



**ONTARIO COLLEGE OF TRADES**  

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**ORDRE DES MÉTIERS DE L'ONTARIO**

Apprenticeship  
Curriculum Standard

Residential Air Conditioning  
Systems Mechanic  
Branch 2

Level 2 Intermediate

Trade Code: 313D

Date: 2008

**Please Note:** Apprenticeship Training and Curriculum Standards were developed by the Ministry of Training, Colleges and Universities (MTCU). As of April 8<sup>th</sup>, 2013, the Ontario College of Trades (College) has become responsible for the development and maintenance of these standards. The College is carrying over existing standards without any changes.

However, because the Apprenticeship Training and Curriculum Standards documents were developed under either the *Trades Qualification and Apprenticeship Act* (TQAA) or the *Apprenticeship and Certification Act, 1998* (ACA), the definitions contained in these documents may no longer be accurate and may not be reflective of the *Ontario College of Trades and Apprenticeship Act, 2009* (OCTAA) as the new trades legislation in the province. The College will update these definitions in the future.

Meanwhile, please refer to the College's website (<http://www.collegeoftrades.ca>) for the most accurate and up-to-date information about the College. For information on OCTAA and its regulations, please visit: <http://www.collegeoftrades.ca/about/legislation-and-regulations>

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## **Introduction**

This curriculum revision for the Level 2 – **Residential Air Conditioning Systems Mechanic** is based upon the on-the-job performance objectives, located in the industry-approved training standard.

The curriculum is organized into 6 reportable subjects. The Program Summary of Reportable Subjects chart summarizes the training hours for each reportable subject.

The curriculum identifies only the learning that takes place off-the-job. The in-school program focuses primarily on the theoretical knowledge and the essential skills required to support the performance objectives of the Apprenticeship Training Standards. Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on the work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to ensure that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

**Program Summary of Reportable Subjects – Level 2 – Intermediate  
 Residential Air Conditioning Systems Mechanic**

<b>Number</b>	<b>Reportable Subjects</b>	<b>Hours Total</b>	<b>Hours Theory</b>	<b>Hours Practical</b>
S0738.0	Applied Psychrometrics - Residential	21	6	15
S0739.0	Prints and Heat Load Calculations - Residential	18	3	15
S0740.0	Air Conditioning Systems - Residential	60	39	21
S0741.0	Air Distribution Systems and Accessories - Residential	36	24	12
S0742.0	Residential Electrical and Control Systems	81	39	42
S0743.0	Electronic Devices and Controls - Residential	24	12	12
	<b>Total</b>	<b>240</b>	<b>123</b>	<b>117</b>

Residential Air Conditioning Systems Mechanic – 313D - Branch 2  
Level 2

Number: **S0738**

Title: **APPLIED PSYCHROMETRICS - RESIDENTIAL**

Duration: Total 21 hours Theory 6 hours Practical 15 hours

Prerequisites: L1CC – S0731, S0732, S0733, S0734, S0735,  
S0736, S0737

Content:

- S0738.1 Describe psychrometric terms and conditions related to the performance of residential air conditioning systems. **(2 / 0 hrs)**
- S0738.2 Describe processes involving alterations to the conditions of a mixture of dry air and water vapour. **(4 / 0 hrs)**
- S0738.3 Demonstrate procedures for constructing and analyzing psychrometric diagrams to determine residential air conditioning system operating parameters. **(0 / 15 hrs)**

Evaluation & Testing: Assignments related to theory and application skills  
Minimum of one mid-term test during the term  
Final test at end of term  
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
30%	70%	100%

Instructional and Delivery Strategies: Lecture  
Video  
Paper based material  
Demonstration – Practical Lab Assignments  
CBT  
E-Learning



Residential Air Conditioning Systems Mechanic – 313D - Branch 2  
Level 2

Reference Materials:

- Occupational Health and Safety Manual for Refrigeration and Air Conditioning
- Dangerous Goods Transportation Act
- Workplace Hazardous Materials Information System
- Occupational Health and Safety Act and Regulations for Construction Projects
- Environmental Code of Practice for the Reduction of Chlorofluorocarbon (ODP program)
- Emissions from Refrigeration and Air Conditioning Systems
- Modern Refrigeration and Air Conditioning (Althouse, Turnquist & Bracciano)
- Applicable Software Training Materials
- Manufacturers' Literature
- Applicable Acts, Regulations, Legislation, and Codes
  - Ontario Fire Code
  - Canadian Electrical Code
  - Boiler Pressure Vessels Act
  - Mechanical Refrigeration Code CSA B52
  - Provincial and Federal Halocarbon Regulations
  - TSSA (Technical Standards and Safety Act)
  - Building Code
  - Municipal Codes

## **S0738.0 Applied Psychrometrics - Residential**

Duration: Total 21 hours Theory 6 hours Practical 15 hours

Cross-Reference to Training Standards:

313D: U6230.0, U6231.0, U6233.0, U6234.0, U6235.0, U6236.0

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### **GENERAL LEARNING OUTCOME**

Upon successful completion, the apprentice will be able to interpret a psychrometric graph, construct psychrometric diagrams, analyze psychrometric diagrams, and interpret a psychrometric process for air conditioning (A/C) systems in a residential location.

### **LEARNING OUTCOMES AND CONTENT**

- 38.1 Describe psychrometric terms and conditions related to the performance of residential air conditioning systems. **(2 / 0 hrs)**

Describes the conditions required to maintain body comfort including:

- metabolism rate
- body heat loss
- body heat gain
- effective temperatures

Identify terms relevant to the condition of a mixture of dry air and water vapour including:

- composition of air
- enthalpy
- density
- barometric pressure
- wet bulb temperatures
- dry bulb temperatures
- dew point temperatures
- specific and relative humidity

- 38.2 Describe processes involving alterations to the conditions of a mixture of dry air and water vapour. **(4 / 0 hrs)**

Interpret processes on psychrometric charts and tables including:

- sensible heating and cooling
- humidification and dehumidification
- heating and humidification
- cooling and dehumidification
- air mixtures

- 38.3 Demonstrate procedures for constructing and analyzing psychrometric diagrams and processes to determine residential air conditioning system operating parameters. **(0 / 15 hrs)**

Demonstrate the construction of psychrometric diagrams.

