

Apprenticeship and Industry Training

Apprenticeship Curriculum Guide Companion Document

Refrigeration and Air Conditioning Mechanic



Apprenticeship
and Industry
Training

Alberta 

Refrigeration and Air Conditioning Mechanic: Apprenticeship Education Program Curriculum Guide Companion
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Introduction

Apprenticeship and Industry Training (AIT) utilizes the curriculum guide as a document to guide and direct the developers of training and lesson plans. The curriculum guide is written to reflect and identify competence-based learning through supporting competence statements. Although this model provides more flexibility and responsiveness for the stakeholders, it creates challenges to developers of lesson plans and assessments.

Purpose

The purpose of this document is to expand on competence and supporting competence statements by identifying and providing outcome and objective statements that are associated with the supporting competence statement.

Outcome Statements

Outcome statements are an observable major task or work activity that an entry-level journey person performs for compensation.

Objective Statements

Objective statements are the knowledge or skill an apprentice learns or demonstrates while attending in-classroom instruction. They support achievement of the outcome statement by the apprentice.

Course Content Overview



The term **“In Context”** indicates that the supporting competence will become integrated learning and/or utilized as a component of the competence statement. It will **not** have an assigned weighting and will **not** be assessed as an examination item.

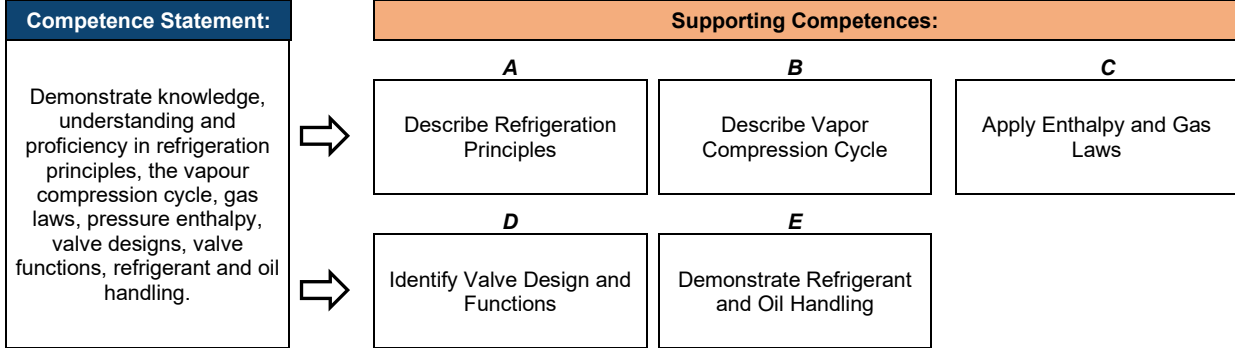
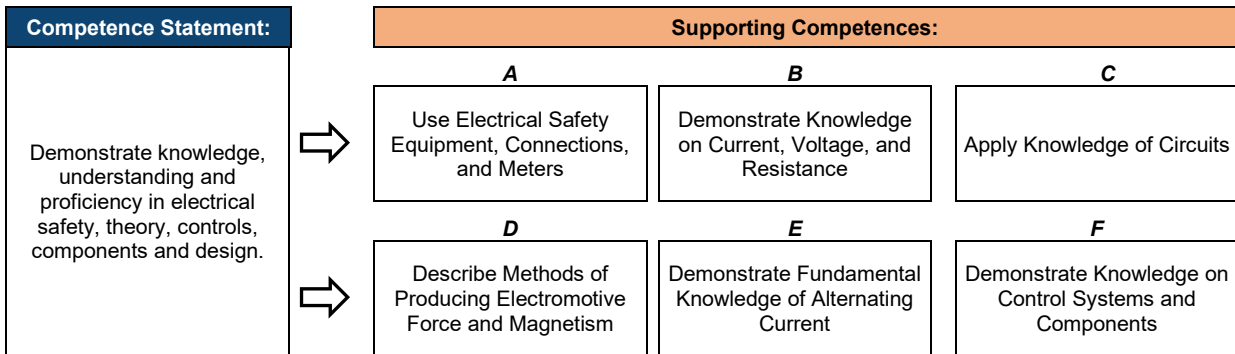
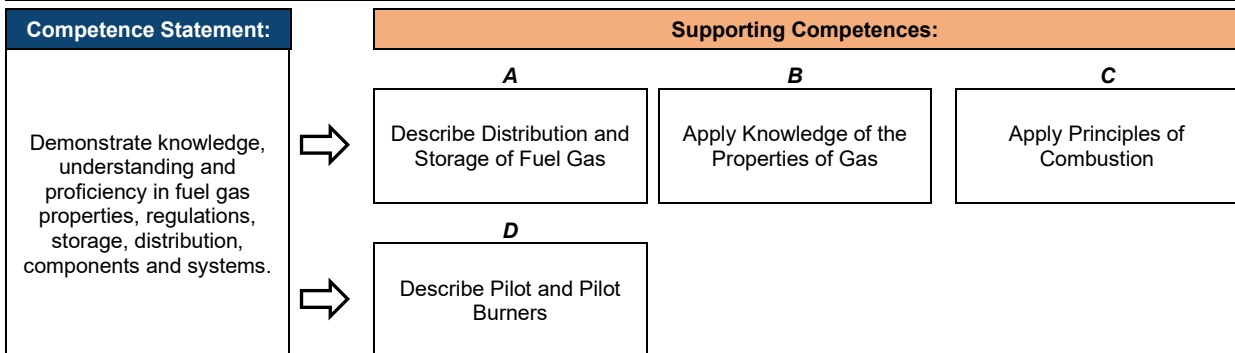
PERIOD ONE COURSE CONTENT

CORE COMPETENCE ONE: Foundational Skills, Job Responsibilities, and Procedures

Competence Statement:	Supporting Competences:		
Apply foundational skills essential to convey and receive critical training and workplace information.	⇒	A Apply Safety Legislation, Regulations, and Industry Policy in the Trades	B Interpret Codes
			C Select, Use and Maintain Tools and Instruments
	⇒	D Interpret Drawings and Schematics	E Demonstrate Numeracy
			F Demonstrate Communication Skills
	⇒	G Demonstrate Literacy and Digital Literacy	
		<i>In Context</i>	<i>In Context</i>

CORE COMPETENCE TWO: Air Handling

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency of air properties, air flow design, air handling systems, accessories and filtration.	⇒	A Calculate Air Properties and Air Flow Design	B Describe Air Handling Systems and Accessories
			C Analyze Air Filtration

CORE COMPETENCE THREE: Refrigeration and Mechanical Cooling**CORE COMPETENCE FOUR: Controls and Electrical Systems****CORE COMPETENCE FIVE: Heating and Fuel Systems**

PERIOD TWO COURSE CONTENT

CORE COMPETENCE ONE: Foundational Skills, Job Responsibilities, and Procedures

Competence Statement:	Supporting Competences:		
Apply foundational skills essential to convey and receive critical training and workplace information.	⇒	A Apply Safety Legislation, Regulations, and Industry Policy in the Trades <i>In Context</i>	B Interpret Codes <i>In Context</i>
		C Select, Use, and Maintain Tools and Instruments <i>In Context</i>	
	⇒	D Interpret Drawings and Schematics <i>In Context</i>	E Demonstrate Numeracy <i>In Context</i>
		F Demonstrate Communication Skills <i>In Context</i>	
	⇒	G Demonstrate Literacy and Digital Literacy <i>In Context</i>	

CORE COMPETENCE TWO: Air Handling

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency of air properties, air flow design, air handling systems, accessories and filtration.	⇒	A Calculate Air Properties and Air Flow Design <i>In Context</i>	B Describe Air Handling Systems and Accessories <i>In Context</i>
		C Analyze Air Filtration <i>In Context</i>	

CORE COMPETENCE THREE: Refrigeration and Mechanical Cooling

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency in refrigeration principles, the vapour compression cycle, gas laws, pressure enthalpy, valve designs, valve functions, refrigerant and oil handling.	⇒	A Describe Refrigeration Principles <i>In Context</i>	B Install and Service Refrigeration and Mechanical Cooling Systems <i>In Context</i>
		C Demonstrate Knowledge of Components in Refrigeration and Mechanical Cooling Systems <i>In Context</i>	
	⇒	D Perform Refrigerant Changeover on Refrigeration and Mechanical Cooling Systems <i>In Context</i>	

CORE COMPETENCE FOUR: Controls and Electrical Systems

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency in electrical safety, theory, controls, components and design.	A	B	C
	Connect and Analyze Motors	Connect Transformers	Describe Class 1 and Class 2 Circuits
	D	E	F
	Describe Three-Phase Fundamentals	Troubleshoot Electrical System Faults	Demonstrate Knowledge of Control Systems and Components

CORE COMPETENCE FIVE: Heating and Fuel Systems

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency in fuel gas properties, regulations, storage, distribution, components and systems.	A	B	C
	Describe Distribution and Storage of Fuel Gas	Apply Knowledge on the Properties of Gas	Apply Principles of Combustion
	<i>In Context</i>	<i>In Context</i>	<i>In Context</i>
	D	E	F
	Describe Flues, Draft Hoods, and Vent Connections	Install and Service Pressure Regulators	Troubleshoot Basic Heating and Cooling Control Circuit of an HVAC unit
	G		
	Calculate and Adjust Gas Consumption on Burners up to 400 MBH		

PERIOD THREE COURSE CONTENT

CORE COMPETENCE ONE: Foundational Skills, Job Responsibilities, and Procedures

Competence Statement:	Supporting Competences:		
Apply foundational skills essential to convey and receive critical training and workplace information.		A	B
	⇒	Apply Safety Legislation, Regulations, and Industry Policy in the Trades <i>In Context</i>	Interpret Codes <i>In Context</i>
		C	
		Select, Use, and Maintain Tools and Instruments <i>In Context</i>	
	⇒	D	E
		Interpret Drawings and Schematics <i>In Context</i>	Demonstrate Numeracy <i>In Context</i>
		F	
		Demonstrate Communication Skills <i>In Context</i>	
	⇒	G	
		Demonstrate Literacy and Digital Literacy <i>In Context</i>	

