 days after the ship date.

Tax Exempt?
If your company or organization is exempt from paying sales tax, fax or mail a copy of your tax exemption certificate along with the completed order form.

List prices are in U.S. dollars and subject to change without notice.

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.

Language/Units: All booklets are available in English only, unless specifically noted. All booklets are dual (I-P and SI) units, unless specifically noted.

Audience: The content is technical in nature and intended for individuals who want to learn the basics of HVAC (e.g. HVAC system designers and installing contractors, architects, system operators, servicing technicians, and owners).

Order Number	Title (Pub. Date)	Price	Abstract
Fundamentals Series			
TRG-TRC001-EN	Psychrometry (2018) • I-P units only	$18.00	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).
TRG-TRC002-EN	Cooling and Heating Load Estimating (2018) • Dual units (I-P/SI)	$18.00	Presentation of cooling and heating load estimating procedures to use 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.
TRG-TRC003-EN	Refrigeration Cycle (2018) • Dual units (I-P /SI)	$18.00	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, and heat of compression).
TRG-TRC004-EN	Refrigeration Compressors (2018) • Dual units (I-P /SI)	$18.00	Introduction of the common compressor types used in air-conditioning applications, including 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 (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).
TRG-TRC005-EN	Refrigeration System Components (2018) • Dual units (I-P /SI)	$18.00	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.
TRG-TRC007-EN	Fundamentals of HVAC Acoustics (2018) • Dual units (I-P /SI)	$18.00	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), 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, and AHRI Standard 260.
Equipment Series			

Order Number	Title (Pub. Date)	Price	Abstract
TRG-TRC010-EN	Centrifugal Water Chillers (2018) • Dual units (I-P /SI)	$18.00	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, and short water loops).
TRG-TRC011-EN	Absorption Water Chillers (2018) • Dual units (I-P /SI)	$18.00	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, and special considerations for direct-fired chillers.
TRG-TRC012-EN	Helical-Rotary Water Chillers (2018) • Dual units (I-P /SI)	$18.00	Presentation of the components, operation, and application of a helical-rotary (screw) water chiller. Topics include: helical-rotary compressor, oil separator, air- and water-cooled condensers, 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- and water-cooled condensing, condensing temperature control, constant or variable evaporator water flow, and short water loops).
TRG-TRC013-EN	Air Conditioning Fans (2018) • Dual units (I-P /SI)	$18.00	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			
TRG-TRC014-EN	VAV Systems (2018) • Dual units (I-P /SI)	$18.00	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, 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 pressure control.)
TRG-TRC015-EN	Water-Source Heat Pump Systems (2018) • Dual units (I-P /SI)	$18.00	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.)
TRG-TRC016-EN	Chilled-Water Systems (2018) • Dual units (I-P /SI)	$18.00	Description of chilled-water systems. Topics include: vapor-compression and absorption chiller types, air- vs. water-cooled condensers, packaged vs. split components, ASHRAE Standard 90.1, equipment rating standards, 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)