Interpret the operation of an air conditioning system using psychrometric charts and tables including:

- entering and leaving air-conditions
- apparatus dew point
- cooling coil bypass factor
- airflow quantities
- system capacity
- air mixtures

Describe procedures for documenting system operating information including:

- entering and leaving air-conditions
- apparatus dew point
- cooling coil bypass factor
- airflow quantities
- cooling system capacity

Residential Air Conditioning Systems Mechanic – 313D - Branch 2  
Level 2

Number: **S0739**

Title: **PRINTS AND HEAT LOAD CALCULATIONS - RESIDENTIAL**

Duration: Total 18 hours Theory 3 hours Practical 15 hours

Prerequisites: L1CC – S0731, S0732, S0733, S0734, S0735, S0736, S0737

Content:

- S0739.1 Interpret building drawings for the design of a residential structure that includes an air conditioning system. **(3 / 5 hrs)**
- S0739.2 Demonstrate freehand sketching for residential air conditioning installations. **(0 / 2 hrs)**
- S0739.3 Describe the impact of heat sources on residential air conditioning applications. **(0 / 2 hrs)**
- S0739.4 Perform simple heat gain and heat loss calculations for residential comfort cooling applications. **(0 / 6 hrs)**

Evaluation & Testing: Assignments related to theory and application skills  
Minimum of one mid-term test during the term  
Final test at end of term  
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
20%	80%	100%

Instructional and Delivery Strategies: Lecture  
Video  
Paper based material  
Demonstration – Practical Lab Assignments  
CBT  
E-Learning

Reference Materials:

- Occupational Health and Safety Manual for Refrigeration and Air Conditioning
- Dangerous Goods Transportation Act
- Workplace Hazardous Materials Information System
- Occupational Health and Safety Act and Regulations for Construction Projects
- Environmental Code of Practice for the Reduction of Chlorofluorocarbon (ODP program)
- Emissions from Refrigeration and Air Conditioning Systems
- Modern Refrigeration and Air Conditioning (Althouse, Turnquist & Bracciano)
- Applicable Software Training Materials
- Manufacturers' Literature
- Applicable Acts, Regulations, Legislation, and Codes
  - Ontario Fire Code
  - Canadian Electrical Code
  - Boiler Pressure Vessels Act
  - Mechanical Refrigeration Code CSA B52
  - Provincial and Federal Halocarbon Regulations
  - TSSA (Technical Standards and Safety Act)
  - Building Code
  - Municipal Codes

## **S0739.0      Prints and Heat Load Calculations - Residential**

Duration:      Total 18 hours    Theory 3 hours    Practical 15 hours

Cross-Reference to Training Standard:

U6230; U6231; U6232; U6233; U6234; U6235; U6236

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### **GENERAL LEARNING OUTCOME**

Upon successful completion, the apprentice will be able to interpret drawings and plans, demonstrate sketching procedures, and perform simple heat gain and heat loss calculations for a residential air conditioning system.

### **LEARNING OUTCOMES AND CONTENT**

39.1 Interpret building drawings for the design of a residential structure that includes an air conditioning system. **(3 / 5 hrs)**

Interpret isometric, orthographic and multi-view drawings and manuals to identify the location and size of mechanical equipment and components.

Describe function of lines used in the production of working drawings including:

- object
- dimension
- extension
- projection
- hidden

Identify the symbols, abbreviations, and nomenclature used in typical drawings and installation manuals.

Identify symbols used on mechanical system drawings including:

- piping
- motors
- compressors
- air moving devices
  - fans
  - blowers
- evaporators
- condensers
- metering devices
- pumps

Determine the precise location and size of mechanical components.

Determine lengths of piping runs by scaling the drawings.

39.2 Demonstrate freehand sketching for residential air conditioning installations.  
**(0 / 2 hrs)**

Demonstrate freehand sketching to locate and position equipment for air conditioning installations including:

- condensing units
- refrigerant piping layout

Demonstrate freehand sketching for the fabrication of items required for installations including:

- duct transitions
- plenums
- filter racks
- brackets for piping
- brackets for condensing units

39.3 Describe the impact of heat sources on residential air conditioning applications.  
**(0 / 2 hrs)**

Identify heat sources for a residence including:

- heat leakage into the building
- air leakage into the building
- ventilation air
- solar load
- appliances
- lighting
- heat gain from occupants
- heat lag

Describe how heat sources impact applications.

39.4 Perform simple heat gain and heat loss calculations for residential comfort cooling applications. **(0 / 6 hrs)**

Identify pertinent information used for determining residential heat gain or heat loss including:

- job survey
- buildings plans
- design conditions as per Ontario Building Code
- geographical location
- building dimensions
- building orientation
- room sizes and use
- type of wall construction
- roof construction
- roofing colour
- type and thickness of insulation
- insulation and vapour barriers
- degree-day
- R, K, U and C factors
- location, type and size of windows
- location, type and size of doors
- heat emitting equipment
- occupancy

Calculate heat gain and heat loss for residential applications.



Residential Air Conditioning Systems Mechanic – 313D - Branch 2  
Level 2

Number: **S0740**

Title: **RESIDENTIAL AIR CONDITIONING SYSTEMS**

Duration: Total 60 hours Theory 39 hours Practical 21 hours

Prerequisites: L1CC – S0731, S0732, S0733, S0734, S0735,  
S0736, S0737

Content:

- S0740.1 Describe operating principles and function of heat pumps. **(3 / 1 hrs)**
- S0740.2 Describe operating principles and function of refrigerant piping in residential air conditioning systems. **(3 / 1 hrs)**
- S0740.3 Describe installation procedures for residential air conditioning systems. **(6 / 6 hrs)**
- S0740.4 Describe procedures for troubleshooting and servicing residential air conditioning systems. **(20 / 10 hrs)**
- S0740.5 Describe verification procedures for residential air conditioning control systems. **(1 / 1 hrs)**
- S0740.6 Describe procedures for troubleshooting problems in residential air conditioning systems. **(6 / 2 hrs)**

Evaluation & Testing: Assignments related to theory and application skills  
Minimum of one mid-term test during the term  
Final test at end of term  
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
65%	35%	100%

Residential Air Conditioning Systems Mechanic – 313D - Branch 2  
Level 2

Instructional and Delivery Strategies:   Lecture  
  Video  
  Paper based material  
  Demonstration – Practical Lab Assignments  
  CBT  
  E-Learning