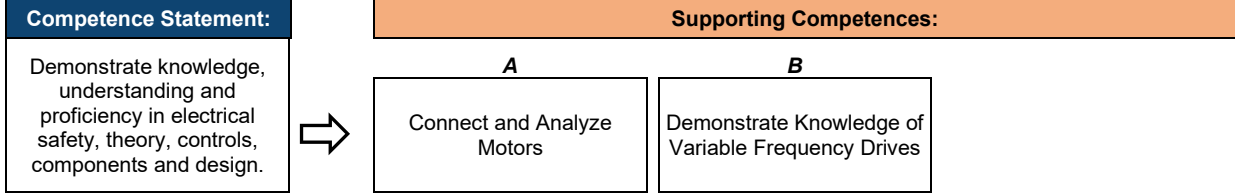
CORE COMPETENCE TWO: Air Handling

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency of air properties, air flow design, air handling systems, accessories and filtration.		A	B
	⇒	Calculate Air Properties and Air Flow Design <i>In Context</i>	Describe Air Handling Systems and Accessories <i>In Context</i>
		C	
		Analyze Air Filtration <i>In Context</i>	
	⇒	D	E
		Describe Make-up Air Systems	Use Air Instruments for System Balancing
		F	
		Calculate HVAC Load Requirements	

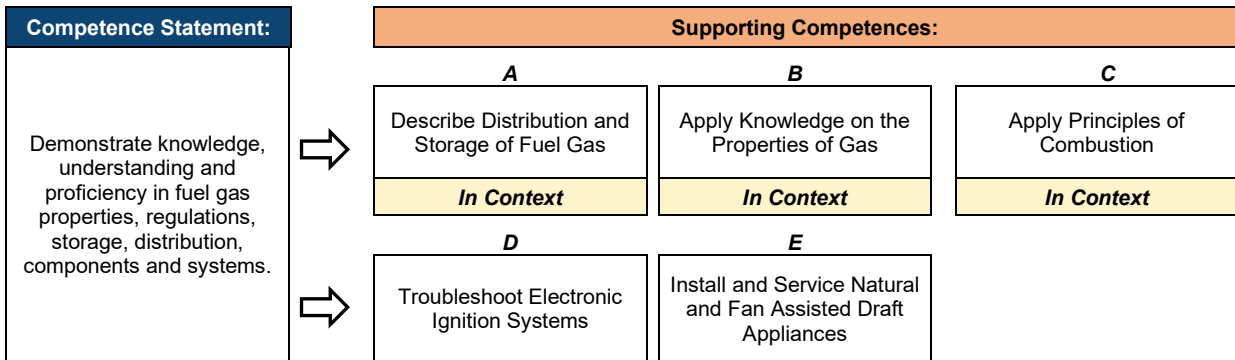
CORE COMPETENCE THREE: Refrigeration and Mechanical Cooling

Competence Statement:	Supporting Competences:		
Demonstrate knowledge, understanding and proficiency in refrigeration principles, the vapour compression cycle, gas laws, pressure enthalpy, valve designs, valve functions, refrigerant and oil handling.		A	B
	⇒	Describe Refrigeration Principles <i>In Context</i>	Demonstrate Knowledge on RAC systems
		C	
		Describe Ice Machine Operations	
	⇒	D	E
		Troubleshoot HVAC/R Systems	Demonstrate Knowledge on Defrost Methods, Circuits, and Controls
		F	
		Design and Install HVAC/R Piping System	
	⇒	G	
		Calculate Refrigeration and Air Conditioning Load Requirements	

CORE COMPETENCE FOUR: Controls and Electrical Systems



CORE COMPETENCE FIVE: Heating and Fuel Systems



PERIOD FOUR COURSE CONTENT

CORE COMPETENCE ONE: Foundational Skills, Job Responsibilities, and Procedures

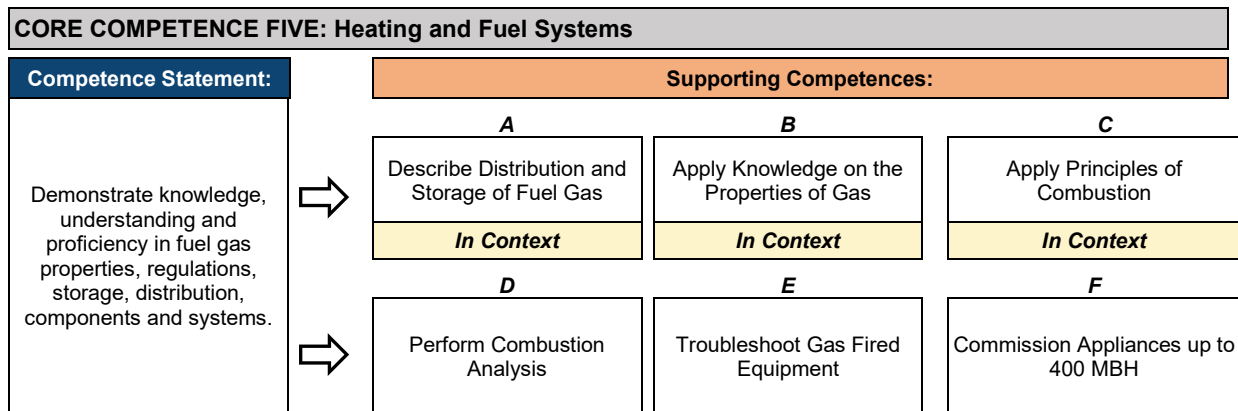
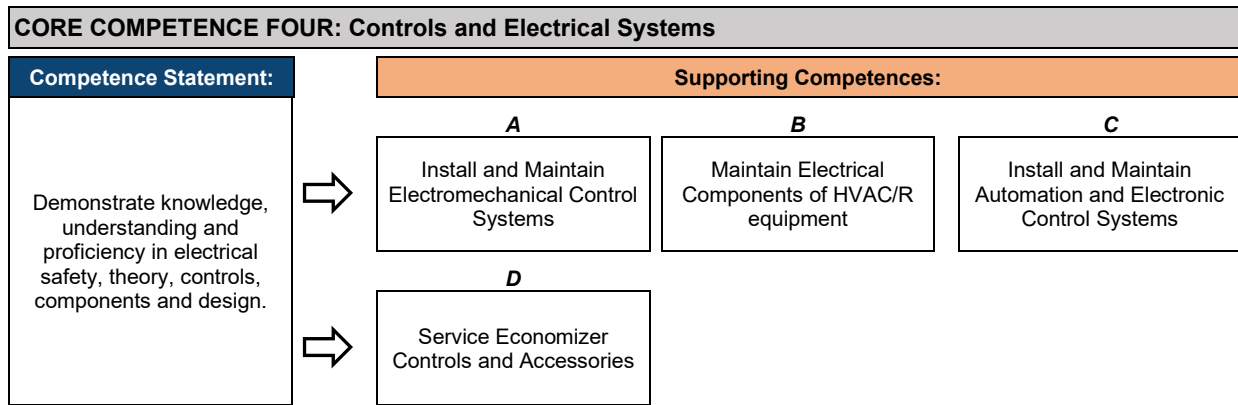
Competence Statement:		Supporting Competences:		
Apply foundational skills essential to convey and receive critical training and workplace information.	⇒	A	B	C
		Apply Safety Legislation, Regulations, and Industry Policy in the Trades	Interpret Codes	Select, Use, and Maintain Tools and Instruments
				<i>In Context</i>
	⇒	D	E	F
		Interpret Drawings and Schematics	Demonstrate Numeracy	Demonstrate Communication Skills
			<i>In Context</i>	<i>In Context</i>
	⇒	G		
		Demonstrate Literacy and Digital Literacy		
		<i>In Context</i>		

CORE COMPETENCE TWO: Air Handling

Competence Statement:	Supporting Competences:			
Demonstrate knowledge, understanding and proficiency of air properties, air flow design, air handling systems, accessories and filtration.	⇒	A	B	C
		Calculate Air Properties and Air Flow Design	Describe Air handling Systems and Accessories	Analyze Air Filtration
		<i>In Context</i>	<i>In Context</i>	<i>In Context</i>
	⇒	D	E	F
		Service HVAC and Make-up Air systems	Install of HVAC/R Systems	Troubleshoot Make-Up Air Systems
	⇒	G	H	
		Troubleshoot HVAC/R Systems	Describe New Environmental Technology	

CORE COMPETENCE THREE: Refrigeration and Mechanical Cooling

Competence Statement:	Supporting Competences:			
Demonstrate knowledge, understanding and proficiency in refrigeration principles, the vapour compression cycle, gas laws, pressure enthalpy, valve designs, valve functions, refrigerant and oil handling.	⇒	A	B	C
		Describe Refrigeration Principles	Demonstrate Knowledge of Ultra Low Compression Systems	Service Industrial Refrigeration Systems
		<i>In Context</i>		
	⇒	D	E	F
		Service a Chiller System	Service Multiplex Systems	Demonstrate Knowledge of Circulating Pumps



Period One Course Content

(8 weeks – 240 hours)

Period One Core Competences	Weighting
Foundational Skills, Job Responsibilities, and Procedures	28%
Air Handling	5%
Refrigeration and Mechanical Cooling	25%
Controls and Electrical Systems	27%
Heating and Fuel Systems	15%

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures Weighting – 28%



The outcomes for this supporting competence include applying safety regulations and industry standards, using tools and equipment, and understanding codes and drawings. It also involves recognizing hazards, completing training, and managing an apprenticeship.



Apply foundational skills essential to convey and receive critical training and workplace information.