Order Number	Title (Pub. Date)	Price	Abstract
TRG-TRC017-EN	HVAC System Control (2018) • Dual units (I-P /SI)	$18.00	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, wired vs. wireless, interoperability, BACnet.
TRG-TRC018-EN	Introduction to HVAC Systems (2018) • Dual units (I-P /SI)	$18.00	Introduction to HVAC systems that dissects the entire system into five subsystems, or "loops." Topics include: requirements for occupant comfort, five "loops" (airside loop, chilled-water loop, refrigeration 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.
TRG-TRC019-EN	Ice Storage Systems (2018) • Dual units (I-P /SI)	$18.00	Part of the Trane Air Conditioning Clinic series. 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).
TRG-TRC020-EN	Variable Refrigerant Flow Systems (2018) Dual units (I-P /SI)	$18.00	Variable Refrigerant Flow Systems focuses on VRF systems, which use a combination of zone-level indoor terminals and outdoor components to provide heating and air conditioning. Topics include: system component overview (outdoor units, indoor units, controls, refrigerant piping, heat recovery control units), air- and water-cooled heat rejection, ducted and non-ducted indoor units, system configurations (cooling only, heat pump, heat recovery), maintenance considerations, refrigerant safety, space humidity control, ventilation air delivery, cooling coil condensate, equipment rating standards, combination ratio, low ambient operation, defrost operation, lubrication and oil recovery.
Bundled Sets			
1-43.186	Set of all *Air Conditioning Clinic* booklets	$215.00	Set of all *Air Conditioning Clinic* booklets
1-43.165	“Air Conditioning Clinic” bundle	$240.00	This bundle includes: • Set of all *Air Conditioning Clinic* booklets (see pages 2-4) • Ductulator duct sizing calculator (see page 13) • Psychrometric Charts – pad of 25, standard altitude, I-P units (see page 13) *Note: The Trane Air Conditioning Manual is no longer included in this bundle.*

Translated Air Conditioning Clinics – Spanish version

Order Number	Title (Pub. Date)	Price	Abstract
Fundamentals Series			
TRG-TRC001-ES	Psychrometry (2018) • I-P units only	$18.00	**Spanish translation.** See description above.
TRG-TRC002-ES	Cooling and Heating Load Estimating (2018) • Dual units (I-P/SI)	$18.00	**Spanish translation.** See description above.
TRG-TRC003-ES	Refrigeration Cycle (2018) • Dual units (I-P /SI)	$18.00	**Spanish translation.** See description above.
TRG-TRC004-ES	Refrigeration Compressors (2018) • Dual units (I-P /SI)	$18.00	**Spanish translation.** See description above.
TRG-TRC005-ES	Refrigeration System Components (2018) • Dual units (I-P /SI)	$18.00	**Spanish translation.** See description above.
Equipment Series			
TRG-TRC010-ES	Centrifugal Water Chillers (2018) • Dual units (I-P /SI)	$18.00	**Spanish translation.** See description above.
TRG-TRC012-ES	Helical-Rotary Water Chillers (2018) • Dual units (I-P /SI)	$18.00	**Spanish translation.** See description above.
Systems Series			
TRG-TRC016-ES	Chilled-Water Systems (2018) • Dual units (I-P /SI)	$18.00	**Spanish translation.** See description above.
TRG-TRC017-ES	HVAC System Control (2018) • Dual units (I-P /SI)	$18.00	**Spanish translation.** See description above.
TRG-TRC020-ES	Variable Refrigerant Flow Systems (2018) • Dual units (I-P /SI)	$18.00	**Spanish translation.** See description above.

Trane Air Conditioning Manual

Order Number	Title (Pub. Date)	Price	Abstract
AC MANUAL	Trane Air Conditioning Manual (1996) • IP units only	$40.00	A comprehensive textbook, initially published in the 1930's, on the fundamentals of heating, ventilating, and air conditioning (HVAC). The audience is broad and has historically included students, HVAC system designers, installing contractors, architects, system operators, and service technicians. Chapters include: • Heat and Its Measurement • Comfort • Heat Gains • Properties of Air and the Psychrometric Chart • Calculations for the Conditioned Air Supply • Refrigeration Theory, Compressors, and Refrigeration Cycle Components • Refrigeration and Cooling Apparatus • Use of Water in Air Conditioning • Air Transport Systems • The Air Conditioning System

Application Manuals

Purpose: Comprehensive reference guides to increase awareness and working knowledge of heating, ventilating, and air conditioning (HVAC) system design concepts, component combination possibilities, system operating/control concepts and characteristics, general industry issues, and HVAC fundamentals.

Audience: Intended audience is HVAC system designers, however, depending on the topic the manual may also be of interest to others in the industry.

Language/Units: All booklets are available in English only, unless specifically noted. All booklets are in IP units only, unless specifically noted.

