



Certifying the
finest in HVACR

CHP-5

Electrical and Controls

KATE

Knowledge Areas of
Technician Expertise

www.NATEX.org



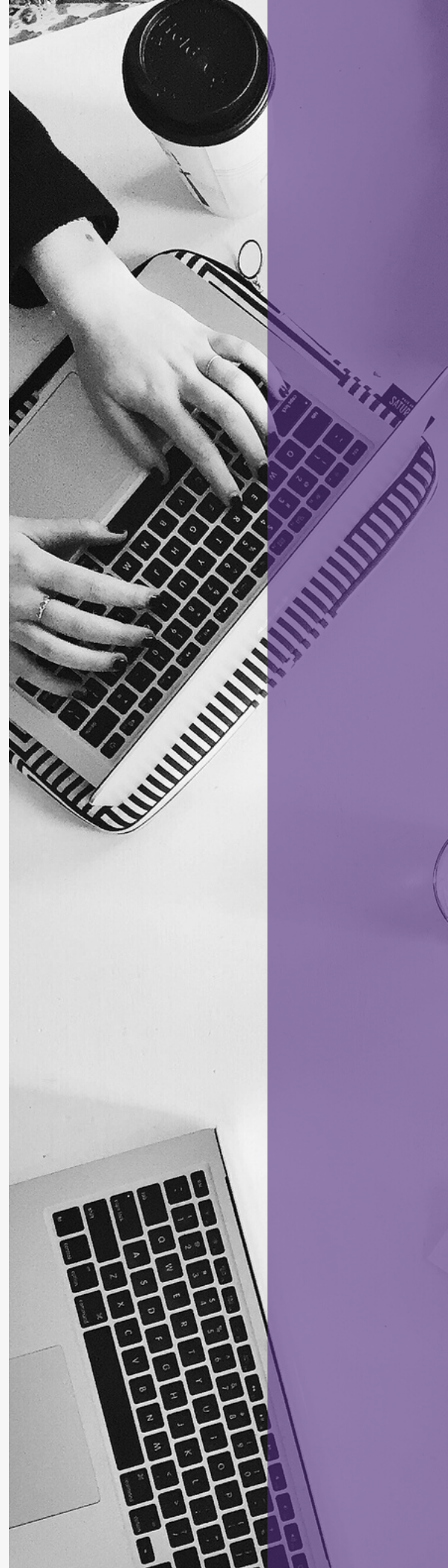
Table Of Contents

03 Exam Information

04 Exam Subject Areas
& Specifications

05 Industry References

07 KATES



CHP-5: Electrical and Controls Exam

Exam Information & Qualifications



The Certified HVAC Professional (CHP-5): Electrical and Controls exam tests a candidate's knowledge of the installation, service, maintenance, and repair of HVAC systems. This is a test and certification for technicians in the HVAC industry. The test is designed for top level technicians. This test for certification is not intended for the HVAC system designer, sales force, or the engineering community.

To become NATE-certified, you must pass all five of the Certified HVAC Professional exams (HVAC Fundamentals, Electrical and Controls, Comfort and Air Flow, Installation, and Service). This test will measure what 80% of candidates have an 80% likelihood of encountering at least once during the year on a national basis.

Exam Copyrights

All testing documents and questions are the copyrighted property of North American Technician Excellence Inc. NATE. It is forbidden under federal copyright law to copy, reproduce, record, distribute or display these documents or questions by any means, in whole or part, without written permission from NATE. Doing so may subject you to severe civil and/or criminal penalties, including imprisonment and/or fines for criminal violations.



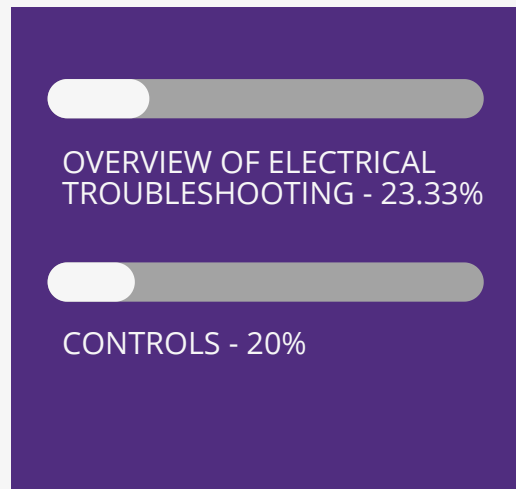
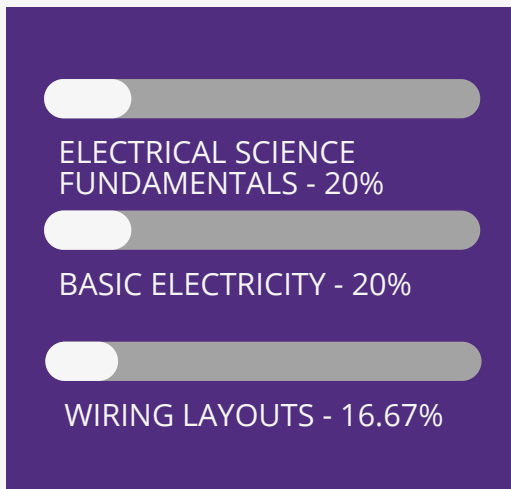
Passing Score Development Process