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
1A. Apply Safety Legislation, Regulations & Industry Policy in the Trades Outcomes for this supporting competence include: 1) Apply legislation, regulations and practices ensuring safe work in this trade. 1. Demonstrate the application of the Occupational Health and Safety Act, Regulation and Code.	I, II	31%

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
2. Describe the sponsor's and employee's role with Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations and related advisory bodies and agencies. 3. Describe industry practices for hazard assessment and control procedures including welding fumes. 4. Describe the responsibilities of worker and sponsors to apply emergency procedures. 5. Describe tradesperson responsibility in housekeeping, personal protective equipment and emergency procedures. 6. Describe the roles and responsibilities of sponsors and employees with the selection and use of personal protective equipment (PPE). 7. Maintain required PPE for tasks. 8. Use required PPE for tasks. 9. Identify hazards for welding and cutting operations. 10. Describe procedures for welding or cutting in confined spaces. II) Apply industry standard practices for hazardous materials and fire protection in this trade. 1. Describe roles, responsibilities, features and practices related to the Workplace Hazardous Materials Information System (WHMIS) program. 2. Describe three key elements of WHMIS. 3. Describe handling, storing and transporting procedures for hazardous material. 4. Describe venting procedures when working with hazardous materials. 5. Describe hazards, classes, procedures and equipment related to fire protection. III) Use industry standard practices for climbing, lifting, rigging and hoisting in this trade. 1. Describe manual lifting procedures. 2. Describe rigging hardware and associated safety factors. 3. Select equipment for rigging loads. 4. Describe hoisting and load moving procedures. 5. Describe the use of various types of ladders. 6. Describe the use of various types of scaffolds. 7. Describe the use of various types of mobile elevated work platform. 8. Maintain personal protective equipment (PPE) for climbing, lifting and load moving equipment. 9. Use PPE for climbing, lifting and load moving equipment. 10. Describe the various types, parts, care and maintenance of natural and synthetic rope. 11. Identify and describe the proper procedure for tying knots, and hitches used within industry. 12. Describe types, parts, care, and maintenance of wire ropes. 13. Name differences between chain falls, come-a-longs, tirsors and snatch blocks. 14. Describe characteristics of safe workloads of slings used for hoisting materials. 15. Describe hand signals when directing a crane. 16. Demonstrate tying of knots, and hitches.		

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
IV) Recognize arc flash hazards in electrical installations. 1. Identify the hazards associated with arc flash. 2. Describe the personal protective equipment related to arc flash. 3. Describe lockout procedures related to energized systems. V) Refrigerant and oil handling. 1. Complete Heating Refrigeration Air Conditioning Institute (HRAI) refrigerant handling training. VI) Manage an apprenticeship to earn journeyperson certification. 1. Describe the contractual responsibilities of the apprentice, sponsor and Alberta Apprenticeship and Industry Training. 2. Describe the purpose of the apprentice competency portfolio. 3. Describe the procedure for changing employers during an active apprenticeship. 4. Describe the purpose of the curriculum guide. 5. Describe the procedure for progressing through an apprenticeship. 6. Describe advancement opportunities in this trade.		
1B. Interpret Codes Outcomes for this supporting competence include: I) Identify codes used in the refrigeration and air conditioning (RAC) industry. 1. Identify the B52 codes that apply to RAC work. 2. Identify the B149 code books that apply to RAC work. 3. Describe the code documents relating to pipe trades including ASME/ ABSA, CSA, NRC, NFPA, ASHRAE. 4. Identify the National Plumbing codes that apply to RAC work. 5. Identify the CEC that apply to RAC work. 6. Identify the National Building Code Alberta Edition sheet metal standards that apply to RAC work. II) Interpret the B52 Mechanical Refrigeration Code and the Canadian Code of Practice in the Refrigeration and Air Conditioning industry work in Alberta. 1. Explain the scope and jurisdiction of the different codes. 2. Describe how the B52 relates to the Refrigeration and Air Conditioning industry. 3. Describe how the Canadian Environmental Code of Practice relates to the Refrigeration and Air Conditioning industry. 4. Demonstrate how the B52 is used in determining minimum standards in refrigeration and air conditioning install and maintenance work. 5. Demonstrate how the Canadian Environmental Code of Practice is used in determining minimum standards in a refrigeration and air conditioning install and maintenance work.	I, II	15%

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
III) Interpret standards pertaining to the installation of piping and tubing systems for various conditions of use in accordance with the CAN/CSA B149.1 Natural Gas and Propane Installation Codes (Sections 1-4) and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins. - Describe the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to installer's responsibilities. - Apply the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to installation of piping and fittings. - Apply the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to testing of piping and fittings. - Apply the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to purging of piping and fittings. - Describe safety practices pertaining to installation of piping and fittings. - Describe safety practices pertaining to testing of piping and fittings. - Describe safety practices pertaining to purging of piping and fittings.		
1C. Select, Use, and Maintain Tools and Instruments Outcomes for this supporting competence include: I) Use hand tools and power tools. - Describe types, uses and care of hand, power tools and instruments. - Demonstrate the use of hand tools and power tools used in the industry. - Demonstrate connections of refrigeration gauges and operation of service valves. II) Apply pipe working skills on refrigeration, gas, and plumbing pipe and tubing. - Identify types, applications, designations, and pressure ratings of pipe, tubing, and fittings - Describe tools, equipment and material used for pipe work. - Describe tools and equipment used for soldering. - Describe tools and equipment used for brazing. - Describe tools and equipment used for joining plastic pipe. - Describe oxyfuel equipment components, functions and maintenance. - Demonstrate use of tools, equipment and material for pipe work. - Demonstrate use of tools and equipment for soldering. - Demonstrate use of tools and equipment for brazing. - Demonstrate oxyfuel leak detection, adjusting, operating, and shutdown procedures. - Identify five basic welded joint types. - Identify types of welds and their required dimensions. - Identify types of metals using practical tests. - Identify oxyfuel cutting equipment. - Identify arc welding equipment. - Identify procedures and requirements for pneumatic and hydrostatic testing.	I, II	48%

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
III) Use materials and fasteners commonly used in the industry. 1. Identify types of hangers, supports and fasteners. 2. Describe applications of hangers, supports and fasteners. 3. Describe metallic and non-metallic materials' characteristics and applications. 4. Describe types of threaded fasteners and their applications. 5. Describe thread repair methods. 6. Describe types of non-threaded fasteners and their applications. 7. Demonstrate removal of seized and damaged fasteners.		
1D. Interpret Drawings and Schematics Outcomes for this supporting competence include: I) Interpret basic drawings information. 1. Use basic information found on drawings. 2. Interpret basic drawings. 3. Identify common symbols used in drawings and legends. 4. Identify abbreviations used in drawings.	I, II	6%
1E. Demonstrate Numeracy		In Context
1F. Demonstrate Communication Skills		In Context
1G. Demonstrate Literacy and Digital Literacy		In Context

Core Competence 2: Air Handling

Weighting – 5%



The outcomes for this supporting competence include mastering air flow design, maintaining air handling systems and accessories, and analyzing air filtration efficiencies. It also involves installing and aligning fans, belts, and mechanical drives, ensuring optimal system performance and air quality.



Demonstrate knowledge, understanding and proficiency of air properties, air flow design, air handling systems, accessories and filtration.

Core Competence 2: Air Handling

Supporting Competence	Taxonomy	Weighting
2A. Calculate Air Properties and Air Flow Design Outcomes for this supporting competence include: I) Apply the properties of air as it relates to basic air flow design. - Describe air properties as it relates to heat transfer. - Describe methods of heat transfer as they relate to air flow. - Describe units of measurement as it relates to air properties. - Describe methods used in calculating air flow design. - Calculate air flow required for a given heat transfer system. - Describe psychrometrics. - Describe the meaning, function and uses of psychrometric charts. - Plot and interpret a psychrometric chart.	I, II, III	34%
2B. Describe Air Handling Systems and Accessories Outcomes for this supporting competence include: I) Describe air handling systems and accessories. - Describe air handling systems. - Describe air handling systems components. - Describe air handling accessories. - Describe air handling equipment maintenance requirements. - Define terms and components used in fans, belts and mechanical drives. - Demonstrate fan belt installation and mechanical drive alignment.	I, II	33%
2C. Analyze Air Filtration Outcomes for this supporting competence include: I) Analyze efficiencies of air filtration systems. - Define terms related to filtration. - Define filtration components and their application - Describe the operation and efficiency of air filters - Calculate velocities and pressure drops through filters.	I, II, III	33%

Core Competence 3: Refrigeration and Mechanical Cooling

Weighting – 25%



The outcomes for this supporting competence include understanding refrigeration principles, describing the vapour compression cycle, applying gas laws and pressure enthalpy charts, identifying valve designs and functions, and demonstrating refrigerant and oil handling. It also involves performing calculations, converting temperatures and pressures, and maintaining refrigeration systems for optimal performance.



Demonstrate knowledge, understanding and proficiency in refrigeration principles, the vapour compression cycle, gas laws, pressure enthalpy, valve designs, valve functions, refrigerant and oil handling.

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
3A. Describe Refrigeration Principles Outcomes for this supporting competence include: I) Explain the basic operation of a refrigeration system. 1. Define terms related to refrigeration principles. 2. Describe basic concepts of heat transfer. 3. Describe methods of heat transfer. 4. Describe the laws of thermal dynamics. 5. Describe the units of measure pertaining to heat transfer. 6. Describe the function of refrigeration in transportation. 7. Perform calculations related to heat transfer. 8. Convert temperatures and pressures between various scales.	I, II	23%
3B. Describe the Vapour Compression Cycle Outcomes for this supporting competence include: I) Describe the vapour compression cycle. 1. Describe basic concepts of the vapour compression cycle. 2. Describe the four essential components of a refrigeration system. 3. Describe the stages of the refrigeration cycle. 4. Describe basic operating principles and applications of multiple evaporator systems. 5. Describe the basic difference between single and multiple evaporator systems. 6. Measure the refrigeration cycle on a working system. 7. Demonstrate the operation of a refrigeration system using a diagram.	I, II	18%
3C. Describe Gas Laws and Pressure Enthalpy Outcomes for this supporting competence include: I) Apply gas laws and pressure enthalpy charts to refrigeration systems. 1. Define terms used in refrigeration and heating. 2. Describe gas laws and how they apply to thermal dynamics. 3. Describe fluids and fluid piping systems as it relates to refrigeration systems. 4. Describe the units of measurement used in refrigeration calculations. 5. Apply formulas used in calculating gas laws and pressure enthalpy. 6. Describe the components of a pressure enthalpy diagram. 7. Plot a basic cycle using a pressure enthalpy diagram. 8. Demonstrate use of formulas for calculating gas laws and pressure enthalpy.	I, II	33%

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
3D. Identify Valve Designs and Functions Outcomes for this supporting competence include: I) Identify / Describe valves in RAC systems. - Describe general valve designs. - Describe applications of various valves. - Describe valve designs for various RAC system applications. - Describe the purpose, types and procedures for service valves. - Describe the purpose, types, construction, location and operation of RAC valves. - Demonstrate operation of service valves.	I, II	7%
3E. Demonstrate Refrigerant and Oil Handling Outcomes for this supporting competence include: I) Demonstrate refrigerant and oil handling. - Describe the properties of refrigerants and their oils. - Describe the handling and storage of refrigerants and refrigeration oils. - Describe the recovery and disposal of refrigerants and refrigeration oils. - Describe leak testing methods and instruments used. - Describe the evacuation process of refrigeration systems. - Describe non-OEM refrigerant products available in the industry. - Demonstrate the recovery and disposal of refrigerants. - Demonstrate the recovery and disposal of refrigeration oils. - Demonstrate leak testing methods and instruments used. - Demonstrate the evacuation process of refrigeration systems. - Demonstrate the proper maintenance procedures of recovery and evacuation equipment. - Demonstrate cleaning procedures for a contaminated system.	I, II	19%

Core Competence 4: Controls and Electrical Systems

Weighting – 27%



The outcomes for this supporting competence include using electrical safety equipment, understanding current, voltage, and resistance, applying circuit knowledge, describing EMF and magnetism, demonstrating knowledge of alternating current, and maintaining HVAC/R control systems for optimal performance.



