

HVAC Service Technicians Training Center

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Integrated Refrigeration/Air Conditioning Systems: Evaluation & Diagnostics (IRD-1)

DAY 1

SUBJECT: Course Introduction and Expectations; Prior Knowledge
Evaluation and Review of Prior Studies of HVAC/R Electricity

**OBJECTIVES/
SUBJECT
CONTENTS** State the objectives of the course
State the instructor's expectations and student responsibilities
Identify areas of electrical knowledge requiring further study. (Star B7)

**METHODS/
TECHNIQUES:** Lecture, Hands-on, Lab-rooms required: Systems room,
Electrical Room

RESOURCES: Customized study guide and training materials (BMMSA)
Mechanical Systems Diagnostics
UASTAR Study Guide

EVALUATION: Weekly Quiz
Performance-based (Hands-on live equipment)

DAY 2

SUBJECT: Single Phase Motor Testing and Diagnostics, including: amping-out motors; testing motor starting relays, centrifical switches and capacitors. Schematic reading and circuit wiring for contactors, switching relays and motor control.

GOAL: Measure contactor coil and contact resistances
Check appropriateness of contactor in systems

OBJECTIVES: Verify transformer output and operation. (Star B8)
Check control fuses. (StarB8)
Verify thermostat operation. (StarB8)
Diagnose contactors and switching relays.
Check all operational and safety controls (pressure controls; lube-oil protection)

**METHODS/
TECHNIQUES:** Lecture, Hands-on, Lab-rooms required: Systems room,
Electrical Room

RESOURCES: Customized study guide and training materials (BMMSA)

Mechanical Systems Diagnostics
UASTAR Study Guide

EVALUATION: Weekly Quiz
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DAY 3

SUBJECT: Three Phase Motor Testing and Diagnostics, including: checking for phase balance; amping out and megging motors; motor starters/controllers and overload protectors. Schematic reading and circuit wiring for thermostats and control panels.

GOAL: Inspect motor bearings and shaft
Inspect motor wiring and insulation with megger

OBJECTIVES: Determine motor type and requirements (horsepower, voltage, type or wiring, etc.) (Star B9)
Size the motor and frame. (Star B9)
Inspect termination & Identify single phase motor terminals or leads; reterminate. (Star B9)
Test motor starting relays, and centrifugal switches.
Test capacitors.
Wire a single phase motor to a control panel.
Verify supply voltage and amp-out single phase motors.

METHODS/
TECHNIQUES: Lecture, Hands-on, Lab-rooms required: Systems room, Electrical Room

RESOURCES: Customized study guide and training materials (BMMSA)
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DAY 4

SUBJECT: Diagnosing Electrical Accessories, Controls and Control Circuits, including: transformers; Thermostats; contactors; switching relays; pressure controls; lube-oil protection switches; and solenoid and four-way valves

GOAL: Inspect condition of breaker
Perform visual inspection of and check circuit board inputs and outputs

OBJECTIVES: Meg a three phase motor. (Star B9)
Read a three phase motor wiring diagram
Verify three phase voltage and power supply (Star B8/B11).
Diagnose distribution problems, phase and current imbalance, phase loss, phase reversal, phase shift, power factor (Star B8)
Amp-out a three phase motor and check for current imbalance. (Star B11)
Diagnose motor starters and overload protectors. (Star B8)

METHODS/ TECHNIQUES: Lecture, Hands-on, Lab-rooms required: Systems room, Electrical Room

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DAY 5

SUBJECT: Diagnosing Electrical Condenser Fan Controls

GOAL: Perform visual/auditory inspection of the unit oil residue, frost, wear on copper tubing, damaged piping, hissing sound

OBJECTIVES: Diagnose electrical controls for condenser fans. (Star B12)
Test solenoids and valve operation for liquied line, de-icing, hot gas bypass, and four-way reversing valves, etc. (Star B11)
Verify operation of resistance heating elements (crankcase heaters, de-icing heaters, etc.)