The passing scores for the NATE tests were established using a systematic procedure (a Passing Score Study). This procedure employed the judgment of experienced HVAC professionals and educators representing various HVAC specialties and geographical areas. The passing scores were set using criteria defining competent performance. The passing score for different test forms may vary slightly due to the comparative difficulty of the test questions.

Exam Subject Areas

Percentages of questions that will be in each section of the exam:



Exam Specifications:



Passing Score: Pass/Fail



1 Hour Time Limit



Closed Book



30 Questions

Industry References

The reference materials list below will be helpful in preparing for this exam. These materials may not contain all of the information necessary to be competent in this specialty or to pass the exam.



- American National Standards Institute (ANSI) / Air Conditioning Contractors of America (ACCA) Manuals – Latest Edition.
 - Manuals “D” “J” “QI” – Quality Installation, and “S”
- ACCA Manuals “T” and “RS” – Latest Editions
- ACCA Residential Duct Diagnostics and Repair – Latest Edition
- AHRI-Hydronics Section – IBO/RAH – Latest Edition
- International Energy Conservation Code - Latest Edition with Addendum
- International Mechanical Code - Latest Edition with Addendum
- International Plumbing Code - Latest Edition with Addendum
- Uniform Mechanical Code - Latest Edition with Addendum
- Specification of Energy-Efficient Installation and Maintenance Practices for Residential HVAC Systems developed by Consortium for Energy Efficiency (CEE) - Latest Edition with Addendum

References continue on next page

Industry References (continued)

- ASHRAE Standard-62.2 - Latest Edition with Addendum
- ANSI//ASHRAE Standard- 152-2004 – Latest Edition with Addendum
- ENGERY STAR™ Home Sealing Standards – Latest Edition with Addendum
- Duct Calculators – Sheet Metal, Ductboard, and Flexible Duct
- American National Standards Institute (ANSI)/Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Manuals
 - HVAC Duct Construction Standards - Metal and Flexible
- Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Manuals
 - Fibrous Glass Duct Construction Standards, Residential Comfort System Installation Standards Manual, and HVAC Air Duct Leakage Test Manual
- Air Diffusion Council Flexible Duct Performance & Installation Standards
- North American Insulation Manufacturers Association (NAIMA) Manuals
 - Fibrous Glass Duct Construction Standards and A Guide to Insulated Air Duct Systems
- International Fuel Gas Code – Latest Edition with Addendum
- National Fuel Gas Code – Latest Edition with Addendum



KATES

Knowledge Areas of Technician Expertise

All NATE exams are based on Knowledge Areas of Technician Expertise (KATES), statistically proven job task analysis from experts in the HVACR industry. This KATES outline covers all information tested in the **CHP-5: Electrical and Controls Exam** and should be used as reference material.

Electrical Science Fundamentals

- Electrons in Electricity
 - Fundamental electrical concepts
 - Electrical charge
 - Conductors
 - Insulators
 - Dielectrics
- Electrical Basic Terms
 - Voltage
 - Amps - milliamps, microamps, etc.
 - Resistance - Ohm's, megohms, etc.
 - Power - watts
- Magnetism
 - Magnetic principles in electricity
 - Magnetic components - coils
 - Magnetic components - transformer
- AC and DC Circuits
 - Simple DC circuit
 - Basic control and loads Polarity
 - Ohm's Law in DC circuits
 - Introduction to AC circuits
 - Effects of AC on controls and loads
- Basic Circuit Analysis
 - Difference between AC & DC power Series circuits
 - Parallel circuits
 - Ohm's Law
 - Current distribution in multiple load circuits
 - Complex circuits
- Electricity - Generation and Distribution
 - Intro to electrical distribution
 - Transformer distribution
 - Impact of available electrical power on equipment
- Solid State Electronics
 - Intro to electrical distribution
 - Transformer distribution
 - Impact of available electrical power on equipment