Demonstrate knowledge, understanding and proficiency in electrical safety, theory, controls, components and design.

Core Competence 4: Controls and Electrical Systems

Supporting Competence	Taxonomy	Weighting
4A. Use Electrical Safety Equipment, Connections, and Meters Outcomes for this supporting competence include: I) Use safe work practices on electrically energized equipment. - Describe the hazards related to working with electrical circuits. - Describe safety precautions when working with electrical circuits. - Describe the physical properties of conductors, semiconductors and insulators. - Describe lockout tag out procedures related to working on electrical equipment. - Describe types of electrical connections. - Describe the applications of the various meters. - Describe the care and precautions associated with using meters. - Demonstrate range selection and connections of voltmeter, ammeter, ohmmeter and insulation testers.	I, II	12%
4B. Demonstrate knowledge of Current, Voltage, and Resistance Outcomes for this supporting competence include: I) Demonstrate knowledge of voltage, current and resistance and determine how changing the value of any one of them affects the circuit. - Describe an electric circuit. - Describe voltage, current and power. - Describe resistance and state and apply Ohm's Law. - Connect a circuit and verify relationships between voltage, current and resistance according to Ohm's Law.	I, II, III	9%
4C. Apply Knowledge of Circuits Outcomes for this supporting competence include: I) Connect a series resistive circuit and analyze the relationships between current, resistance and voltage. - Define a series circuit. - Apply the formula for total resistance in a series circuit. - Apply Kirchhoff's voltage law to a series circuit. - Determine the voltage drop across components in series circuits. - Connect and verify Kirchhoff's current and voltage laws in a series resistive circuit. II) Connect a parallel resistive circuit and analyze the relationships between current, resistance and voltage. - Define a parallel circuit. - Apply the formula for a total resistance in a parallel circuit. - Apply Kirchhoff's current law to a parallel circuit. - Describe the effects of open circuits on a parallel circuit. - Connect and verify Kirchhoff's current law in a parallel resistive circuit. III) Connect and analyze a series-parallel resistive circuit. - Identify resistors that are in series. - Identify resistors that are in parallel. - Calculate the total resistance of a series-parallel circuit. - Apply Kirchhoff's current law. - Apply Kirchhoff's voltage law. - Solve problems involving series-parallel circuits. - Connect and verify the relationship of current, voltage and resistance in each part of a series/parallel circuit.	I, II, III	22%

Core Competence 4: Controls and Electrical Systems

Supporting Competence	Taxonomy	Weighting
4D. Describe Methods of Producing Electromotive Force (EMF) and Magnetism Outcomes for this supporting competence include: I) Apply knowledge of EMF when servicing RAC equipment. - Describe the production of EMF by using chemicals. - Describe the production of EMF by using heat. - Describe the production of EMF by using pressure. - Describe the production of EMF by using light. - Describe the production of EMF by using magnetism. - Describe the production of EMF by using electrostatics. - Describe the properties of magnetic materials. - Define the terminology related to magnetism. - Describe electromagnetism and basic design considerations for electromagnetic devices. - Describe how an induced voltage is generated. - Describe the process of electromagnetic induction.	I, II	12%
4E. Demonstrate Fundamental Knowledge of Alternating Current Outcomes for this supporting competence include I) Apply knowledge of alternating current (ac) circuits when servicing RAC equipment. - Describe the generation of an ac sine wave. - Determine the output frequency of an ac generator. - Calculate standard ac sine wave values. - Demonstrate the relationship between sine waves and phasor diagrams. - List the factors affecting impedance in an ac circuit.	I, II	9%
4F. Demonstrate Knowledge on Control Systems and Components Outcomes for this supporting competence include: I) Describe HVAC/R control circuits. - Describe components used in control circuits for refrigeration systems. - Describe the components of a medium temperature control circuit. - Describe the components of a low temperature control circuit. - Describe the differences between medium and low temperature control circuits. - Connect and verify operation of a medium temperature cooling control system. - Connect and verify operation of a low temperature cooling control system. - Describe components used in HVAC control circuits. - Describe the construction of HVAC control system components. - Describe the application of control components for HVAC system. - Describe the operation of HVAC control system components. - Connect and verify operation of a HVAC control system. - Describe components used in building control circuits. - Describe components and their applications of a pneumatic control system. - Describe the construction of building control system components. - Describe the application of control components for building control systems. - Describe the operation of building control systems. - Describe other systems that affect building control systems.	I, II	36%

Core Competence 5: Heating and Fuel Systems

Weighting – 15%



The outcomes for this supporting competence include describing the distribution and storage of natural and propane gas, understanding fuel gas properties, calculating pressures, and explaining combustion principles. It also involves adhering to regulations, performing calculations, and ensuring safe practices with fuel gases and gas-fired equipment.



Demonstrate knowledge, understanding and proficiency in fuel gas properties, regulations, storage, distribution, components and systems.

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
5A. Describe Distribution and Storage of Fuel Gas Outcomes for this supporting competence include: I) Describe distribution and storage of propane and natural gas. - Describe distribution and storage of natural gas. - Describe distribution and storage of propane gas. - Describe regulations pertaining to the distribution and storage of natural gas and propane gas. II) Install and service propane storage and handling systems. - Describe types of propane handling vessels. - Describe components used on propane systems. - Describe types of vaporizers. - Explain maintenance procedures for vessels and components. - Calculate size and placement of components.	I, II, III	49%
5B. Apply Knowledge on the Properties of Fuel Gas Outcomes for this supporting competence include: I) Explain basic fuel gas fundamentals. - Identify chemical formulas of fuel gas. - Describe the properties of fuel gas. - Calculate appliance input values using properties of fuel gas. II) Calculate pressures in metric and imperial values. - Define pressure and force. - State the six principles of hydrostatics. - Define pressure constants used for calculating pressures. - Describe atmospheric pressure and the effect of altitude. - Perform pressure and force calculations in both imperial and metric units. - Perform calculations to convert pressure units.	I, II, III	29%

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
5C. Apply Principles of Combustion Outcomes for this supporting competence include: I) Explain basics of combustion. 1. Identify definitions specific to combustion. 2. Explain the principles of combustion as a chemical change. 3. Identify impurities found in fuel gas 4. Describe the three methods of heat transfer. 5. Describe the principles of Charles and Boyles Law. 6. Define the terms latent and specific heat in combustion. 7. Describe the requirements for combustion air 8. Describe the products of complete and incomplete combustion. 9. Describe flame adjustment techniques and safety practices when adjusting gas-fired equipment.	I	6%
5D. Describe Pilot and Pilot Burners Outcomes for this supporting competence include: I) Service pilots, pilot burners, thermocouples and thermopiles. 1. Describe pilot burner types and terminology. 2. Describe characteristics of pilot burners 3. Identify parts of aerated and non-aerated pilot burners. 4. State the primary purpose of a gas pilot 5. Describe burner ignition tests performed on all pilots. 6. Describe operating principles of thermocouples and thermopiles. 7. Describe the operation tests performed on proven pilots energizing a thermocouple. 8. Describe methods of installing thermocouples and thermopiles on standard circuits. 9. Describe operational tests performed on thermocouples and thermopiles. 10. Describe diagnostic tests for thermocouples. 11. State causes for thermocouple failures. 12. Identify ignition systems. 13. Describe flame rectification. 14. Describe the operating principles. 15. Describe the sequence of operations. 16. Prepare the sequence of operations.	I, II	16%

Period Two Course Content

(8 weeks – 240 hours)

Period Two Core Competences	Weighting
Foundational Skills, Job Responsibilities, and Procedures	1%
Air Handling	N/A
Refrigeration and Mechanical Cooling	52%
Controls and Electrical Systems	25%
Heating and Fuel Systems	22%

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures Weighting – 1%



The outcomes for this supporting competence include understanding the application of the Canadian Electrical Code (CEC) in relation to the safe installation and maintenance of HVAC/R equipment and identifying those responsible for electrical installations.



Apply foundational skills essential to convey and receive critical training and workplace information.

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
1A. Apply Safety Legislation, Regulations & Industry Policy in the Trades		In Context

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
1B. Interpret Codes Outcomes for this supporting competence include: <i>1) Apply the Canadian Electrical Code (CEC) Part I, and the Alberta Electrical STANDATA to verify electrical installations in Alberta.</i> - Describe the purpose of the CEC Part 1. - Describe the procedures for the acceptance of the CEC by the provinces and the local authorities. - Describe the function of the electrical STANDATA. - Describe the organizational layout of the CEC. - Identify those responsible for an electrical installation.	II	100%
1C. Select, Use, and Maintain Tools and Instruments		In Context
1D. Interpret Drawings and Schematics		In Context
1E. Demonstrate Numeracy		In Context
1F. Demonstrate Communication Skills		In Context
1G. Demonstrate Literacy and Digital Literacy		In Context

Core Competence 2: Air Handling

Weighting – 0%



The outcomes for this supporting competence include mastering air flow design, maintaining air handling systems and accessories, and analyzing air filtration efficiencies. It also involves installing and aligning fans, belts, and mechanical drives, ensuring optimal system performance and air quality.



Demonstrate knowledge, understanding and proficiency of air properties, air flow design, air handling systems, accessories and filtration.

