Refrigeration and Air Conditioning Mechanic - Residential

Provincial Occupational Analysis

October 2006

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GUIDE TO ANALYSIS

DEVELOPMENT OF ANALYSIS

A draft analysis is developed by a knowledgeable consultant who, with the assistance of a committee of industry experts, identifies all the tasks performed in the occupation.

The analysis is forwarded to other trade experts in the field for validation. Their recommendations are assessed and incorporated into the final draft.

STRUCTURE OF ANALYSIS

To facilitate the understanding of the nature of the occupation, the work performed is divided into the following divisions:

BLOCK (DUTY AREA)

The largest division within the analysis and reflects a distinct operation relevant to the occupation.

TASK

A distinct activity that, combined with others, makes up the logical and necessary steps an individual is required to perform to complete a specific assignment within a "BLOCK."

SUB-TASK

The smallest division into which it is practical to sub-divide any work activity and, combined with others, fully describes all duties constituting a "TASK."

Supporting Knowledge and Abilities

The elements of skill and knowledge that an individual must acquire to perform the task adequately.

VALIDATION METHOD

A draft of the analysis is reviewed for validity by several Manitoba trade experts. The trade experts review each sub-task and provide feedback on whether it is performed by others in the occupation in Manitoba.

The committee of industry experts applies percentage ratings to the blocks. These ratings facilitate the weighting of the Provincial Certification Examination.

SCOPE OF THE OCCUPATION

This Provincial Occupational Analysis (POA) outlines the major tasks performed by Residential Heating, Ventilation, and Air-conditioning (RHVAC) Technicians in Manitoba as identified by work in the RHVAC market, and who participated in a DACUM Workshop convened by the Apprenticeship Branch, Manitoba Department of Competitiveness, Training and Trade, during October to December, 2006. technicians themselves. This POA is based on consultations with subject matter experts who
The resulting POA identifies the RHVAC Technician as a tradesperson who specializes in the planning, installation, and maintenance of residential HVAC systems. The analysis attempts to cover the full range of competencies required in the residential home heating and cooling industry, some of which are shared with other trades.

For the purpose of this POA, the term 'residential' refers to single-family dwellings that include private houses, condominium units, and duplexes with individual heating and cooling HVAC systems. The term 'HVAC system' refers to heating, cooling, as well as indoor air quality (IAQ). Specifically, the home heating dimension of the RHVAC technician's work includes electric, gas, and oil furnaces; hydronic heating systems, geothermal, and solid fuel appliances. By contrast, the home cooling dimension includes vapour-compression air-conditioning systems.

Manitoba RHVAC Technicians may be self-employed in their own home heating and cooling businesses or employed by companies that service residential clients. Some of these employers provide both commercial and residential services to their various clients. However, the entitlement to undertake commercial work is subject to provincial regulations which also delineate the relationship between RHVAC and the work of Refrigeration/Air-Conditioning Mechanics, Sheet Metal Workers and other trades.

The RHVAC specialty is a relatively recent innovation within the Manitoba trade community and shares skill sets with a number of other trades. In a climate characterized by extremes in hot and cold temperatures, the work of maintaining the comfort and habitability of private dwellings is crucial and in keeping with provincial regulations shared by a number of designated trades.

In recent years, the RHVAC specialty has evolved in response to increased requirements for specialized skills and knowledge to address safety and environmental concerns. For instance, ozone layer depletion, indoor air quality and higher efficiencies related to fuel costs. Another driver in the RHVAC as a field of specialized knowledge/trade practice is the need for increased knowledge/understanding of residential structures as integrated systems best served by tradespeople who are dedicated to the planning, installing and maintaining of these systems.

An important dimension of the RHVAC technicians work involves new construction where state of the art components are used. However, the Manitoba residential housing stock varies widely in age and quality and the ability to maintain that stock frequently makes demands on the technician's ability to retrofit state of the art components, systems and appliances into older structures. Consequently RHVAC technicians need to be aware of current knowledge and be familiar with older ways of building and living in homes. Regardless of the age of dwellings, a significant dimension of the technician's

work involves technical and other communications with homeowners and other occupants about matters of vital concern that have economic, health as well as safety-related implications.

At the technical level, RHVAC technicians are required to work with a variety of indoor air quality systems that include air exchangers, specialty filters, air cleaners/purifiers, humidifiers, UV sterolizers, heat pump equipment and low and high voltage work. The tasks of the RHVAC specialty entails specialty skill sets that include the ability to interpret and comply with a complex regulatory environment, ability to visualize and design air handling systems and to use a variety of sophisticated tools and equipment. The latter are identified in a detailed appendix to the POA and include a number of tools that are shared with other Manitoba tradespeople. With few exceptions, the vast majority of the RHVAC technician's work is concentrated on residential project job sites, although, on occasion some technicians are required to produce or customize sheet metal fittings to comply with individual projects.