Order Number	Title (Pub. Date)	Price	Abstract
APP-APM001-EN	Refrigerating Systems and Machinery Rooms: ASHRAE Standard 15 (2012)	$16.00	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.
ISS-APM001-EN	Acoustics in Air Conditioning (2006)	$16.00	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.
SYS-APM001-EN	Chiller System Design and Control (2009) • Dual units (IP/SI)	$16.00	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.
SYS-APM003-EN	Air-to-Air Energy Recovery in HVAC Systems (2008) • Dual units (IP/SI)	$16.00	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.
SYS-APM004-EN	Dehumidification in HVAC Systems (2002) • Dual units (IP/SI)	$16.00	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 (packaged direct expansion DX equipment, energy recovery, fan-speed adjustment, mixed-air bypass, return-air bypass, DX coil circuiting, dual path air handlers, supply-air tempering or reheat), dehumidification performance of VAV systems (minimum airflow settings, supply-air temperature reset, supply-air tempering at VAV terminals, colder supply-air temperatures), dedicated outdoor-air systems (neutral versus cold, to space versus to other units, reset control strategies), unoccupied humidity control, building pressure control, airside economizer control, ASHRAE Standards 62 and 90.1.
SYS-APM005-EN	Waterside Heat Recovery in HVAC Systems (2003) • Dual units (IP/SI)	$16.00	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.

Order Number	Title (Pub. Date)	Price	Abstract
SYS-APM007-EN	Rooftop VAV Systems (2012)	$16.00	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).
SYS-APM008-EN	Chilled-Water VAV Systems (2012)	$16.00	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).
SYS-APM009-EN	Central Geothermal Systems (2011)	$20.00	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). Printed in full color.
SYS-APM010-EN	Water-Source and Ground-Source Heat Pump Systems (2013)	$16.00	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).
AM-SYS-6	Variable Air Volume Duct Design (1981)	$4.00	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.
SYS-AM-7	Water Source Heat Pump System Design (1994)	$16.00	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.
AM-SYS-9	Self-Contained/VAV System Design (1984)	$5.00	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.
SYS-AM-10	Ice Storage Systems (1987)	$5.00	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 "Ice Storage Systems" series of Engineered Systems Clinics (ISS-CLC-1, 2, 3, 4).
SYS-AM-13	Absorption Chiller System Design (1999) • Dual units (IP/SI)	$16.00	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.

Order Number	Title (Pub. Date)	Price	Abstract
SYS-AM-15	Managing Building Moisture (2010)	$16.00	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.
AM-CON-10	Hot Gas Bypass Control (1982)	$1.25	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.
AM-CON-17	Building Pressurization Control (1982)	$5.00	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.
ICS-AM-4	Control of Ice Storage Systems (1988)	$5.00	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.
ED-FAN	Fans and Their Application in Air Conditioning (1982)	$10.00	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.

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.

Order Number	Title (Program Date)	Price	Abstract
APP-CMC001-EN	The Low Dollar Chiller Plant (August, 1999)	$30.00	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.
APP-CMC002-EN	Specifying Quality Sound (March, 2000)	$30.00	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).
APP-CMC003-EN	Lowering Supply Air Temperatures (May, 2000)	$30.00	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.
APP-CMC004-EN	Advanced System Control Strategies (June, 2000)	$30.00	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 life-cycle 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).
APP-CMC005-EN	Building Moisture and Humidity Management (August, 2000)	$30.00	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.
APP-CMC006-EN	Air-to-Air Energy Recovery (October, 2000)	$30.00	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.
APP-CMC007-EN	Geothermal Heat Pump Systems (May, 2001)	$30.00	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.