Core Competence 2: Air Handling

Supporting Competence	Taxonomy	Weighting
2A. Calculate Air Properties and Air Flow Design		In Context

Core Competence 2: Air Handling

Supporting Competence	Taxonomy	Weighting
2B. Describe Air Handling Systems and Accessories		In Context
2C. Analyze Air Filtration		In Context

Core Competence 3: Refrigeration and Mechanical Cooling

Weighting – 52%



The outcomes for this supporting competence include installing, commissioning, and troubleshooting refrigeration and mechanical cooling systems, identifying and operating system components, and performing refrigerant changeovers. It also involves preparing schematics, performing start-ups, and ensuring optimal system functionality and safety.



Demonstrate knowledge, understanding and proficiency in refrigeration principles, the vapour compression cycle, gas laws, pressure enthalpy, valve designs, valve functions, refrigerant and oil handling.

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
3A. Describe Refrigeration Principles		In Context
3B. Install and Service Refrigeration and Mechanical Cooling Systems Outcomes for this supporting competence include: 1) Performs system install and commissioning of refrigeration and mechanical cooling (RMC) systems. - Describe methods of selecting and locating system components. - Describe methods of mounting condensing units and evaporators. - Describe methods of connecting piping and accessories to an RMC system. - Compare the use of various piping materials. - Prepare an electrical wiring schematic for an RMC system. - Prepare a piping schematic for an RMC system. - Install and connect an RMC system. - Start-up an RMC system. - Complete a commissioning report for an RMC system.	I, II, III	49%

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
II) Identify types of cooling systems. 1. Identify the components used in a cooling system. 2. Describe the operation of a cooling system. 3. Identify the requirements for combining a basic cooling system with an existing forced-air heating system. 4. Observe the operation of a combined heating and cooling system. III) Troubleshoot, calculate and analyze refrigeration and mechanical cooling (RMC) systems. 1. Define thermal dynamics as it pertains to service and troubleshooting of RMC systems. 2. Describe pressure enthalpy diagrams as they relate to various RMC system conditions. 3. Describe formulas used in analyzing system thermal dynamics. 4. Analyze and troubleshoot RMC systems using pressure enthalpy diagrams and thermal dynamic formulas. 5. Use tools and charts to troubleshoot RMC systems under various conditions.		
3C. Demonstrate Knowledge of Components in Refrigeration and Mechanical Cooling Systems. Outcomes for this supporting competence include: I) Demonstrate knowledge of evaporator feed controls on refrigeration equipment. 1. Define terms related to evaporator feed control and refrigeration effect. 2. Describe types and operations of evaporator feed controls. 3. Describe components of evaporator feed control systems. 4. Describe control characteristics of expansion control devices. 5. Describe methods of producing the refrigeration effect. 6. Determine the proper metering device for various applications. 7. Demonstrate troubleshooting techniques of metering devices. 8. Measure superheat and adjust a thermal expansion valve (TXV). II) Identify refrigeration accessories. 1. Define terms related to refrigeration accessories. 2. Describe components related to refrigeration accessories. 3. Describe the operation of various refrigeration accessories. 4. Describe the application of various refrigeration accessories. III) Describe the operation and components of evaporative condensers and cooling towers. 1. Define terms related to evaporative condensers and cooling towers. 2. Describe evaporative condenser components and their applications. 3. Describe cooling tower components and their applications. 4. Describe water treatment procedures as it relates to cooling towers. 5. Describe seasonal operation of cooling towers. IV) Describe the operation and components of evaporators and condensers. 1. Define terms related to evaporators and condensers. 2. Describe evaporator components and their applications. 3. Describe evaporator defrost methods. 4. Describe condenser components and their applications. 5. Describe service and repair of evaporators and condensers. 6. Describe how distributors avoid excessive pressure drops in a system. 7. Demonstrate evaporator and condenser sizing and balancing methods.	I, II	45%

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
V) Perform compressor diagnosis and repairs. 1. Define terms related to compressors and refrigeration circuit components. 2. Describe types of compressors used in refrigeration and mechanical cooling systems. 3. Describe the components and operating characteristics of compressors. 4. Define terms related to compressor mechanical components. 5. Describe compressor components and their applications. 6. Describe the compression process and the flow of gas through the compressor. 7. Describe types of compressor lubrication. 8. Describe mechanical and electrical oil failure controls. 9. Describe compressor capacity control systems. 10. Label a compressor circuit. 11. Disassemble and reassemble a small semi hermetic compressor. 12. Identify required direction of rotation of compressor. 13. Install, wire and check the operation of an oil failure control. VI) Describe automatic flow controls in a refrigeration system. 1. Define terms related to automatic flow controls. 2. Describe components of automatic flow controls. 3. Describe the operation of automatic flow controls. 4. Describe the application of automatic flow controls. 5. Demonstrate service of automatic flow controls.		
3D. Perform Refrigerant Changeover on Refrigeration and Mechanical Cooling Systems. Outcomes for this supporting competence include: I) Perform Refrigerant Changeover on RMC systems. 1. Describe steps used in changing refrigerants within RMC system. 2. Describe the hazards related to changing refrigerants RMC systems. 3. Describe start-up and monitoring steps of a changing refrigerants RMC system. 4. Describe considerations of system functionality following a changeover (glide, leaks, glands, oil compatibility, seal compatibility, capacity) 5. Perform a refrigerant changeover.	I, II	6%

Core Competence 4: Controls and Electrical Systems

Weighting – 25%



The outcomes for this supporting competence include connecting and analyzing motors, compressors, and transformers, understanding three-phase electrical systems, troubleshooting electrical faults, and demonstrating knowledge of control system, circuits and components.



Demonstrate knowledge, understanding and proficiency in electrical safety, theory, controls, components and design.

Core Competence 4: Controls and Electrical Systems

Supporting Competence	Taxonomy	Weighting
4A. Connect and Analyze Motors Outcomes for this supporting competence include: I) Connect and analyze split-phase, single phase motors. - Describe the components, principles of operation and applications of a resistive start split-phase motor. - Describe the components, principles of operation and applications of a capacitor-start motor. - Describe the components, principle of operation and applications of a permanent-split-capacitor motor. - Describe the components, principle of operation and applications of a capacitor start/capacitor run motor. - Describe the components, principle of operation and applications of an ECM motor. - Draw connection diagrams for single phase motors. - Connect and analyze a dual voltage motor and reverse it. - Connect and analyze a multispeed single-phase motor. II) Connect and analyze compressors and circuit components. - Describe motor starters and relays of compressors. - Describe motor protection used for compressors. - Prepare a motor starter circuit. - Prepare a compressor overload circuit. - Connect a single-phase compressor circuit. - Troubleshoot compressor motor failures and determine clean up procedures.	I, II, III	39%
4B. Connect Transformers Outcomes for this supporting competence include: I) Connect single-phase transformers. - Describe the construction of a mutual induction transformer. - Describe the construction of a single winding transformer. - Determine the transformation ratio and volts-per-turn value of a transformer. - Describe transformer operation. - Describe the operation of current limiting (Class 2) transformers. - Describe the efficiency of a transformer. - Calculate the efficiency of a transformer. - Describe the connections for a multiple tap transformer. - Identify, connect and perform tests on transformers.	I, II, III	7%
4C. Describe Class 1 and Class 2 Circuits Outcomes for this supporting competence include: I) Describe CEC requirements for Class 1 and Class 2 Circuits. - Define the terms from the CEC on Class 1 and Class 2 circuits. - Identify the requirements for Class 1 and Class 2 circuits. - Identify the Class 2 circuits as they apply to industry.	I	3%

Core Competence 4: Controls and Electrical Systems

Supporting Competence	Taxonomy	Weighting
4D. Describe Three-Phase Fundamentals Outcomes for this supporting competence include: I) Describe three phase electrical systems. - Describe the difference between single phase power and three phase power. - Describe the generation of the phase voltages of a three-phase system. - Describe the phase sequence of three phase sine waves. - Describe the advantages and disadvantages of three phase power over single phase power.	I, II	10%
4E. Troubleshooting Electrical Systems Faults Outcomes for this supporting competence include: I) Troubleshoot electrical system faults. - Describe electrical problems. - Describe methods used to test circuits. - Describe the possible effects of over voltage and under voltage on components. - Describe the importance of full load amps, lock rotor amps and free running amps. - Use wiring diagrams to troubleshoot electrical systems. - Diagnose electrical motor problems using systematic test flowcharts. - Perform tests on other electrical devices.	I, II, III	15%
4F. Demonstrate Knowledge of Control Systems and Components Outcomes for this supporting competence include: I) Connect and troubleshoot basic 24 V and 120 V gas-fired, forced-air heating systems. - Identify the components used in a basic gas-fired, forced-air heating system. - Describe the operation of a domestic heating system using a 24 V control circuit. - Describe the operation of a unit heater using a 120 V control circuit. - Describe the installation and operation of a fan interlock system on a residential forced air heating system. - Connect and verify a 24 V and 120 V control heating system. - Diagnose and repair 24 V and 120 V heating systems. II) Explain the basic principles for automatic controls for heating and cooling systems. - Describe the basic requirements of heating and cooling systems. - Describe the control components of a basic forced-air heating system. - Interpret basic electrical diagrams used to show the function of a heating or cooling control system. - Identify code requirements relating to the electrical installation of heating and cooling systems. III) Service temperature sensing and control devices. - Identify operating characteristics of temperature-sensing devices. - Describe the application of temperature-sensing devices used in heating and cooling systems. - Describe the functions of thermostats in heating and cooling systems.	I, II	26%

Core Competence 5: Heating and Fuel Systems

Weighting – 22%



The outcomes for this supporting competence include servicing draft hoods, vent connectors, pressure regulators, orifices, pilots, pilot burners, and propane storage systems, and troubleshooting HVAC control circuits.



Demonstrate knowledge, understanding and proficiency in fuel gas properties, regulations, storage, distribution, components and systems.