Similarly, some technicians will use skills sets from other trades to install tubing, piping and electrical components and techniques such as brazing and soldering during the installation or servicing of RHVAC systems.

However, as noted earlier, some of the processes may require additional certification and/or licensing as per provincial regulations and many technicians will seek these credentials. Important examples include the limited electrical license, the Gas B License, the Wood Energy Technology Transfer (WETT) Certificate, confined entry, MOPIA, and TODG Certificates. RHVAC technicians require highly-developed mechanical and mathematical aptitudes, hand-eye coordination, spatial perception and manual dexterity. They also require some technical and scientific knowledge with regard to safety, electricity, electronics, electric motors, microprocessors, troubleshooting strategies, blueprint reading and other document use, sketching, computer skills and customer relations.

An increasingly important dimension of RHVAC practice is the ability to provide workplace skills coaching/mentoring and other supports for apprentice level trade learning on the job. These technicians must also apply customer service skills which include effective strategies for communication, problem solving and conflict resolution.

SAFETY

Residential HVAC (RHVAC) technicians may be faced with a number of hazards on a daily basis. Such hazards as open flames, electricity and pressurized vessels can result in serious injury as well as equipment damage. Technicians who work in confined spaces may experience fumes and gases from refrigerants, soil substrates, adhesives, acetylene and other materials while servicing and installing. Other hazards include working with sharp metal pieces, at heights, with hot metals and cutting processes and moving/handling heavy equipment and tools..

RHVAC technicians need to be aware of all risks associated with their trade. An awareness of immediate surroundings, e.g., furnaces, and potential safety hazards is the best tool for maintaining safety standards on the job. The use of fire condensers, extinguishers, first aid and cardiopulmonary resuscitation (CPR) skills are invaluable in times of emergency.

Trade practitioners need to apply the provincial occupational Health and Safety Act and Workplace Hazardous Materials Information System (WHMIS) Regulations. Personal safety practices are not specifically recorded in this provincial occupational analysis. However, safety aspects related to each task and sub-task are included throughout this analysis.

List of Safety Regulations for RHVAC Technicians:

- MOPIA
- WHMIS
- Asbestos Abatement
- B.149A Gas Code
- TODG Certificate (Transportation of Dangerous Goods)
- Workplace Health and Safety Guideline
- Company Workplace Policies

Occupational Observations

New clean air regulations and consumer demands for improved efficiencies and air quality in living spaces requires
high quality installations, maintenance and servicing skills.

Older systems (furnaces and air conditioners) are being replaced by improved models with more sophisticated electronics. In addition, regional codes and regulations are increasingly important to the occupation in residential settings.

Consumers are seeking advancements in both heating and cooling for their homes. As a result, tradespeople are facing the increased use of electronic diagnostic and monitoring equipment such as computerized test equipment to assess air quality and new approaches to heat/energy recovery ventilation systems. Consequently, heat pumps and hydronic heating and cooling systems are becoming more common.

Home construction and renovation projects are larger and more advanced requiring exceptional service and trade expertise. Technicians must be expertly trained to safely install and service air conditioning and heating equipment to ensure the comfort and safety of those within homes. For this to occur, technicians must also understand the basics of matter (solid, liquid, vapour) energy and heat transfer theory (thermodynamics).

Residential clients are increasingly sophisticated in their knowledge of mechanical systems within homes. As a result, technicians must be aware of advancements related to product knowledge, new construction techniques and materials, and approaches to troubleshooting and customer-service techniques.

BLOCK A

OCCUPATIONAL SKILLS

***Trends**:* *Persistence of the established trend toward clients' greater knowledge of their own HVAC needs/expectations, resulting in higher demands upon RHVAC Technician's skills in such areas as technical communications, project/time management, problem-solving techniques, and customer relations.*

Task 1 Communicates with others regarding project.

Sub-task

1.01 Advises clients about current technologies and product options.

Supporting Knowledge and Abilities

1.01.01	Knowledge of HVAC technology past and present, including compatibility requirements when retrofitting older systems with newer products/components
1.01.02	Knowledge of options re: location, selection, efficiencies, trade-offs and other key considerations in project design and decision-making
1.01.03	Knowledge of options and limitations imposed by existing utility supply or service provider (electrical, gas, propane)
1.01.04	Knowledge of conflict-resolution concepts and practices
1.01.05	Ability to formulate viable options re: selection, location, compatibility, etc.
1.01.06	Ability to communicate HVAC technical information in lay terms
1.01.07	Ability to identify, locate, and interpret all requisite information from appropriate sources
1.01.08	Ability to focus on conflict or issue to point of resolution.