Reference Materials:

Occupational Health and Safety Manual for Refrigeration and Air Conditioning  
Dangerous Goods Transportation Act  
Workplace Hazardous Materials Information System  
Occupational Health and Safety Act and Regulations for Construction Projects  
Environmental Code of Practice for the Reduction of Chlorofluorocarbon (ODP program)  
Emissions from Refrigeration and Air Conditioning Systems  
Modern Refrigeration and Air Conditioning (Althouse, Turnquist & Bracciano)  
Applicable Software Training Materials  
Manufacturers' Literature  
Applicable Acts, Regulations, Legislation, and Codes

- Ontario Fire Code
- Canadian Electrical Code
- Boiler Pressure Vessels Act
- Mechanical Refrigeration Code CSA B52
- Provincial and Federal Halocarbon Regulations
- TSSA (Technical Standards and Safety Act)
- Building Code
- Municipal Codes

## **S0740.0 Residential Air Conditioning Systems**

Duration: Total 60 hours Theory 39 hours Practical 21 hours

Cross-Reference to Training Standard: U6231; U6232; U6233; U6234; U6235; U6236

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### **GENERAL LEARNING OUTCOME**

Upon successful completion, the apprentice will be able to describe procedures for installing, maintaining, and servicing residential air conditioning (A/C) systems.

### **LEARNING OUTCOMES AND CONTENT**

#### **40.1 Describe the operating principles and function of heat pumps. (3 / 1 hrs)**

Describe the operating principles and function of a heat pump including:

- cooling cycle
- heating cycle
- defrost cycle
- air to air
- ground or water source

Identify the operating temperatures and pressures for a heat pump including:

- cooling cycle
- heating cycle
- defrost cycle

Describe operating principles and functions of heat pump accessories including:

- liquid indicators
- moisture indicators
- accumulators
- crankcase heaters
- four way valves
- solenoid valves
- check valves
- pressure relief valves
- sound attenuators
  - mufflers
  - compressor insulating jackets

Describe troubleshooting procedures for identifying problems that can occur with heat pump accessories.

40.1 Continued

Describe procedures to maintain heat pump accessories including:

- inspection
- replacement
- repair

Describe the operating principles and function for liquid source heat exchangers utilized in heat pump systems.

Describe the operating principles and function of secondary refrigerant or coolant piping, pumps and accessories required for ground or water source heat pump systems.

Describe troubleshooting procedures for identifying problems that can occur with heat pumps.

Describe procedures for maintaining heat pumps.

40.2 Describe the operating principles and function of refrigerant piping in residential air conditioning systems. **(3 / 1 hrs)**

Interpret the layout for refrigerant piping to ensure the required oil return.

Interpret the refrigerant piping layout to identify:

- compressor safeguards
- shut down requirements
- piping function during operating cycles

Identify the refrigerant piping installation and support methods to ensure:

- minimum damage to piping and equipment
- minimum release of refrigerants

Identify various materials and fittings used to connect piping components including:

- materials
  - copper
  - copper alloys
  - aluminum
  - ferrous alloys
- grades of copper tubing and pipe
- isolating valves
- pipe insulation

## 40.2 Continued

Describe specific requirements and precautions for suction line piping in air conditioning systems.

Identify pipe sizes and quantity for suction lines using:

- manufacturers' specifications
- charts
- tables
- technical literature
- applicable teaching software
- codes and regulations

Describe troubleshooting procedures for identifying problems that can occur with excessive pressure drop or reduced velocity in suction line piping.

Identify specific requirements and precautions for liquid line piping in air conditioning systems.

Identify pipe sizes and quantity for liquid lines using:

- manufacturers' specifications
- charts
- tables
- technical literature
- codes and regulations

Describe liquid-line piping pressure drop or gain as a result of component pressure drop or elevation changes due to refrigerant density.

Identify required sub-cooling for liquid line piping.

40.3 Describe installation procedures for residential air conditioning systems.  
**(6 / 6 hrs)**

Identify residential installation requirements of Acts, Regulations, Legislation, and Codes including:

- unit location
- noise
- seer
- approvals
- required permits
- inspections
- sub-trades

Identify required planning documentation including:

- work orders
- sign-off sheets
- manufacturers' checklists

Describe the operating principles and function of condensing units in air conditioning systems.

Interpret manufacturers' equipment specification and installation manuals to determine unit capacities and physical characteristics.

Describe the operating principles and function of evaporator coil configurations in air conditioning systems including:

- A coil
- inclined coil
- slab coil

Describe the operating principles and function of:

- air handling units and fans
- heat recovery ventilators

Describe installation requirements for heat recovery ventilators in air conditioning systems.

Describe the operating principles and function for energy recovery ventilators in air conditioning systems.

Describe residential installation requirements for energy recovery ventilators.

Describe the operating principles and function for humidifiers in air conditioning systems.

40.4 Describe procedures for troubleshooting and servicing residential air conditioning systems. **(20 / 10 hrs)**

Interpret manufacturers' specifications to verify air conditioning:

- operating pressures
- temperatures
- flow rates
- voltage
- amperage
- power consumption

Describe procedures for maintaining ground loop heat transfer medium in an air conditioning system including:

- inspection
- adjusting
- replacing

Describe procedures for checking the pressure drop across refrigerant filters in air conditioning systems.

Determine the pressure drop across the refrigerant filter.

Describe procedures for replacing a refrigerant filter drier.

Describe the operating principles and application of:

- heat transfer devices
- evaporators
- condensers

Describe procedures for testing evaporators and condensers in air conditioning systems using:

- pressure measuring devices
- temperature measuring devices

Describe troubleshooting procedures for identifying problems that can occur with evaporators and condensers.

Describe maintenance procedures for evaporators and condensers including:

- cleaning
- repairing
- replacing

Identify required heat transfer medium in an air conditioning system including:

- specific gravity/density
- pressures
- flow rates
- velocities

#### 40.4 Continued

Describe procedures for using temperature or pressure differential tests including:

- temperature measuring devices
- pressure measuring devices

Describe the operating principles and function of air handling units and fans in air conditioning systems.

Describe troubleshooting procedures for identifying problems that can occur with air handling units and fans.

Describe maintenance procedures for air handling units and fans including:

- cleaning
- repairing
- replacing

Describe the operating principles and function of air conditioning:

- condensate traps
- drain piping
- drain pans
- condensate pumps.