Order Number	Title (Program Date)	Price	Abstract
APP-CMC008-EN	Dedicated Outdoor-Air Systems (September, 2001)	$30.00	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.
APP-CMC009-EN	Split System Refrigerant Piping Design (December, 2001)	$30.00	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 program 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.
APP-CMC012-EN	Coil Fundamentals (February, 2002)	$30.00	This program 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.
APP-CMC013-EN	Commercial Building Pressurization (April, 2002)	$30.00	This program 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.
APP-CMC014-EN	Underfloor Air Distribution (February, 2003)	$30.00	This ENL program discusses the benefits and issues associated with underfloor air distribution (UAD) 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)
APP-CMC015-EN	Variable-Primary-Flow Chilled-Water Systems (May, 2003)	$30.00	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.
APP-CMC016-EN	High Performance Schools (October, 2003)	$30.00	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/ASI 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).
APP-CMC017-EN	HVAC and LEED (February, 2004)	$30.00	This program provides an overview of the U.S. Green Building Council's "Leadership in Energy and Environmental Design" (LEED) Green Building Rating System, with specific focus placed on how it relates to HVAC systems.
APP-CMC018-EN	Improving Dehumidification in Restaurants and Retail Stores (May, 2004)	$30.00	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.

Order Number	Title (Program Date)	Price	Abstract
APP-CMC019-EN	Small Chilled-Water Systems – Design and Application (September, 2004)	$30.00	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.
APP-CMC020-EN	Cooling Towers and Condenser-Water Systems – Design and Operation (January, 2005)	$30.00	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.
APP-CMC022-EN	Energy Analysis – LEED™ Modeling (May, 2005)	$30.00	Energy models are a critical requirement in the U.S. Green Building Council’s LEED-NC rating system. Under Energy & 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.
APP-CMC023-EN	ASHRAE Standard 62.1-2004: Ventilation Requirements (September, 2005)	$30.00	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.
APP-CMC024-EN	CO_2-Based Demand-Controlled Ventilation (November, 2005)	$30.00	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 (CO_2) sensors to vary outdoor airflow based on actual demand. It also considers the related requirements for compliance with ASHRAE Standard 62.1-2004.
APP-CMC025-EN	Variable-Speed Drives and Their Effect on HVAC System Components (February, 2006)	$30.00	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.
APP-CMC026-EN	HVAC Systems and Airside Economizers (May, 2006)	$30.00	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.
APP-CMC027-EN	HVAC Design for Places of Assembly (September, 2006)	$30.00	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.
APP-CMC028-EN	Energy-Saving Strategies for Rooftop VAV Systems (November, 2006)	$30.00	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 reheat, 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.
APP-CMC029-EN	Waterside Heat Recovery (February, 2007)	$30.00	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.

Order Number	Title (Program Date)	Price	Abstract
APP-CMC030-EN	Improving Dehumidification in HVAC Systems (September, 2007)	$30.00	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.
APP-CMC031-EN	LEED® Case Studies (November, 2007)	$30.00	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 program 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.
APP-CMC032-EN	Energy-Saving Strategies for LEED® and the Energy Policy Act (May, 2008)	$30.00	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.
APP-CMC033-EN	Small Chilled-Water Systems – Part II (September, 2008)	$30.00	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.
APP-CMC034-EN	ASHRAE Standards 62.1 and 90.1, and VAV Systems (November, 2008)	$30.00	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.
APP-CMC035-EN	LEED® 2009 Modeling and Energy Analysis (March, 2009)	$30.00	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.
APP-CMC036-EN	Ice Storage System Design and Application (May, 2009)	$30.00	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.