Sub-task

1.02 Consults with project team and/or individual subtrades re: project requirements.

Supporting Knowledge and Abilities

1.02.01	Knowledge of respective roles and responsibilities among team members and/or individual subtrades
1.02.02	Knowledge of technical communication and coordination requirements at project-team level
1.02.03	Knowledge of conflict-resolution concepts and practices
1.02.04	Ability to interpret technical documents and terminology used in other trades
1.02.05	Ability to monitor project re: adherence to specifications
1.02.06	Ability to schedule appropriately for time line sensitive projects with other trades

Sub-task

1.03 Provides workplace skills-coaching and other project-specific support to apprentices.

Supporting Knowledge and Abilities

1.03.01	Knowledge of the technical subject matter and skill requirements of the trade, including special hazards and precautions re: apprentice participation in RHVAC work
1.03.02	Knowledge of workplace skills coaching practices (e.g. assessment of learner needs; observation, questioning, modeling, demonstration, follow-up, etc.)
1.03.03	Knowledge of journey-level roles and responsibilities, including the scope, limits, and interplay of same (e.g. coach vs. mentor; foreman vs. coach)

1.03.05	Knowledge of journey-level supervisory responsibilities *per* jurisdictional apprenticeship-training standards, employer policies, and relevant legislation (e.g. trade regulations, company training plans, etc.)
1.03.06	Ability to respond to apprentice's skill-development needs and obligations (e.g. compliance with safety precautions; permit/documentation requirements, training standards, etc.)
1.03.07	Ability to reconcile supervisory role(s)/responsibilities assignment with project-specific constraints and production requirements
1.03.08	Ability to manage stress and to resolve interpersonal conflict associated with providing journey-level support to apprentices

Sub-task

1.04 Prepares and uses technical documentation.

Supporting Knowledge and Abilities

1.04.01	Knowledge of the scope and general use of RHVAC technical documents (e.g. manufacturer specifications, technical drawings, blueprints, shop drawings, electrical/mechanical schematic drawings, service/installation manuals, service reports, warranty forms, etc.)
1.04.02	Ability to use conventional as well as computer-based technical documents to suit project-specific purposes and applications

Task 2 Uses tools and equipment.

Sub-task

2.01	**Selects, uses, and maintains hand/power tools and equipment.**	**Supporting Knowledge and Abilities**	
		2.01.01	Knowledge of hand/power tools, and their use in performing RHVAC work (*Note*: RHVAC tools and equipment are identified in the Appendix Section)
		2.01.02	Knowledge of special hazards and precautions associated with use of RHVAC tools and equipment
		2.01.03	Ability to use specific tools in compliance with manufacturer specifications, industry requirements, and other standards (e.g. lubrication, sharpening, feed-rates, electrical power supply, etc.)
		2.01.04	Ability to interpret project requirements re: selection of tools and equipment, e.g., bit/blade selection when used for wood, metal, or masonry work.

Sub-task

2.02	**Selects, uses, and maintains tools/equipment for charging, evacuating, and storage.**	**Supporting Knowledge and Abilities**	
		2.02.01	Knowledge of hazards and precautions associated with selection, use, maintenance of tools used for charging, evacuating and storage.
		2.02.02	Knowledge of special procedures and techniques re: use of tools for charging and evacuating (e.g. refrigerant-gas recovery unit, vacuum pump, refrigerant gauges, pressure testing equipment, nitrogen dioxide cylinder /gauges, etc.)

	2.02.03	Knowledge of regulations re: selection and use of specified tools and equipment for performing charging/evacuation, and of decommissioning procedures (e.g. Montreal Protocol)
	2.02.04	Ability to maintain current personal knowledge of changing regulations and protocols respecting tools, equipment, and techniques associated with charging/evacuation and decommissioning of RHVAC systems.
	2.02.05	Ability to record and document (Log) the handling of refrigerants.
	2.02.06	Ability to apply industry standard procedures for recovery, storage, and reuse of refrigerants using appropriate tools and equipment.