Describe the operating principles and application of hermetic compressors in air conditioning systems including:

- reciprocating
- scroll
- rotary.

Identify procedures for analyzing the operation of compressors.

Identify reasons for hermetic compressor failure.

Identify procedures for analyzing compressor oil.

Describe troubleshooting procedures for identifying failures that can occur with mechanical or electrical components in air conditioning systems.

Describe maintenance procedures for mechanical or electrical failures including:

- hermetic compressor replacement
- system clean up

Describe the application of suction filters in air conditioning systems.



#### 40.4 Continued

Describe operating principles of refrigerant flow control devices/metering devices used in an air conditioning system including:

- fixed orifice
- capillary tubes
- thermostatic expansion valves
- verification procedures

Describe troubleshooting procedures for identifying problems that can occur with metering devices.

Demonstrate adjustment procedures for refrigerant flow control devices and thermostatic expansion valves used in air conditioning systems.

Determine required system settings including:

- pressures
- temperatures
- superheat
- sub-cooling.

Describe procedures to check that the system contains refrigerant charge.

Identify required tools, instruments, devices, or equipment to perform a diagnosis of the air conditioning system including:

- voltage
- amperage
- power consumption
- equipment rotation

Demonstrate the application of tools, instruments, devices, and equipment including:

- hand tools
- electrical measuring instruments
- pressure measuring devices
- flow measuring devices/meters
- temperature sensing instruments
- specialty tools and instruments

40.5 Describe verification procedures for control systems in residential air conditioning systems. **(1 / 1 hrs)**

Interpret control system design specifications for an air conditioning system using:

- manufacturers' specifications
- charts
- tables
- technical literature
- job documentation
- codes and regulations

Determine required operating control settings.

Describe procedures for rectifying control components on air conditioning systems including:

- testing
- adjusting
- repairing
- replacing

40.6 Describe procedures for troubleshooting problems in residential air conditioning systems. **(6 / 2 hrs)**

Determine the air conditioning system design parameters and settings using:

- charts
- tables
- technical literature
- job documentation
- codes and regulations

Describe procedures for checking, inspecting, and testing the air conditioning system to verify operating conditions.

Describe procedures for identifying faulty conditions, damaged or defective components.

Describe procedures for isolating the major section of the air conditioning system causing the problem.

Describe maintenance procedures or corrective actions that are used for restoring the air conditioning system to design specifications.

Describe procedures to restore air conditioning system operations to design specifications.

Number: **S0741**

Title: **AIR DISTRIBUTION SYSTEMS AND ACCESSORIES - RESIDENTIAL**

Duration: Total 36 hours Theory 24 hours Practical 12 hours

Prerequisites: L1CC – S0731, S0732, S0733, S0734, S0735, S0736, S0737

Content: distribution

S0741.1 Describe the operating principles and function of fans used in residential air distribution systems. **(3 / 1 hrs)**

S0741.2 Identify the components and layout plans for a residential designed room air distribution system. **(2 / 3 hrs)**

S0741.3 Describe the operating principles and function of components in a residential air distribution system. **(12 / 2 hrs)**

S0741.4 Describe the operating principles and application of an air filtration apparatus in a residential air distribution system. **(3 / 0 hrs)**

S0741.5 Describe residential ventilation and indoor air quality requirements. **(2 / 2 hrs)**

S0741.6 Describe verification procedures to check that the residential air distribution system is operating to design parameters. **(2 / 4 hrs)**

Evaluation & Testing: Assignments related to theory and application skills  
Minimum of one mid-term test during the term  
Final test at end of term  
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
67%	33%	100%

Instructional and Delivery Strategies: Lecture  
Video  
Paper based material  
Demonstration – Practical Lab Assignments  
CBT  
E-Learning

Reference Materials:

Occupational Health and Safety Manual for Refrigeration and Air Conditioning

Dangerous Goods Transportation Act

Workplace Hazardous Materials Information System

Occupational Health and Safety Act and Regulations for Construction Projects

Environmental Code of Practice for the Reduction of Chlorofluorocarbon (ODP program)

Emissions from Refrigeration and Air Conditioning Systems

Modern Refrigeration and Air Conditioning (Althouse, Turnquist & Bracciano)

Applicable Software Training Materials

Manufacturers' Literature

Applicable Acts, Regulations, Legislation, and Codes

- Ontario Fire Code
- Canadian Electrical Code
- Boiler Pressure Vessels Act
- Mechanical Refrigeration Code CSA B52
- Provincial and Federal Halocarbon Regulations
- TSSA (Technical Standards and Safety Act)
- Building Code
- Municipal Codes

**S0741.0            Air Distribution Systems and Accessories- Residential**

Duration:            Total 36 hours    Theory 24 hours    Practical 12 hours

Cross-Reference to Training Standard:

U6230; U6231; U6232; U6233; U6234; U6235; U6236

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**GENERAL LEARNING OUTCOME**

Upon successful completion, the apprentice will be able to describe the operating principles and function of air distribution systems in a residential air conditioning application.

**LEARNING OUTCOMES AND CONTENT**

41.1 Describe the operating principles and function of fans used in residential air distribution systems. **(3 / 1 hrs)**

Identify fan components in an air distribution system including:

- bearings
- bushings
- blades
- blowers
- housings
- shafts
- motors

Identify the nomenclature that describe drive arrangements for fans.

Interpret information on a fan performance curve or a fan performance table.

Describe the effects of fan performance on the air distribution system.

Describe features of fan performance in an air distribution system including:

- CFM
- RPM
- system static
- motor horsepower

Describe procedures to check fan:

- drive mechanism alignment
- direction of rotation
- bearings
- air flow
- noise level
- vibration
- balance

41.1 Continued

Describe the operating principles and function of axial and centrifugal fan capacity controls on an air distribution system including:

- static controls
- electronic speed control devices
- inlet vanes

Describe drive systems for fans including:

- pulleys
- belts

Solve problems regarding pulley diameters and speed.

Describe procedures to check for fan vibrations and running amperages.

Describe fan maintenance procedures including:

- replacing damaged pulleys
- replacing damaged fan bearings
- repairing components
- lubricating fan components
- tension adjustment of V-belts

41.2 Identify the components and layout plans for a residential designed room air distribution system. **(2 / 3 hrs)**

Describe characteristics of air including:

- air distribution
- air properties
- air measurements

Describe an Occupied Zone.