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DAY 6

SUBJECT: Diagnosing Solid State Controls

GOAL: Check charge based on condenser subcooling

OBJECTIVES: Determine function of board or module. (Star B10)
Set jumpers or dip switches as required. (Star B10)
Follow vendor procedures to install board. (Star B10)
Perform visual inspection of board. (Star B10)
Check inputs and outputs. (Star B10)
Program unit. (Star B10)
Replace board. (Star B10)

**METHODS/
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Electrical Room

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DAY 7

SUBJECT: Midterm Evaluation and Review

GOAL: Check charge based on highside and lowside pressure
temperature relationships

OBJECTIVES: Pass a multiple choice exam with a minimum grad of 75%
accuracy.

**METHODS/
TECHNIQUES:** Lecture, Hands-on, Lab-rooms required: Systems room,
Electrical Room

RESOURCES: Customized study guide and training materials (BMMSA)
Mechanical Systems Diagnostics
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EVALUATION: Weekly Quiz
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DAY 8

SUBJECT: Air Conditioning System Diagnostics: Introduction and Prior
Knowledge Evaluation.

GOAL: Check charge based on evaporator superheat
Lock out and tag; isolate pressure sensitive components

OBJECTIVES: Identify types of air conditioning systems (i.e., self contained, split, built up, etc.) (Star D22)
State saturated conditions at off cycle for an R-22 system
State standard low-side design conditions for an R-22 system
State standard high-side design conditions for an R-22 system

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TECHNIQUES:** Lecture, Hands-on, Lab-rooms required: Systems room,
Electrical Room

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DAY 9

SUBJECT: Airside System Diagnostics.

GOAL: Check ventilation system capacity

OBJECTIVES: Measure air duct openings
Calculate free area of air duct outlets
Measure air velocity
Measure and/or calculate supply/return air volume
Measure air duct static, velocity and total pressure.
Check fan/blower speed.
Check for wear condition and tension or blower belts (Star D21)
Verify *matching* blower belts.

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DAY 10

SUBJECT: Air Conditioning Cooling System Diagnostics: Lowside

GOAL: Troubleshoot fans and air handling equipment
Lock out and tag air handling equipment

OBJECTIVES: Check lowside operating conditions, pressure, temperature and temperature split. (Star D21)
Analyze operating conditions based on design criteria.
Diagnose variations between operating conditions and design criteria.
Analyze system charge based on lowside operating conditions.

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DAY 11

SUBJECT: Air Conditioning Cooling System Diagnostics: Highside

GOAL: Check system capacity and charge based on psychrometrics

OBJECTIVES: Check highside operating conditions, pressure temperature and temperature split. (Star D21)
Check pressure and temperature drop across dryer. (Star D34)
Troubleshoot/install metering devices. (Star D 33)

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DAY 12

SUBJECT: Integrated Diagnostics

GOAL: Inspect indoor air quality using air sniffers
Check belt tension; replace belts

OBJECTIVES: Inspect and tighten all electrical connections and termination. (Star D21)
Perform visual inspection including inspecting for leaks. (Star D 21)
Inspect covers and panels. (Star D21)
Check cleanliness and operation of blower, compressors, dampers. (Star 21)
Check evaporator fan blades. (Star D21)

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EVALUATION: Weekly Quiz
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DAY 13

SUBJECT: Final Examination and Review

GOAL: Final Exam

OBJECTIVES: Pass a multiple choice exam based on the course and UA STAR sample questions with a minimum accuracy of 75%.

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TECHNIQUES:** Lecture, Hands-on, Lab-rooms required: Systems room, Electrical Room

RESOURCES: Customized study guide and training materials (BMMSA)
Mechanical Systems Diagnostics
UASTAR Study Guide

EVALUATION: Weekly Quiz
Performance-based (Hands-on live equipment)