Order Number	Title (Program Date)	Price	Abstract
APP-CMC037-EN	Air-Handling Systems, Energy, and IAQ (November, 2009)	$30.00	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).
APP-CMC038-EN	Fans In Air-Handling Systems (March 2010)	$30.00	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.
APP-CMC039-EN	Central Geothermal Systems (May 2010)	$30.00	Most designers are familiar with heat pump systems, using small, "geothermal" 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.
APP-CMC040-EN	ASHRAE Standard 90.1-2010 (October 2010)	$30.00	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.
APP-CMC041-EN	Upgrading Existing Chilled-Water Systems (March 2011)	$30.00	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.
APP-CMC042-EN	High Performance VAV Systems (June 2011)	$30.00	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.
APP-CMC043-EN	Dedicated Outdoor-Air Equipment (October 2011)	$30.00	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.
APP-CMC044-EN	High-Performance Green Buildings: ASHRAE Standard 189.1-2011 (March 2012)	$30.00	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.
APP-CMC045-EN	Energy-Saving Strategies for Water-source and Ground-source Heat Pump Systems (June 2012)	$30.00	This ENL discusses HVAC system design and control strategies that can save energy in water-source heat pump (WSHP) 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 WSHP/GSHP systems.

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APP-CMC046-EN	Air-to-Air Energy Recovery (October 2012)	$30.00	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 discusses the various technologies used for air-to-air energy recovery and the importance of properly controlling these devices in various systems types.
APP-CMC047-EN	ASHRAE Standard 62.1-2010 (February 2013)	$30.00	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 airflows.
APP-CMC048-EN	Single-Zone VAV Systems (April 2013)	$30.00	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.
APP-CMC049-EN	All-Variable-Speed Chilled-Water Plants (October 2013)	$30.00	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.
APP-CMC050-EN	LEED v4 (March 2014)	$30.00	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.
APP-CMC051-EN	Applying Variable Refrigerant Flow (May 2014)	$30.00	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.
APP-CMC052-EN	Chilled Water Terminal Systems (Oct 2014)	$30.00	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.
APP-CMC053-EN	Variable-Speed Compressors On Chillers (Mar 2015)	$30.00	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.
APP-CMC054-EN	Coils Selection and Optimization (May 2015)	$30.00	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.

Order Number	Title (Program Date)	Price	Abstract
APP-CMC055-EN	Evaluating Sound Data (May 2015)	$30.00	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.
APP-CMC056-EN	Chilled-Water System Design Trends (October 2015)	$30.00	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.
APP-CMC057-EN	DIY Chiller Plant Performance Modeling: Easy and Easier (March 2016)	$30.00	Analyzing chilled-water plants and optimizing their performance with building loads is desirable to minimize energy use. However, chiller plant design often is set during the schematic design phase, when there are many unknowns. This ENL examines a number of quick analysis tools available that help system designers determine which chilled-water plant design options benefit the building owner and result in efficient system operation.
APP-CMC058-EN	Delivering Performance From Airside Economizers (May 2016)	$30.00	Airside economizers are an effective way to save energy and operational cost in many unitary and air handling systems. In some instances, the promise of energy savings hasn't been fully realized. This ENL will discuss the current energy code requirements related to economizers, how economizers can be used to save energy, common problems, and how modern design and technology can be used to ensure that the expected energy savings are realized.
APP-CMC059-EN	Fan Efficiency Regulations and Technology Advances (October 2016)	$30.00	This program discusses common fan efficiency metrics, and explains the requirements of new regulations and industry energy standards. It will also discuss fan technology advances, including motorized impellers, direct-drive plenum fans, and fan arrays.
APP-CMC060-EN	Acoustics in Outdoor HVAC Applications (November 2016)	$30.00	Acoustics in Outdoor Applications reviews the analysis steps required to avoid noise complaints caused by outdoor HVAC equipment. Topics include equipment and sound attenuation selection, equipment location, sound ordinances, barrier walls, reflective surfaces and sound power to sound pressure conversion calculations.
APP-CMC061-EN	Trends in Small Rooftop Systems (March 2017)	$30.00	A large number of buildings use small, packaged rooftop units for HVAC. This ENL will discuss several recent regulatory changes and technology advances that affect systems using this class of equipment.
APP-CMC062-EN	HVAC Myths and Realities (May 2017)	$30.00	This ENL addresses various "myths," claims, and misunderstandings in the HVAC & R market place. Topics will include energy efficiency claims, system performance, acoustics, technologies, and others. Each myth will be explored with respect to why it "seems correct on the surface." This will be followed by technically correct details, examples and situations so building owners, operators and project teams can evaluate the likelihood of actually realizing claimed effectiveness, performance and savings.