Describe elements of a designed room air distribution system including:

- primary air
- secondary air
- stratification.

Describe the comfort characteristics for air being delivered into an occupied Zone of a residence.

41.3 Describe the operating principles and function of components in a residential air distribution system. **(12 / 2 hrs)**

Describe the characteristics of air including:

- air distribution
- air properties
- air measurements

Identify the layout plans for an air distribution system.

Identify air distribution components and equipment including:

- extended plenum duct system
- reducing trunk duct system

Describe the construction and function of air distribution components including:

- material types
- wall thickness
- round versus rectangular
- plenums
- fittings
- directional adjusting devices
- volume dampers
- parallel blade
- opposed blade dampers
- butterfly dampers

Describe the operating principles and function of zoning components including:

- dampers
- actuators
- bearings
- linkages
- wiring

Describe troubleshooting procedures for identifying failures that can occur with the zoning components in a residential air distribution system.

Describe maintenance procedures for zoning components including:

- tools
- equipment
- adjustments
- repairing
- measuring and checking devices

### 41.3 Continued

Describe the operating principles and function of variable volume and variable temperature in air distribution systems including:

- variable air volume (VAV) boxes
- power sources
- associated controls
- components of VAV boxes
- controls
- accessories

Interpret drawings, manufacturers' specifications and manuals to identify the design, settings and parameters of the zoning control in a residential setting.

Determine zoning control parameters including:

- air pressures
- flow rates
- velocities.

Describe procedures to verify that the air distribution system is operating to design specifications including:

- tools
- equipment
- devices
- specialty equipment
- testing procedures
- temperature tests
- pressure differential tests

Describe airflow adjustment procedures for a residential air distribution system.



41.4 Describe the operating principles and application of an air filtration apparatus in a residential air distribution system. **(3 / 0 hrs)**

Describe the advantages of an efficient air filtration system in an air distribution system including:

- reduction in cleaning and maintenance costs
- reduced sick time
- increased cooling system efficiency
- increased life expectancy of equipment

Describe the criteria used in selecting the air filtration equipment including:

- particles in conditioned air
  - size
  - concentration
  - types
- removal of contaminants
- cost effective filtration
  - labour
  - maintenance
  - energy requirements
- pollutant disposal after removal
- resistance to airflow

Identify methods for the removal of air pollutants including:

- straining
- impingement
- interception
- diffusion (HEPA)
- electrostatic filters
- absorbents

Describe the types of filters used to remove air pollutants including:

- panel filters
- dry-type extended filters
- renewable media filters
- electronic air filters

Identify filtration components including:

- controls
- filter racks
- frames
- drive mechanisms
- air-flow sensors

#### 41.4 Continued

Describe the operation and configuration of electronic air cleaners on residential air distribution systems.

Describe inspection procedures for air filters including:

- visually checking
- checking operation of air filters
- measuring static pressure drop across air filter

#### 41.5 Describe residential ventilation and indoor air quality requirements. **(2 / 2 hrs)**

Identify procedures for checking indoor air quality of a residence including:

- air comfort levels
- air system parameters
- types of pollutants
- pollutant removal

Identify mechanical ventilation components and parameters in an air conditioning system including:

- exhaust fans
- building pressurization
- fresh air supply systems
- building ventilation requirements
  - Ontario Building Code (sections 6 and 9)
  - American Society of Heating Refrigeration and Air Conditioning Engineers' Standards
  - Manufacturers' specifications

Describe the operating principles and function of heat recovery ventilators and related controls in an air conditioning system.

Describe troubleshooting procedures for identifying failures that can occur with heat recovery ventilators including:

- discoloration
- odours
- moisture
- corrosion

#### 41.5 Continued

Describe procedures for maintaining heat recovery ventilators in an air conditioning system including:

- visual inspection
- resistance measurements
- checking
- repairing
- replacing

Describe the operating principles and function of energy recovery ventilators and related controls in an air conditioning system.

Describe troubleshooting procedures for identifying failures that can occur with the energy recovery ventilators in air conditioning systems including:

- discoloration
- odours
- moisture
- corrosion

Describe procedures for maintaining energy recovery ventilators including:

- visual inspection
- resistance measurements
- checking
- repairing
- replacing

Describe the operating principles and function of different humidification systems and related controls in an air conditioning system.

Describe the operating principles and function of humidification equipment in a heat exchanger including:

- steam
- ultra-sonic
- atomizing

Describe repair or replacement procedures for defective humidification and dehumidification equipment.

41.6 Describe verification procedures to check that the residential air distribution system is operating to design parameters. **(2 / 4 hrs)**

Interpret manufacturers' specifications to verify air distribution:

- operating pressures
- temperatures
- flow rates
- voltage
- amperage
- power consumption

Describe procedures used to balance an air distribution system in a residence.

Describe the operating principles and function for airflow measuring devices and instruments including:

- U-tube manometers
- inclined manometer
- electronic manometer
- pitot tube
- bourdon type (magnehelic™)
- rotating vane anemometer
- deflecting vane anemometer
- thermal anemometer
- flow hood
- tachometer

Demonstrate the application of the airflow measuring instruments.

Interpret test and balance reports.

Number:	<b>S0742</b>
Title:	<b>ELECTRICAL AND CONTROL SYSTEMS - RESIDENTIAL</b>
Duration:	Total 81 hours    Theory 39 hours    Practical 42 hours
Prerequisites:	L1CC – S0731, S0732, S0733, S0734, S0735, S0736, S0737
Content:	<p>S0742.1 Identify applicable Acts, Regulations, Legislation, and Codes, when working on an electrical system accessories and components in residential air conditioning systems. <b>(2 / 0 hrs)</b></p> <p>S0742.2 Describe the operating principles and function of alternating current inductive devices and circuits on residential air conditioning systems. <b>(18 / 3 hrs)</b></p> <p>S0742.3 Describe the operating principles and function of single-phase electric motors in a residential air conditioning system. <b>(2 / 2 hrs)</b></p> <p>S0742.4 Interpret control system terminology for a residential air conditioning system. <b>(2 / 0 hrs)</b></p> <p>S0742.5 Describe operating principles and function of safety and operating controls in residential air conditioning systems. <b>(3 / 0 hrs)</b></p> <p>S0742.6 Describe operational sequences of electrical and control systems in residential air conditioning systems. <b>(3 / 20 hrs)</b></p> <p>S0742.7 Describe troubleshooting procedures to service and maintain control circuits and electrical components in residential air conditioning systems. <b>(5 / 9 hrs)</b></p> <p>S0742.8 Describe the operating principles and function of electronic devices and control systems in residential air conditioning systems. <b>(4 / 8 hrs)</b></p>
Evaluation & Testing:	Assignments related to theory and application skills Minimum of one mid-term test during the term Final test at end of term Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
48%	52%	100%