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
5A. Describe Distribution and Storage of Fuel Gas		In Context
5B. Apply Knowledge on the Properties of Gas		In Context
5C. Apply Principles of Combustion		In Context
5D. Describe Flues, Draft Hoods, and Vent Connections Outcomes for this supporting competence include: I) Service draft hoods and vent connectors. 1. Define terminology pertaining to flues and draft control devices. 2. Describe flue collars and types of draft hoods including installation procedures. 3. Explain regulations pertaining to the sizing, installation and use of draft hoods on gas burning appliances as listed in the CAN/CSA B149.1 <i>Natural Gas and Propane Installation Code and STANDATA</i>. 4. Describe installation procedures for single and double acting barometric dampers. 5. Explain regulations pertaining to the selection, sizing, installation and use of draft control devices as specified in the CAN/CSA B149.1 <i>Natural Gas and Propane Installation Code and STANDATA</i>. 6. Describe vent connectors and installation techniques. 7. Explain regulations pertaining to vent connectors as listed in the CAN/CSA B149.1 <i>Natural Gas and Propane Installation Code and STANDATA</i>. 8. Size vent connectors using minimum size rules.	I, II	11%

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
5E. Install and Service Pressure Regulators and Orifices Outcomes for this supporting competence include: I) Service gas line components. - Describe types, operating principles and applications of various gas pressure regulators. - Identify regulator sizing tables and list and describe correct installation procedures for various regulators. - Troubleshoot a regulator. - Describe maintenance procedures for various regulators. - Describe pressure regulator problems and corrective procedures. - Calculate sizing of relief vents. - Describe the types of meters. II) Service burner orifices. - Identify types of orifices. - Use orifice sizing charts to determine orifice sizing for specific gas consumptions and pressure in both metric and imperial units. - Drill an orifice according to specific gas requirements. - Demonstrate procedures for testing an orifice and adjust manifold pressure on HVAC equipment.	I, II	28%
5F. Troubleshoot Basic Heating and Cooling Control Circuits of an HVAC Unit. Outcomes for this supporting competence include I) Troubleshoot a basic commercial heating and cooling control circuit for an HVAC unit. - Describe the components of an HVAC unit. - Describe the operation of an HVAC unit. - Describe the applications of thermostats. - Describe procedures for troubleshooting a HVAC unit. - Troubleshoot the operation of a HVAC unit. II) Connect and troubleshoot mid and high-efficiency, gas-fired, forced-air heating systems. - Identify the components of a mid-efficiency, gas-fired, forced-air heating system. - Troubleshoot a mid-efficiency, gas-fired, forced-air heating system. - Troubleshoot a high-efficiency, gas-fired, forced-air heating system. - Describe the purpose of and application of auxiliary equipment used with gas-fired, forced-air heating systems. - Connect and verify the operation of a direct spark ignition system in a high-efficiency gas-fired furnace. - Connect and verify the operation of a hot surface ignition system in a high-efficiency gas-fired furnace. III) Troubleshoot basic hydronic heating systems. - Describe the operation of a basic hot water heating system. - Identify the purpose and application of the components of a hot water heating system. - Analyze and troubleshoot the operation of a hot water heating system. IV) Service alternative heating systems. - Describe alternative heat sources. - Describe alternative heat source systems.	I, II, III	35%

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
5G. Demonstrate Knowledge on Burners up to 400 MBH Adjustments and Calculate Gas Consumption Outcomes for this supporting competence include: I) <i>Install and service burners up to 400 MBH.</i> - Describe types of burners. - Describe components of burners. - Explain the ignition process for burners. II) <i>Install and adjust pressure controls and gas-fired burners using ratings plates, gas meters, manometers and mechanical gauges to optimize consumption for gas-fired appliances.</i> - Determine appliance settings using rating plates, altitude designation and listed approval agencies. - Describe the requirements from the CAN/CSA B149.1 Natural Gas and Propane Installation Codes, CAN/CSA B149.2 Propane Storage and Handling Code and the Plumbing and Gas Safety Service Bulletin pertaining to gas appliance and adjustments and installer's responsibilities. - Define parts of a burner and burner terminology. - Measure manifold pressures to determine gas consumption of burners in both imperial and metric units. - Adjust orifices and manifold pressures to optimize gas consumption. - Identify meter dials and meter indexes in both metric and imperial units. - Calculate gas consumption using timed high and low pressure meter readings.	I, II	26%

Period Three

Course Content

(8 weeks – 240 hours)

Period One Core Competences	Weighting
Foundational Skills, Job Responsibilities, and Procedures	2%
Air Handling	9%
Refrigeration and Mechanical Cooling	51%
Controls and Electrical Systems	8%
Heating and Fuel Systems	30%

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Weighting – 2%



The outcomes for this supporting competence include applying the B52 Mechanical Refrigeration Code and the Canadian Code of Practice to ensure safe and compliant installation and maintenance of refrigeration and air conditioning equipment in Alberta and interpreting electrical diagrams for HVAC systems.



Apply foundational skills essential to convey and receive critical training and workplace information.

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
1A. Apply Safety Legislation, Regulations & Industry Policy in the Trades		In Context

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
1B. Interpret Codes Outcomes for this supporting competence include: I) Apply the B52 Mechanical Refrigeration Code and the Canadian Code of Practice to install Refrigeration and Air Conditioning equipment in Alberta. - Describe how the B52 relates to the refrigeration and air conditioning installations. - Describe how the Canadian Code of Practice relates to the refrigeration and air conditioning installations. - Demonstrate how the B52 is used in determining minimum standards in a refrigeration and air conditioning install and maintenance work in industrial applications. - Demonstrate how the Canadian Environmental Code of Practice is used in determining minimum standards in a refrigeration and air conditioning install and maintenance work in industrial applications. - Describe how ABSA is used to determine the standards of piping and pressure vessel requirements.	I, II	40%
1C. Select, Use, and Maintain Tools and Instruments		In Context
1D. Interpret Drawings and Schematics Outcomes for this supporting competence include: I) Interpret electrical diagrams used in refrigeration and HVAC systems. - Describe electrical diagrams used in refrigeration and HVAC systems. - Describe symbols and terminology used in refrigeration and HVAC systems. - Interpret diagrams for refrigeration and HVAC systems. - Prepare electrical diagrams for a refrigeration and HVAC system.	I, II	60%
1E. Demonstrate Numeracy		In Context
1F. Demonstrate Communication Skills		In Context
1G. Demonstrate Literacy and Digital Literacy		In Context

Core Competence 2: Air Handling

Weighting – 9%



The outcomes for this supporting competence include calculating air properties and air flow design, servicing make-up air units, using air instruments for system balancing, and calculating HVAC load requirements. It also involves understanding advanced air flow calculations, psychrometric charts, and troubleshooting techniques for HVAC systems.



Demonstrate knowledge, understanding and proficiency of air properties, air flow design, air handling systems, accessories and filtration.

Core Competence 2: Air Handling

Supporting Competence	Taxonomy	Weighting
2A. Calculate Air Properties and Air Flow Design Outcomes for this supporting competence include: <i>I) Explain the properties of air as it relates to advanced air flow design.</i> - Describe terminology and formulas used in advanced air flow calculations. - Describe the psychrometric chart as it relates to air conditioning systems. - Identify the points and lines represented on a psychrometric chart. - Describe tools used for measuring air properties. - Measure and plot an HVAC system to determine its characteristics. - Describe troubleshooting techniques used for air handling equipment in HVAC systems. - Demonstrate troubleshooting techniques for air handling equipment in an HVAC system.	I, II	28%
2B. Describe Air Handling Systems and Accessories		In Context
2C. Analyze Air Filtration		In Context
2D. Describe Make-Up Air Systems Outcomes for this supporting competence include: <i>I) Service make-up air units.</i> - Describe terminology used in make-up air units. - Describe components used in make-up air units. - Describe applications and limitations of make-up air components. - Describe designs of make-up air systems.	I, II	27%
2E. Use Air Instruments for System Balancing Outcomes for this supporting competence include: <i>I) Use air instruments to analyze and balance HVAC systems.</i> - Define terms used in air balancing. - Describe the tools and instruments used in system balancing. - Calculate air velocity and volumes using tables and charts. - Use air instruments to measure, analyze and balance a HVAC system.	I, II	18%

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
2F. Calculate HVAC Load Requirements Outcomes for this supporting competence include: 1) Calculate loads for HVAC systems, design and select equipment. - Describe terminology and formulas used in HVAC load calculations. - Describe HVAC loads. - Describe short and long methods of load calculating. - Calculate HVAC load requirements. - Describe ventilation requirements using ASHRAE standards. - Describe terminology and formulas used in system design and equipment selection. - Describe HVAC systems and equipment. - Describe equipment applications and limitations. - Select HVAC equipment components.	I, II, III	27%

Core Competence 3: Refrigeration and Mechanical Cooling

Weighting – 51%



The outcomes for this supporting competence include demonstrating knowledge of air conditioning and industrial refrigeration systems, installing and maintaining ice machines, troubleshooting HVAC/R systems, understanding defrost methods, designing and installing HVAC/R piping systems, and calculating load requirements for refrigeration and air conditioning systems.



Demonstrate knowledge, understanding and proficiency in refrigeration principles, the vapour compression cycle, gas laws, pressure enthalpy, valve designs, valve functions, refrigerant and oil handling.

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
3A. Describe Refrigeration Principles		In Context
3B. Demonstrate knowledge on RAC Systems Outcomes for this supporting competence include: 1) Apply knowledge of the principal operations of an air conditioning system in servicing RAC equipment. - Describe terms associated with air conditioning systems. - Describe the components and their applications of comfort air conditioning systems.	I, II	29%

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
3. Describe the components and their applications of year-round air-conditioning systems. 4. Describe the components and their applications of process air conditioning systems. 5. Analyze the operation of an air conditioning system. 6. Plot readings from an air conditioning system on a psychrometric chart. 7. Measure and analyze a residential split system. 8. Measure and analyze a commercial air conditioning system. 9. Measure and analyze a heat pump system. 10. Measure and analyze a process air conditioning system. II) Describe industrial refrigeration systems. 11. Describe terminology used in industrial refrigeration systems. 12. Describe components of industrial refrigeration systems. 13. Describe applications and limitations of industrial refrigeration components. 14. Describe designs of industrial refrigeration systems. 15. Observe an industrial refrigeration system in operation.		
3C. Describe Ice Machine Operations Outcomes for this supporting competence include: I) Install and maintain ice machines. 1. Describe the operation of ice machines. 2. Describe the harvest methods of ice machines. 3. Describe the maintenance of ice machines. 4. Describe the cleaning of ice machines. 5. Connect and analyze ice machines.	I, II	2%
3D. Troubleshoot HVAC/R Systems Outcomes for this supporting competence include: I) Troubleshoot refrigeration and HVAC systems. 1. Describe electrical problems with HVAC/R systems. 2. Describe oil problems with HVAC/R systems. 3. Describe refrigerant problems with HVAC/R systems. 4. Describe compressor problems with HVAC/R systems. 5. Describe piping problems with HVAC/R systems. 6. Describe air flow problems with HVAC/R systems. 7. Describe methods used to test circuits in HVAC/R systems. 8. Use test equipment to troubleshoot HVAC/R system problems.	I, II, III	18%
3E. Demonstrate knowledge of Defrost methods, Circuits and Controls Outcomes for this supporting competence include: I) Install and Analyze Operation of defrosts circuits and controls. 1. Describe terminology and formulas used in defrost circuits and controls. 2. Describe methods of defrosting. 3. Describe defrost components and their applications. 4. Install, connect and analyze operation of defrost components.	I, II, III	7%