Order Number	Title (Program Date)	Price	Abstract
APP-CMC063-EN	High-Performance Air Systems (September 2017)	$30.00	This program will discuss the properties of high-performance air systems and provide guidance on their design. Air handling equipment design best practices such as right-sizing and proper component selection will be discussed in detail. Duct design guidelines including velocity and fitting placement will complete the air distribution system. System control strategies and damper control strategies will be briefly reviewed. Also included: selection for part-load operation and part-load efficiency requirements, economics of oversizing, and comparisons to traditional air-handling systems. (75 minutes)
APP-CMC064-EN	Demand Response in Commercial Buildings (October 2017)	$30.00	This program discusses the relevant improvements that load shifting and demand response can provide, with examples of the types of utility and funding programs that are available.
APP-CMC065-EN	Chilled-Water System Decisions (March 2018)	$30.00	Many chilled-water system decisions are made during the course of the design process. Those design decisions and the specific application lead to other system decisions – such as bypass line sizing and length, pump location, use of pressure independent valves, buffer tank size, etc. This ENL covers the reasons for many system decisions in a more "millennial" format than previous ENLs.
APP-CMC066-EN	Controls Communication Technologies (May 2018)	$30.00	Recent innovations in the industry have made open, standard communication protocols that deliver flexible, interoperable control systems more prevalent today. This ENL will review these various communication protocols (using both wired and wireless technologies), discuss where each best applies, and describe ways to ensure the needs of the owner are met. (60 minutes)
APP-CMC067-EN	Demand-Controlled Ventilation (October 2018)	$30.00	The mobility of a building's occupants poses a ventilation challenge: To bring enough outdoor air into the building to help ensure good indoor air quality without wasting energy by bringing in (and conditioning) too much. This ENL will discuss various methods used to vary outdoor airflow based on actual demand. It also review the related requirements for compliance with ASHRAE Standards 62.1 and 90.1.
APP-CMC068-EN	Controls for Small Rooftop Systems (March 2019)	$30.00	Recent innovations provide several options to consider for controls in smaller buildings. This ENL will review different packaged rooftop system configurations (single-zone constant-volume, single-zone VAV, changeover bypass, changeover VAV, and multiple-zone VAV with terminal heat) and discuss the advantages and limitations of technology options available to control each system. And we'll demonstrate how to specify the controls to best meet the needs of the client.
APP-CMC069-EN	Selecting Chilled-Water Coils for 15®F ΔT: ASHRAE 90.1's New Requirement (May 2019)	$30.00	The 2016 version of ASHRAE Standard 90.1 requires many chilled-water cooling coils be selected for at least a 15°F ΔT. This ENL will review this new requirement, demonstrate the process for selecting coils to meet this ΔT requirement, and discuss related impacts on chiller plant design and operation.

NOTE: Many of the programs have an accompanying *Engineers Newsletter*. Current and past versions of the *Engineers Newsletter* are available on the Trane Web site at http://www.trane.com/engineersnewsletter.

HVAC System Design Tools

Order Number	Title (Pub. Date)	Price	Abstract
94.24	Ductulator® (2011) • Dual units (IP/SI)	$12.00	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.
1-43.190	Psychrometric Chart (1983) • standard altitude (29.921 in. Hg) • 11” x 17” pad of 25 sheets • I-P units • Includes "coil curves"	$10.00	Chart used for determining properties of moist air and analyzing air conditioning processes.
1-43.191	Psychrometric Chart (1983) • standard altitude (29.921 in. Hg) • (1) 11” x 17” laminated chart • I-P units • Includes "coil curves"	$15.00	(see above)
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