Instructional and Delivery Strategies:   Lecture  
Video  
Paper based material  
Demonstration – Practical Lab Assignments  
CBT  
E-Learning

Reference Materials:

- Occupational Health and Safety Manual for Refrigeration and Air Conditioning
- Dangerous Goods Transportation Act
- Workplace Hazardous Materials Information System
- Occupational Health and Safety Act and Regulations for Construction Projects
- Environmental Code of Practice for the Reduction of Chlorofluorocarbon (ODP program)
- Emissions from Refrigeration and Air Conditioning Systems
- Modern Refrigeration and Air Conditioning (Althouse, Turnquist & Bracciano)
- Applicable Software Training Materials
- Manufacturers' Literature
- Applicable Acts, Regulations, Legislation, and Codes
  - Ontario Fire Code
  - Canadian Electrical Code
  - Boiler Pressure Vessels Act
  - Mechanical Refrigeration Code CSA B52
  - Provincial and Federal Halocarbon Regulations
  - TSSA (Technical Standards and Safety Act)
  - Building Code
  - Municipal Codes

**S0742.0            Electrical and Control Systems - Residential**

Duration:            Total 81 hours    Theory 39 hours    Practical 42 hours

Cross-Reference to Training Standard:

U6230; U6231; U6232; U6233; U6234; U6235; U6236

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**GENERAL LEARNING OUTCOME**

Upon successful completion, the apprentice will be able to describe the operating principles and function of electrical and control systems on air conditioning systems in a residential location.

**LEARNING OUTCOMES AND CONTENT**

42.1 Identify applicable Acts, Regulations, Legislation, and Codes, when working on electrical system accessories and components in residential air conditioning systems. **(2 / 0 hrs)**

Identify pertinent requirements of Canadian Electrical Code (CEC) including:

- CEC regulations regarding grounding (section 10)
- CEC regulations regarding wiring methods for air conditioning systems (section 12).

Describe procedures for lockout and tagging electrical devices.

Identify procedures for connecting and disconnecting electrical equipment in an air conditioning system including:

- legal requirements
- mandatory permits
- inspections.

Identify legislative limitations and scope of electrical work of the Residential Air Conditioning Systems Mechanic including:

- ESA (Electrical Safety Authority)
- TQAA (Trade Qualification and Apprenticeship Act)
- Ministry of Labour
- Ontario Health and Safety Act

42.2 Describe the operating principles and function of alternating current inductive devices and circuits on residential air conditioning systems.  
**(18 / 3 hrs)**

Perform calculations to determine:

- electrical quantities for series circuits
- electrical quantities for parallel circuits
- electrical quantities for combination circuits.

Describe features of inductance including:

- factors which effect inductance
- AC induction and the effect on current.
- purpose of the iron core
- induced electro-motive force
- unit of measurement
- symbol for inductance
- inductive reactance
- equation for inductive reactance.

Describe the phase relationship between voltage and current in an inductive circuit.

Describe the operating principles and function of solenoids including:

- relays
- contactors
- valves

Demonstrate procedures for constructing circuits for an air conditioning system including:

- circuits in which contactors control various loads
- circuits in which solenoid valves control the flow of a fluid

Describe the operating principles and function of transformers in air conditioning systems including:

- turns ratio
- step up versus step down
- VA rating
- primary and secondary voltage
- primary and secondary current
- no load voltage

Describe standard terminal and winding identification.

Describe transformers characteristics including:

- connected in series
- connected in parallel
- transformer polarity
- load sharing for two transformers connected in parallel



## 42.2 Continued

Describe troubleshooting procedures for identifying failures that can occur with a transformer in an air conditioning system including:

- visually inspecting
- testing procedures
- oil leakage
- defects
- discoloration

Describe 120/240 volt single-phase electrical services and panels.

Describe features of over-current protection devices including:

- circuit breakers
- fuses

Describe sizing procedures for over-current devices for:

- hermetic
- non-hermetic loads

Describe over-load protection devices.

Describe operating principles and function of conductors in air conditioning systems including:

- insulation
- voltage rating
- conductor sizing
- voltage drop

Describe operating principles and function of capacitors in air conditioning systems including:

- capacitor construction and characteristics
- capacitance and the effecting factors
- start capacitor
- run capacitor
- unit of measurement
- symbol for a capacitor
- dielectric strength
- capacitive reactance
- symbol for capacitive reactance
- capacitive reactance unit of measurement
- equation for capacitive reactance

Describe the phase relationship between voltage and current in a capacitive circuit.

## 42.2 Continued

Determine the total capacitance for capacitors in series or parallel.

Describe characteristics of impedance including:

- unit of measure for impedance
- capacitive reactance unit of measurement
- equation for impedance.

Describe characteristics of power including:

- unit of measurement
- symbol for power
- apparent power
- identify the apparent power symbol
- power factor.

Describe the operating principles and function of low voltage thermostats in air conditioning systems including:

- installation considerations
- thermostat troubleshooting techniques.

Describe the operating principles and function of control transformers in air conditioning systems.

Describe the operating principles and function of relays and contactors used in air conditioning condensing units or compressors.

Describe the operating principles and function of relays used in air conditioning fans.

Describe procedures for checking the operation of electric heaters in air conditioning systems.