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
3F. Design and Install HVAC/R Piping System I) Design and install refrigeration and HVAC systems. - Describe terminology and formulas used in piping design. - Describe refrigeration and HVAC piping systems. - Describe piping applications and limitations. - Describe gas defrost piping methods. - Calculate requirements for HVAC/R piping systems. - Connect and analyze a low temperature refrigeration system and components. - Analyze the design and installation of a medium temperature refrigeration system and components. - Analyze the design and installation of a split HVAC system and components.	I, II, III	24%
3G. Calculate Refrigeration and Air Conditioning Load Requirements. I) Calculate loads for refrigeration systems and select equipment. - Describe terminology and formulas used in refrigeration load calculations. - Describe refrigeration loads. - Describe short and long methods of load calculating. - Describe infiltration loads and food preservation. - Calculate refrigeration load requirements. - Describe terminology and formulas used in system design and equipment selection. - Describe refrigeration systems and equipment. - Describe equipment applications and limitations. - Select refrigeration equipment components.	I, II	20%

Core Competence 4: Controls and Electrical Systems

Weighting – 8%



The outcomes for this supporting competence include installing, analyzing, and troubleshooting three-phase motors and variable frequency drives (VFDs), understanding motor connections, protection, and characteristics, and programming VFDs for optimal performance.



Demonstrate knowledge, understanding and proficiency in electrical safety, theory, controls, components and design.

Core Competence 4: Controls and Electrical Systems

Supporting Competence	Taxonomy	Weighting
4A. Connect and Analyze Motors Outcomes for this supporting competence include: I) Install three-phase motors. - Describe motor installation methods. - Describe three phase motor connections. - Describe three phase motor starting methods. - Describe methods of reversing three phase motors. - Describe three phase motor protection. - Install and analyze a three-phase dual voltage motor connection. - Install and analyze a three-phase two speed motor connection. - Install and analyze a three-phase part winding motor connection. - Install and analyze a three-phase wye motor connection. - Install and analyze a three-phase delta motor connection. II) Describe three-phase motors. - Identify terms related to three-phase induction motor. - Describe the characteristics of mechanical loads. - Describe the construction of a three-phase induction motor. - Describe the principle of operation of a squirrel-cage induction motor. - Describe information located on a motor nameplate and calculate horsepower, motor efficiency and speed regulation. - Describe rotor parameters including synchronous speed, breakdown torque, and the effect that slip has on rotor parameters. - Identify NEMA ratings. - Describe the wound-rotor motor and its electrical and mechanical characteristics. - Describe the relationship between torque and rotor electrical characteristics in a squirrel-cage induction motor.	I, II, III	70%
4B. Demonstrate Knowledge of Variable Frequency Drives (VFD) Outcomes for this supporting competence include: I) Program, adjust and troubleshoot variable frequency drives. - Describe the principles of operation of ac induction in VFD motors. - Compare methods of speed control of ac induction motors. - Describe the application of a VFD. - Describe the principles of operation and application of a dc motor used with VFD. - Connect, program and troubleshoot a VFD.	I, II, III	30%

Core Competence 5: Heating and Fuel Systems

Weighting – 30%



The outcomes for this supporting competence include troubleshooting electronic ignition systems, installing and servicing natural and fan-assisted draft appliances, venting systems, air supply systems, gas appliances, and gas-fired boilers. It also involves understanding regulations, performing installations, and ensuring safe and efficient operation of HVAC systems.



Demonstrate knowledge, understanding and proficiency in fuel gas properties, regulations, storage, distribution, components and systems.

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
5A. Describe Distribution and Storage of Fuel Gas		In Context
5B. Apply Knowledge on the Properties of Gas		In Context
5C. Apply Principles of Combustion		In Context
5D. Troubleshoot Electronic ignition Systems Outcomes for this supporting competence include: I) Troubleshoot electronic ignitions. - Describe the operation of basic ignition systems used in mid and high-efficiency appliances. - Describe the application and sequence of operation of electronic controls. - Interpret electrical schematic drawings. - Describe diagnostic techniques and routine maintenance requirements for electrical controls.	I, II	11%
5E. Install and Service Natural and Fan Assisted Draft Appliances Outcomes for this supporting competence include: I) Install and service gas fired appliances, and conversion burners. - Describe requirements of the types of burners used in natural and power assisted draft appliances. - Explain the relationship between fan speed and volume delivered. - Explain the relationship between volume delivered and static pressure. - Explain the selection requirements for fan units. - Describe the differences in fan location between natural, induced and forced. - Describe procedures for converting an appliance from one gas to another.	I, II, III	89%

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
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7. Describe regulations, applicable Gas Codes and as they apply to natural and fan-assisted draft appliances.
8. List and explain the safe light-up requirements for burners.

II) Size a gas line system.

1. Identify the type of gas and pressure.
2. Identify the type of gas line material.
3. Calculate the volume of gas consumed by appliance(s).
4. Draw a gas line system.
5. Calculate the length of the gas piping system using different piping materials.

III) Install a gas line system.

1. Prepare a materials list for a gas line.
2. Install a gas line.
3. Test a gas line.

IV) Install and service venting systems.

1. Describe venting principles.
2. Describe the types of flues and draft control devices.
3. List the installation procedures for types of venting materials.
4. Size vents according to appliance category.
5. Size chimneys and liners.
6. Describe installation procedures for single and double acting barometric dampers.
7. Describe vent and chimney applications for gas and alternate fuel appliances.

V) Install and service air supply systems.

1. Describe air supply principles.
2. Calculate the free area of grills and louvers.
3. Calculate the size of air supply ducts.
4. Calculate the air required for combustion, ventilation and flue gas dilution.

VI) Install a gas appliance.

1. Describe the categories of appliances.
2. Identify rating plate requirements for specific appliances.
3. Identify gas appliance approval agencies.
4. Describe installation requirements for finish piping.
5. Explain the altitude rating requirements for appliances.
6. Calculate altitude ratings.
7. Apply manufacturer specifications with appliance installation.

VII) Install and service gas fired boilers.

1. Describe the operation of boilers.
2. Apply standards from CSA B149.1, ASME and CSA B51.
3. Describe the operation of boiler controls.
4. List the sequencing process of the boiler controls.
5. Prepare wiring diagrams for a gas fired boiler.
6. Troubleshoot a gas fired boiler.

Period Four Course Content

(8 weeks – 240 hours)

Period One Core Competences	Weighting
Foundational Skills, Job Responsibilities, and Procedures	10%
Air Handling	28%
Refrigeration and Mechanical Cooling	28%
Controls and Electrical Systems	21%
Heating and Fuel Systems	13%

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures Weighting – 10%



The outcomes for this supporting competence include using Red Seal products to challenge an interprovincial examination, applying the B52 Mechanical Refrigeration Code and the Canadian Code of Practice for HVAC/R piping systems, and demonstrating knowledge of HVAC/R drawings and schematic diagrams.



Apply foundational skills essential to convey and receive critical training and workplace information.

Core Competence 1: Foundational Skills, Job Responsibilities, and Procedures

Supporting Competence	Taxonomy	Weighting
1A. Apply Safety Legislation, Regulations & Industry Policy in the Trades Outcomes for this supporting competence include: 1) Use Red Seal products to challenge an Interprovincial examination. - Identify Red Seal products used to develop Interprovincial examinations. - Use Red Seal products to prepare for an interprovincial examination.	I	8%

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
1B. Interpret Codes Outcomes for this supporting competence include: I) Apply the B52 Mechanical Refrigeration Code and the Canadian Code of Practice to install Air Conditioning piping systems in Alberta. - Describe how the B52 relates to the Refrigeration and Air Conditioning piping systems design and construction. - Describe how to use the practical hand book for implementing B52 code. - Describe how the Canadian Environmental Code of Practice relates to the Refrigeration and Air Conditioning piping systems design and construction.	I, II	17%
1C. Select, Use, and Maintain Tools and Instruments		In Context
1D. Interpret Drawings and Schematics Outcomes for this supporting competence include: I) Demonstrate Knowledge of HVAC/R drawings. - Describe the process for developing a material takeoff list. - Develop a scale layout for refrigeration or HVAC system. - Compile a list of equipment. - Compile a list of supply materials. - Develop a material takeoff list from drawings. II) Interpret schematic diagrams used in refrigeration and HVAC systems. - Describe types of schematic diagrams used in refrigeration and HVAC systems. - Describe symbols and terminology used in refrigeration and HVAC schematic diagrams. - Interpret schematic diagrams for refrigeration and HVAC systems. - Draw schematic diagrams for a refrigeration and HVAC system.	I, II	75%
1E. Demonstrate Numeracy		In Context
1F. Demonstrate Communication Skills		In Context
1G. Demonstrate Literacy and Digital Literacy		In Context

Core Competence 2: Air Handling

Weighting – 29%



The outcomes for this supporting competence include installing, maintaining and servicing complex HVAC systems and make-up air systems. It involves understanding components, control methods, maintenance procedures, and systematic troubleshooting approaches and applications of new technology.



Demonstrate knowledge, understanding and proficiency of air properties, air flow design, air handling systems, accessories and filtration.