Sub-task

2.03	**Selects, uses, and maintains electronic and other tools for measuring and RHVAC diagnostics**	**Supporting Knowledge and Abilities**
	2.03.01	Knowledge of the calibration and use of measuring and diagnostic tools and equipment, e.g. checking batteries
	2.03.02	Knowledge of baseline comparative standards, e.g., manufacturer specifications
	2.03.03	Knowledge of thermodynamic principles, electrical properties, air flow chars., including units and systems of measurement
	2.03.04	Knowledge of physical properties of different types of refrigerants
	2.03.05	Knowledge of inspection targets and criteria for taking measurements
	2.03.06	Ability to test equipment and compare it to specifications

	2.03.07	Ability to observe, document and interpret instrument readings accurately

Sub-task

2.04	**Uses computer equipment.**	**Supporting Knowledge and Abilities**
	2.04.01	Knowledge of basic computer system components and functions, e.g. , CPU, monitor, mouse, hard drive
	2.04.02	Knowledge of trade-specific computer applications, e.g. for skill development, technical reference, diagnostic and service purposes
	2.04.03	Ability to use computer equipment to generate, retrieve, store and use information as required, e.g. customer and equipment profiles: gas permit applications, etc.
	2.04.04	Ability to use information generated in computer format, e.g. schematic drawings in CADD-file format

Sub-task

2.05	**Uses oxy-fuel, air-fuel and compressed-gas equipment.**	**Supporting Knowledge and Abilities**
	2.05.01	Knowledge of brazing and soldering
	2.05.02	Knowledge of special hazards and precautions assoc. with brazing and soldering, eg. storage of compressed gas cylinders, use of gauges/compound gauges, standards for use of PPE, regulations re: transport of cylinders, etc.
	2.05.03	Knowledge of cutting/brazing torches, cylinders, materials
	2.05.04	Ability to connect materials using appropriate brazing/soldering methods

Sub-task

2.06	**Selects, uses and maintains equipment for rigging, hoisting and project- site access.**	**Supporting Knowledge and Abilities**
	2.06.01	Knowledge of workplace health and safety standards and regulations re: the use of ladders, harnesses and PPE
	2.06.02	Knowledge of PPE
	2.06.03	Knowledge of hazards and precautions re: the use and maintenance of equipment for rigging, hoisting and access
	2.06.04	Knowledge of manual and mechanical equipment used for hoisting and rigging
	2.06.05	Ability to assess and respond to project-specific hazards re: rigging, hoisting and access requirements

Sub-task

2.07	**Stocks and operates service/installation truck**	**Supporting Knowledge and Abilities**
	2.07.01	Knowledge of employer tools/inventory management policy re: restocking levels, seasonal changes, daily requirements, eg. first aid supplies, TODG placarding, test equipment, record keeping, etc.
	2.07.02	Knowledge of roles/responsibilities for maintaining/stocking service installation truck and supply of tools per employment agreements
	2.07.03	Knowledge of basic checks and standards re: mechanical maintenance of service vehicle, eg. WHS regulations related to road worthiness of service vehicle checks
	2.07.04	Ability to monitor and communicate with employer re: updating/restocking of tools and equipment

2.07.05	Ability to identify products and technologies to upgrade service vehicle, e.g. ladder rack
2.07.06	Ability to effect the required repairs and maintenance of the service vehicle

Task 3 Installs, repairs and maintains systems per specific codes, compliance standards, and variations.

Sub-task

3.01 Installs, repairs, and maintains electrical components and accessories re: RHVAC requirements.

Supporting Knowledge and Abilities

3.01.01	Knowledge of electrical principles
3/01.02	Knowledge of special hazards and precautions re: electrical components and accessories
3.01.03	Knowledge of electrical testing equipment
3.01.04	Knowledge of electrical components and accessories, including wire-sizing, circuit protection, fuses/breakers, etc.
3.01.05	Knowledge of industry standards re: electrical components and accessories
3.01.06	Knowledge of RHVAC roles/responsibilities and regulatory constraints re: electrical codes/licensing requirements (e.g. Limited Specialized Trade Electricians License: Class M; Endorsement E on Class B Gas License.)
3.01.07	Ability to interpret electrical schematics and other technical documents assoc. with electrical components
3.01.08	Ability to modify work in accordance with project specific requirement re: electrical components and accessories

Sub-task

3.02	**Installs, repairs, and maintains gas and other piping components/ accessories re: RHVAC requirements.**	**Supporting Knowledge and Abilities**	
		3.02.01	Knowledge of gas and other piping principles/techniques
		3.02.02	Knowledge of gas testing equipment
		3.02.03	Knowledge of gas and gas piping components and accessories, including tubing, regulators, valves, etc.
		3.02.04	Knowledge of the physical and chemical properties of gases, eg. combusting characteristics, Lower and Upper Explosive Limits (LEL, UEL), inert gases, specific gravity, etc.
		3.02.05	Knowledge of special hazards and precautions re: gases and piping components/accessories
		3.02.06	Knowledge of industry standards re: gas and other piping components and accessories
		3.02.07	Knowledge of roles/responsibilities and regulatory constraints re: gas codes/licensing requirements in RHVAC trade practice. (Eg., Class B Gas License, National/Manitoba Building Code, etc.)
		3.02.08	Ability to interpret piping schematics and other technical documents assoc. with gas and other piping components
		3.02.09	Ability to detect and repair leaks
		3.02.10	Ability to modify work in accordance with project-specific requirements re: gas and other piping components/accessories