42.3 Describe the operating principles and function of single-phase electric motors in residential air conditioning systems. **(2 / 2 hrs)**

Identify the components of a single-phase electric motor including

- stator
- rotor
- cover plates
- bearings
- starting switches
- capacitors
- number of poles and synchronous speed
- overload devices
- wiring
- information on motor nameplate

Describe the sequence of events to start and run a shaded pole motor including:

- transformer action between the stator and the rotor

Describe the sequence of events to start and run a split-phase motor including:

- transformer action between the stator and the rotor
- operation of starting switches or relays

Describe the sequence of events to start and run a capacitor start motor including:

- transformer action between the stator and the rotor
- start capacitor
- operation of starting switches or relays

Describe the sequence of events to start and run a permanent-split capacitor motor including:

- transformer action between the stator and the rotor
- purpose of the run capacitor

Describe the sequence of events to start and run a capacitor-start capacitor run motor including:

- transformer action between the stator and the rotor
- purpose of the run and start capacitors
- operation of starting relays

42.4 Interpret control system terminology for a residential air conditioning system. **(2 / 0 hrs)**

Interpret control system terminology including:

- anticipation
- averaging
- closed loop
- open loop
- control medium
- control point
- set point
- controlled device
- controller
- differential
- direct acting
- reverse acting
- feedback
- normally closed
- normally open
- range
- throttling range

42.5 Describe operating principles and function of safety and operating controls in residential air conditioning systems. **(3 / 0 hrs)**

Identify safety and operating controls including

- temperature controls
- humidity
- line voltage
- low voltage
- programmable
- two position
- proportional
- pressure controls
- oil safety controls
- fluid flow controls
- liquid level controls
- amperage
- timer controls

#### 42.5 Continued

Describe troubleshooting procedures for identifying failures that can occur with safety and operating controls in air conditioning systems including:

- defective
- damaged
- equipment for checking functions
  - thermometer
  - pressure gauge
  - hygrometer
  - psychrometer
  - multimeter
  - ammeter
  - voltmeter
  - ohmmeter
  - manometer

#### 42.6 Describe operational sequences of electrical and control systems in residential air conditioning systems. **(3 / 20 hrs)**

Describe purpose and structure of electrical diagrams for an air conditioning system including:

- pictorial diagrams
- electrical installation diagrams
- schematic diagrams

Interpret manufacturers' data to determine the type of control devices used in air conditioning systems.

Interpret schematic electrical diagrams for air conditioning systems including:

- symbols
- legend
- motor starting devices
- overload devices
- control devices
- safety devices
- transformers
- applicable voltages

Identify the sequence of electrical operation by reading:

- charts
- tables
- technical literature
- manufacturers' specifications
- schematic wiring diagrams
- codes and regulations

#### 42.6 Continued

Interpret schematic electrical diagrams for a to identify:

- sequence of electrical operation
- sequence of operation
  - heat pump cooling
  - heating
  - defrost cycle
  - three-phase reduce voltage starter
  - Y-Delta starter

Demonstrate sketching procedures to draw electrical schematic control diagrams.

#### 42.7 Describe troubleshooting procedures to service and maintain control circuits and electrical components in residential air conditioning systems. **(5 / 9 hrs)**

Demonstrate the use of electrical measuring devices to measure the performance of electrical control circuits and electrical components including:

- ammeters
- voltmeters
- ohmmeters
- meg ohm meter/insulation tester (meggers™)
- Wattmeters
- multimeters
- capacitor analyzers

Determine the limitations of instruments including:

- measuring range
- scale values
- handling methods
- instrument condition
- calibration procedures

Demonstrate measuring and testing procedures for:

- current flow
- continuity
- voltage (AC-DC)
- amperage (AC-DC)
- resistance and power
- capacitors

## 42.7 Continued

Interpret meter readings by value and unit of measurement.

Describe calibration and adjustment procedures for electrical measuring instruments including:

- adjusting
- range
- scale
- connecting instruments

Demonstrate verification methods for the parameters of control systems in air conditioning systems using:

- simulators
- analyzers
- computers

Describe the operating principles and function of electrical and automated controls in an air conditioning system including:

- fan cycling
- fan speed
- hi/low pressure
- defrost controls for heat pumps
- humidity
- crankcase heaters
- off cycle timers
- electronic or manual thermostats
- zone control devices

Identify tools and specialty devices to check system control systems including:

- hand tools
- pressure measuring devices
- temperature measuring instruments
- flow measuring instruments
- electrical measuring instruments
- level indicators
- simulators
- tachometers

#### 42.7 Continued

Demonstrate verification procedures for operating control system parameters in an air conditioning system including:

- pressures
- temperatures
- flow rate
- voltages
- amperage
- fluid levels
- speeds

Demonstrate procedures for checking and verifying primary and secondary controls in air conditioning systems including:

- voltage
- motor rotation
- fan cycling or fan speed controls
- hi/low pressure controls
- defrost controls for heat pumps
- humidity controls
- crankcase heaters
- off cycle timers
- electronic or manual thermostats
- zone control devices

Describe troubleshooting procedures to locate electrical faults within a control system including the hopscotch method.

Demonstrate procedures for removing or replacing defective control components in air conditioning systems.



42.8 Describe the operating principles and function of electronic devices and control systems in residential air conditioning systems. **(4 / 8 hrs)**

Describe the operating principles and function of electronic components in air conditioning systems including:

- semiconductors (PN junction)
- diodes
- triacs
- rectifiers
- silicon-controlled rectifiers
- sensors and thermistors
- transducers
- thermocouples
- thermoelectric devices

Describe troubleshooting procedures to identify failures that can occur with devices and controls in an air conditioning system including:

- discoloration
- odours
- moisture
- corrosion

Describe verification procedures for electrical devices and control systems.

Describe procedures for setting up programmable controllers in an air conditioning system.

Number: **S0743**

Title: **ELECTRONIC DEVICES AND CONTROLS -  
RESIDENTIAL**

Duration: Total 24 hours    Theory 18 hours    Practical 6 hours

Prerequisites: L1CC – S0731, S0732, S0733, S0734, S0735,  
S0736, S0737

Content:

- S0743.1 Identify the operating principles and function of electronic devices and controls on residential air conditioning systems. **(2 / 0 hrs)**
- S0743.2 Describe the operating principles and function of input/output sensors and devices on residential air conditioning systems. **(2 / 1 hrs)**
- S0743.3 Describe the operating principles and function of electronic controllers on residential air conditioning systems. **(2 / 1 hrs)**
- S0743.4 Describe procedures for installing electronic controllers on residential air conditioning systems. **(2 / 0 hrs)**
- S0743.5 Describe the methods of wiring electronic controllers on residential air conditioning systems. **(2 / 1 hrs)**
- S0743.6 Describe methods for communicating with electronic controllers on residential air conditioning systems. **(2 / 0.5 hrs)**
- S0743.7 Describe programming procedures for changing the control parameters on residential air conditioning systems. **(2 / 1 hrs)**
- S0743.8 Describe troubleshooting procedures for identifying failures that can occur with the electronic controls on residential air conditioning systems. **(2 / 1 hrs)**
- S0743.9 Describe energy conservation methods and strategies used with electronic control systems on residential air conditioning systems. **(2 / 0.5 hrs)**