KATES

Knowledge Areas of
Technician Expertise

Basic Electricity

- Symbols
 - Introduction to basic symbols
 - Symbol standards
 - Use of symbols in diagrams
- Field Wiring Diagrams
 - Basics of field diagram layout
 - Use of field diagrams
- Pictorial Diagrams
 - Basics of pictorial diagram layouts
 - Use of pictorial diagrams
- Schematic (Ladder) Diagrams
 - Basics of schematic (ladder) diagram layouts
 - Reading schematics for determining sequences
 - Reading schematics for wiring connections
- Single Phase Motors
 - Types Components
 - Operating principles
 - Selecting single phase motors
 - Torque characteristics
 - Tapped multi-speed
- Three Phase Motors
 - Types
 - Rotation
 - Selecting multi-phase motors
 - Components
 - Operating principles
 - Torque characteristics
- Constant Airflow Motors
 - Variable speed motors - ECM, BPM, and VSIM
 - Motor mounting and installation requirements
 - Electronic interface and setting for airflow requirements
 - Actuator Motors
 - Overview of damper motors
 - Dual position
 - Proportional

KATES

Knowledge Areas of
Technician Expertise

Basic Electricity (continued)

- Digital Electrical Meters
 - Identify meters and instruments
 - Digital electrical meters - use and setups
 - Resistance measurements
 - Meter calibration and maintenance
 - Milliampere measurements
 - Voltage measurements
 - Amperage measurements
 - Use with temperature probes
 - RMS - correction and meter types
 - Millivolt measurements
- Field Wiring
 - Connecting electrical power
 - Connecting control circuits
 - Meeting manufacturer sizing requirements - wiring sizing (size and number)
- Electrical Components
 - Overcurrent protection
 - Solenoids
 - Capacitors
 - Crankcase heaters
 - Auxiliary strip heat
 - Transformers

Wiring Layouts

- Power Wiring
 - Overview of power wiring
 - Single phase wiring
 - Three-phase wiring
 - Power wiring for package unit furnace
 - Power wiring for split system furnace
- Low Voltage
 - Overview of low voltage wiring
- Control Sequence
 - Overview of control sequence in split systems
 - Overview of control sequence in packaged systems

KATES

Knowledge Areas of
Technician Expertise

Overview of Electrical Troubleshooting

- Low Voltage Circuits
 - Voltage tests
 - Control string analysis
 - Understanding the logic of low voltage troubleshooting
 - Troubleshooting equipment with electronic devices
 - Troubleshooting with schematics
 - Equipment continuity tests
 - Troubleshooting without schematics
 - Current tests
 - Ground tests
- Line Voltage Circuits
 - Voltage tests
 - Circuit tracing line voltages
 - Ground tests
 - Current tests
 - Component tests
 - Troubleshooting with schematics
 - Troubleshooting without schematics
 - Equipment continuity tests
- Electrical Checks
 - Supply checks
 - Indoor auxiliary heat circuits
 - Reversing valve solenoid circuits
 - Compressor circuits
 - Condenser fan circuits
 - Indoor blower circuits
 - Thermostat circuits
 - Transformer circuits
 - Electronic controllers - input / output
 - Defrost control circuits

KATES

Knowledge Areas of
Technician Expertise

Overview of Electrical Troubleshooting (continued)

- Component Checks - Electrical
 - Compressor
 - Low ambient controls for cooling
 - Overcurrent protection
 - Indoor blowers
 - Solenoid valves coils
 - Outdoor thermostats
 - Thermostat
 - Crankcase heaters
 - Transformers
 - Relays and contactors
 - Pressure controls
 - Condenser fans
 - Capacitors
 - Start relays
 - Defrost termination control
 - Defrost controls
 - Reversing valve coils

Controls

- Installing Thermostats
 - Locating and mounting
 - Wiring electromechanical thermostats
 - Wiring electronic thermostats
 - Programming of electronic thermostats
- Overview of Electronic Controllers
 - Input/output operations
 - Logic
- Electronic Thermostats
 - Fundamentals of electronic thermostats
 - Selecting electronic thermostats
 - Overview of electronic thermostat operation
 - Fossil fuel kits
- Electronic Timers
 - Introduction to blower delay timers

KATES

Knowledge Areas of
Technician Expertise

Controls (continued)

- Electromechanical Wall Thermostats
 - Basic thermostat types and operation
 - Using electromechanical thermostats
 - Selecting wall thermostats and sub-bases
 - Thermostat terminals and wiring
 - Selecting location
- Electromechanical Temperature Controls
 - Introduction to bimetal controls
 - Fossil fuel kits
 - Disc type temperature limit controls
 - Fuses and fuse links
 - Motor overloads
- Pressure Controls
 - Operation of pressure controls
 - Combustion air proving (pressure) switch
 - Using pressure controls
- Relays and Contactors
 - Introduction to relays and contactors
 - Basics of relay and contactor operation - inrush and holding
 - Application considerations for relays and contactors
 - Selecting relays and contactors
- Gas Valves - Single Stage
 - Basics of construction
 - Basics of operation
 - Slow opening valves
 - Snap opening valves
 - Step opening valves
- Gas Valves - Two Stage
 - Basics of construction
 - Basics of operation