Core Competence 2: Air Handling

Supporting Competence	Taxonomy	Weighting
2A. Calculate Air Properties and Air Flow Design		In Context
2B. Describe Air Handling Systems and Accessories		In Context
2C. Analyze Air Filtration		In Context
2D. Service HVAC and Make-Up Air Systems Outcomes for this supporting competence include: I) Service mechanical drives for fan systems. 1. Define terms used for advanced mechanical drives for fan systems. 2. Describe components and their applications of mechanical drives for fan systems. 3. Describe the properties of fan performance for fan systems. 4. Describe maintenance and adjustment procedures of advanced mechanical drives for fan systems. 5. Troubleshoot complex mechanical drive systems problems. II) Service complex HVAC systems. 1. Define terms used in complex HVAC systems. 2. Describe components and their applications in complex HVAC systems. 3. Describe methods used to control complex HVAC systems. 4. Describe designs of complex HVAC systems. 5. Describe the operation of complex HVAC systems. 6. Operate and analyze a complex HVAC system. III) Service energy management systems (EMS) to optimize indoor air quality. 1. Define terms used in EMS and indoor air quality. 2. Describe the components and their applications of EMS and indoor air quality equipment. 3. Describe designs and principles of EMS. 4. Describe maintenance procedures of indoor air quality equipment. IV) Service make-up air systems. 1. Describe auxiliary components of make-up air systems. 2. Describe control systems of make-up air units. 3. Describe burner operations of make-up air systems. 4. Describe cooling control systems of make-up air units. 5. Observe operation of a make-up air system.	I, II	52%

Core Competence 2: Air Handling

Supporting Competence	Taxonomy	Weighting
2E. Install of HVAC/R Systems Outcomes for this supporting competence include: <i>I) Install and maintain HVAC equipment.</i> 1. Define installation procedures used in installing HVAC units. 2. Describe considerations of location and equipment when installing HVAC systems. 3. Describe start-up and shut-down procedures of HVAC systems. 4. Describe system maintenance procedures of HVAC systems. 5. Demonstrate start-up and shut-down procedures of HVAC systems	I, II	12%
2F. Troubleshoot Make-Up Air Systems Outcomes for this supporting competence include: <i>I) Troubleshoot make-up air systems.</i> 1. Describe problems associated with make-up air equipment. 2. Describe a systematic approach to troubleshooting make-up air equipment. 3. Commission and start-up a make-up air system. 4. Troubleshoot system faults of make-up air equipment.	I, II, III	14%
2G. Troubleshoot Complex HVAC Systems Outcomes for this supporting competence include: <i>I) Troubleshoot complex HVAC systems.</i> 1. Define problems associated with complex HVAC equipment. 2. Describe a systematic approach to troubleshooting complex HVAC equipment. 3. Describe maintenance procedures of complex HVAC equipment. 4. Troubleshoot complex HVAC equipment.	I, II, III	18%
2H. Describe New Environmental Technology Outcomes for this supporting competence include: <i>I) Apply changing trends in environmental technology to upgrade RAC equipment.</i> 1. Define terms related to environmental technology as it relates to the HVAC and refrigeration industry. 2. Identify issues that relate to environmental technology as it relates to the HVAC and refrigeration industry. 3. Describe authorities having jurisdiction on environmental technology as it relates to the HVAC and refrigeration industry. 4. Identify legislation and codes as it relates to environmental technology for the HVAC and refrigeration industry.	I, II	4%

Core Competence 3: Refrigeration and Mechanical Cooling

Weighting – 28%



The outcomes for this supporting competence include servicing ultra-low temperature systems, industrial refrigeration systems, chiller systems, multiplex systems, and circulating pumps. It involves understanding components, refrigerants, troubleshooting techniques, and performing installations and analyses for optimal system performance.



Demonstrate knowledge, understanding and proficiency in refrigeration principles, the vapour compression cycle, gas laws, pressure enthalpy, valve designs, valve functions, refrigerant and oil handling.

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
3A. Describe Refrigeration Principles		In Context
3B. Demonstrate knowledge on Ultra Low Compression Systems Outcomes for this supporting competence include: I) Service ultra-low temperature systems. 1. Define terms used in ultra-low temperature systems. 2. Describe the components and their applications of ultra-low temperature systems. 3. Describe the refrigerants specific to ultra-low temperature systems. 4. Describe special precautions required in the installation and servicing of ultra-low temperature systems. 5. Describe troubleshooting techniques used on ultra-low temperature systems. 6. Operate and analyze an ultra-low temperature system.	I, II	13%
3C. Service Industrial Refrigeration Systems Outcomes for this supporting competence include: I) Service industrial refrigeration systems. 1. Define terms related to industrial refrigeration systems. 2. Describe the components and their applications of industrial refrigeration systems. 3. Describe the operation of industrial refrigeration systems. 4. Describe troubleshooting techniques used on industrial refrigeration systems. 5. Observe and analyze the operation of an industrial refrigeration system. 6. Overhaul an industrial refrigeration compressor.	I, II, III	30%

Core Competence 3: Refrigeration and Mechanical Cooling

Supporting Competence	Taxonomy	Weighting
3D. Service Chiller Systems Outcomes for this supporting competence include: I) Service a chiller system. 1. Define terms used with chiller systems. 2. Define types of chillers. 3. Describe chiller system components and their applications. 4. Describe an absorption cycle. 5. Describe cooling towers and evaporative condensers. 6. Describe refrigerants specific to chiller systems. 7. Describe start-up and shut-down procedures of chiller systems. 8. List and identify cross connection control devices and describe their operation. 9. Observe a chiller and tower system in operation. 10. Observe a centrifugal chiller tear-down.	I, II	21%
3E. Service Multiplex Systems Outcomes for this supporting competence include: I) Service multiplex systems. 1. Define terms related to multiplex systems. 2. Describe the components and their applications of multiplex systems. 3. Describe the operation of multiplex systems. 4. Describe troubleshooting techniques used on multiplex systems. 5. Observe and analyze the operation of a multiplex system.	I, II, III	24%
3F. Demonstrate Knowledge on Circulating Pumps Outcomes for this supporting competence include: I) Service circulating pumps. 1. Define terms related to circulating pumps. 2. Describe the components and their applications of circulating pumps. 3. Describe the operation of circulating pumps. 4. Describe troubleshooting techniques used on circulating pumps. 5. Calculate performance of a circulating pump using system curve and pump curve. 6. Observe and analyze the operation of a circulating pump.	I, II	12%

Core Competence 4: Controls and Electrical Systems

Weighting – 21%



The outcomes for this supporting competence include installing, maintaining, and troubleshooting electromechanical, automation, electronic control systems, and economizer controls, as well as maintaining electrical components of HVAC/R equipment.



Demonstrate knowledge, understanding and proficiency in electrical safety, theory, controls, components and design.

Core Competence 4: Controls and Electrical Systems

Supporting Competence	Taxonomy	Weighting
4A. Install and Maintain Electromechanical Control Systems. Outcomes for this supporting competence include: I) Install and maintain electromechanical control systems. 1. Define terms used in electromechanical control systems. 2. Describe components and their applications of electromechanical control systems. 3. Describe calibration methods of electromechanical control systems. 4. Describe design and application of electromechanical control systems. 5. Describe maintenance procedures of electromechanical control systems. 6. Connect and calibrate an electromechanical control system.	I, II	24%
4B. Maintain Electrical Components of HVAC/R equipment Outcomes for this supporting competence include: I) Maintain electrical components found in HVAC/R equipment. 1. Identify problems associated with electrical components in HVAC/R equipment. 2. Describe a systematic approach to troubleshooting HVAC/R equipment. 3. Use advanced electrical schematic drawings in troubleshooting electrical problems in HVAC/R equipment. 4. Troubleshoot HVAC/R equipment.	I, II, III	20%
4C. Install and Maintain Automation and Electronic Control Systems Outcomes for this supporting competence include: I) Install and maintain automation and electronic control systems. 1. Define terms used in automation and electronic control systems. 2. Describe components and their applications of automation and electronic control systems. 3. Describe programming methods of automation and electronic control systems. 4. Describe design and application of automation and electronic control systems. 5. Describe maintenance procedures of automation and electronic control systems. 6. Install and program automation and electronic control systems.	I, II	30%

Core Competence 4: Controls and Electrical Systems

Supporting Competence	Taxonomy	Weighting
4D. Service Economizer Controls and Accessories Outcomes for this supporting competence include: I) Service economizer controls and accessories. 1. Define terms used with economizer controls and accessories. 2. Describe components and their application of economizer controls and accessories. 3. Describe calibration methods of economizer controls and accessories. 4. Describe retrofit techniques for economizer controls for HVAC systems. 5. Describe design and applications of economizer controls and accessories. 6. Connect and calibrate an economizer control system with accessories.	I, II	26%

Core Competence 5: Heating and Fuel Systems

Weighting – 13%



The outcomes for this supporting competence include performing combustion analysis, troubleshooting gas-fired equipment, and commissioning appliances up to 400 MBH. It involves understanding combustion procedures, safety concerns, systematic troubleshooting approaches, appliance setup and verification.



Demonstrate knowledge, understanding and proficiency in fuel gas properties, regulations, storage, distribution, components and systems.

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
5A. Describe Distribution and Storage of Fuel Gas		In Context
5B. Apply Knowledge on the Properties of Gas		In Context
5C. Apply Principles of Combustion		In Context

Core Competence 5: Heating and Fuel Systems

Supporting Competence	Taxonomy	Weighting
5D. Perform Combustion Analysis Outcomes for this supporting competence include: <i>I) Perform combustion analysis.</i> 1. Define terms associated with combustion analysis. 2. Describe tools and equipment used for combustion analysis. 3. Describe procedures used in combustion analysis. 4. Describe safety concerns associated with combustion analysis. 5. Calculate CO₂, O₂ and excess air. 6. Describe the effects of flame temperature on nitrogen oxide. 7. Perform combustion analysis.	I, II	27%
5E. Troubleshoot Gas Fired Equipment Outcomes for this supporting competence include: <i>I) Troubleshoot gas fired equipment.</i> 1. Describe problems associated with gas fired equipment. 2. Describe a systematic approach to troubleshooting gas fired equipment. 3. Troubleshoot and solve problems associated with gas fired equipment. 4. Describe principles of modulating heating equipment.	I, II	33%
5F. Commission Appliances up to 400 MBH Outcomes for this supporting competence include: <i>I) Commission appliances up to 400 MBH.</i> 1. Describe appliance testing, start-up and setup procedures as per manufacture specifications. 2. Explain the requirements when conducting a pre-heat chimney procedure. 3. Verify gas pressures for the installation. 4. Verify electrical requirements. 5. Commission an appliance to manufacturer's specification.	I, II	40%



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