Evaluation & Testing: Assignments related to theory and application skills  
Minimum of one mid-term test during the term  
Final test at end of term  
Periodic quizzes

Mark Distribution:

Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Instructional and Delivery Strategies:

- Lecture
- Video
- Paper based material
- Demonstration – Practical Lab Assignments
- CBT
- E-Learning

Reference Materials:

- Occupational Health and Safety Manual for Refrigeration and Air Conditioning
- Dangerous Goods Transportation Act
- Workplace Hazardous Materials Information System
- Occupational Health and Safety Act and Regulations for Construction Projects
- Environmental Code of Practice for the Reduction of Chlorofluorocarbon (ODP program)
- Emissions from Refrigeration and Air Conditioning Systems
- Modern Refrigeration and Air Conditioning (Althouse, Turnquist & Bracciano)
- Applicable Software Training Materials
- Manufacturers' Literature
- Applicable Acts, Regulations, Legislation, and Codes
  - Ontario Fire Code
  - Canadian Electrical Code
  - Boiler Pressure Vessels Act
  - Mechanical Refrigeration Code CSA B52
  - Provincial and Federal Halocarbon Regulations
  - TSSA (Technical Standards and Safety Act)
  - Building Code
  - Municipal Codes

**S0743.0            Electronic Devices and Controls - Residential**

Duration:            Total 24 hours    Theory 12 hours    Practical 12 hours

Cross-Reference to Training Standard:

U6232.09; U6233.02; U6233.05; U6233.06; U6234.09; U6236

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**GENERAL LEARNING OUTCOME**

Upon successful completion, the apprentice will be able to describe procedures for installing and maintaining electronic devices and controls used on residential air conditioning systems.

**LEARNING OUTCOMES AND CONTENT**

43.1 Identify the operating principles and function of electronic devices and controls on residential air conditioning systems. **(2 / 0 hrs)**

Identify control actions including:

- two position
- floating
- proportional
- integral
- derivative

Describe analog and digital control signals.

Identify control loops systems including:

- open
- closed loop systems

Identify the elements and fundamentals of:

- electronic logic
- binary and digital circuits
- digital circuits
- direct digital control
- electronic controller.

Describe the operating principles and function of electronic controls and components on air conditioning systems.

43.2 Describe the operating principles and function of input/output sensors and devices on residential air conditioning systems. **(2 / 0.5 hrs)**

Identify analog and digital inputs/outputs.

Identify analog and digital peripheral control devices.

Describe the operating principles and function of:

- temperature sensors
- pressure sensors
- transducers
- transmitters

Describe procedures for:

- interfacing electronic devices with electro-mechanical devices
- calibrating input/output loop
- troubleshooting input/output loops

43.3 Describe the operating principles and function of electronic controllers on residential air conditioning systems. **(2 / .05 hrs)**

Identify electronic control system architectures on an air conditioning system.

Identify types of electronic controls on an air conditioning system including:

- digital temperature controllers/thermostats
- humidity controllers
- gas detectors
- zone controllers
- equipment interfaces
- unit controllers
- motor speed controllers

Describe interfacing electronic controllers with conventional controlled devices including:

- actuators
- dampers
- relays
- valves

Describe the application of electronic controls on air conditioning systems.

Describe stand-alone and distributed control systems on air conditioning systems.

Describe the sequence of operation of typical control strategies in air conditioning systems.

43.4 Describe procedures for the installing electronic controllers on residential air conditioning systems. **(2 / 0 hrs)**

Interpret drawings and job specifications to identify and plan the installation of electronic control systems on an air conditioning system.

Identify the power supply required for electronic control systems.

Identify types of electronic controls to be installed.

Identify equipment and devices required to install electronic control systems.

Describe the procedures for installing electronic control systems.

Identify procedures for commissioning a electronic control system in an air conditioning system.

43.5 Describe the methods of wiring electronic controllers on residential air conditioning systems. **(2 / 1 hrs)**

Interpret schematics, wiring drawings, and job documentation to identify:

- wiring methods for stand-alone and distributed control networks
- interconnecting wiring media
- connection points on components and controls
- techniques to minimize noise and interference
- wiring media for control networks

43.6 Describe methods for communicating with electronic controller systems on residential air conditioning systems. **(2 / 0.5 hrs)**

Identify communication port standards including:

- RS232
- RS422
- RS485

Identify operator machine interfaces including:

- local (panel)
- hand held
- lap top, palm top
- server
- web server (IP)
- remote (modem)

Describe methods of communicating with various control systems including:

- manufacturers' access methods
- RS232 to 485 converters
- web based

43.7 Describe programming procedures for changing the control parameters on residential air conditioning systems. **(2 / 1 hrs)**

Identify program types including:

- system programs
- application programs

Describe procedures for using interface devices with control programs including:

- computers
- local interfaces
- hand held

Identify procedures for modifying the control system parameters.

43.8 Describe troubleshooting procedures for identifying failures that can occur with electronic controls on residential air conditioning systems. **(2 / 1 hrs)**

Describe procedures for servicing and maintaining electronic controls on an air conditioning system including:

- interpreting control system data
- servicing procedures
- electrical measuring devices
- electronic diagnostic devices
- measuring devices
- maintenance tools and equipment
- interfacing devices to communicate with the system
- testing reports and charts
- analyzing procedures
- inspection procedures
- removal procedures
- replacement procedures
- corrective actions

Identify verification procedures to check:

- correct function of electronic controls
- control system operation meets the design criteria

43.9 Describe energy conservation methods and strategies used with electronic control systems on residential air conditioning systems. **(2 / 0.5 hrs)**

Identify methods for optimizing the operation of electronic control systems for energy conservation including:

- outdoor reset
- time scheduled control
- temperature setback
- VFD speed reduction
- motor speed control devices

Identify the benefits of energy conservation strategies.

Identify energy conservation strategies for air conditioning applications.