Sub-task

3.03	**Installs, repairs, and maintains potable water heaters.**	**Supporting Knowledge and Abilities**	
		3.03.01	Knowledge of types of potable water heaters
		3.03.02	Knowledge of types of components such as elements, burners, venting pipes
		3.03.03	Knowledge of special hazards and precautions re: gases and piping components/accessories and relief valves
		3.03.04	Knowledge of testing equipment and procedures
		3.03.05	Ability to install, retrofit and maintain potable water heaters
		3.03.06	Ability to interpret piping schematics and other technical documents assoc. with gas and other piping components
		3.03.07	Ability to retrofit work in accordance with project-specific requirements re: gas and other piping components/accessories

Sub-task

3.04	**Installs, repairs, and maintains sheet metal components, accessories, re: RHVAC requirements.**	**Supporting Knowledge and Abilities**	
		3.04.01	Knowledge of sheet metal principles/techniques
		3.04.02	Knowledge of testing equipment and procedures re: sheet metal components/ systems and accessories (e.g. use of magnahelic gauge)
		3.04.03	Knowledge of the sheet metal components/systems and accessories, including ducts, pipes, grills, fasteners, hangers, dampers, etc.

	3.04.04	Knowledge of the working properties of sheet metal components/systems and accessories, e.g. selection of joining method, etc.
	3.04.05	Knowledge of special hazards and precautions re: sheet metal components/accessories (e.g. serious cuts from improper finishing/handling of metal edges)
	3.04.06	Knowledge of variations, coding conventions and industry standards re: sheet metal components and accessories (e.g. gauges and finishes of metal)
	3.04.07	Knowledge of roles/responsibilities and regulatory constraints re: building codes and requirements (e.g. Section 9, *National Building Code*)
	3.04.08	Ability to interpret sheet metal technical drawings and other technical documents
	3.04.09	Ability to modify sheet metal work practices in accordance with project-specific requirements

Sub-task

3.05	**Adapts RHVAC work practices for projects requiring specialty systems.**	**<u>Supporting Knowledge and Abilities</u>**
	3.05.01	Knowledge of range and variety of RHVAC systems and sub-systems such as supply air, return air, relief air, exhaust air, fresh air, mixed air, combustion air and infiltration/exfiltration, etc.
	3.05.02	Knowledge of accepted methods for adapting general trade practice to suit the requirements of RHVAC specialty sub-systems

3.05.03	Ability to apply accepted methods to reflect project-specific variations required to achieve acceptable system operation incl. air quality, comfort and code compliance

BLOCK B

PLANNING RESIDENTIAL HVAC SYSTEMS

Trends:

Tendency for clients to expect greater comfort with reduced fuel costs and greater returns on their investment. Increased heat loss/gain testing to meet client needs and increases indoor air quality. Increased attention paid to installations of geo-thermal systems with greater respect for environmental implications. Service contracts, or planned maintenance, is more common along with the use of computers for system monitoring. Computer-based documentation is enhancing the industry's capacity to schedule, monitor and administer service contracts. The increased use of automated systems allow for total climate control and comfort within structures. Technicians require advanced communications and technical knowledge to educate and negotiate with clients re. HVAC systems. Government cash back incentives to reduced energy consumption is often related to decisions to purchase high energy efficient systems.

Task 4 Determines equipment requirement for RHVAC projects.

Sub-task

4.01 Performs heat gain/loss calculations.

Supporting Knowledge and Abilities

4.01.01	Knowledge of range, variety and relative advantage of calculations to determine RHVAC-equipment requirements (e.g. greater accuracy of sizing by heat gain/loss data rather than by square-footage data)
4.01.02	Knowledge of formal versus 'rule-of-thumb' methods of performing required calculations
4.01.03	Knowledge of roles and responsibilities re: heat-loss calculations and their documentation per utility-system protocols, CMHC, employer policy, etc. (e.g. use of *Manual J* or equivalent)
4.01.04	Ability to apply mathematical and scientific concepts to solve technical and trade-related problems
4.01.05	Ability to select calculation methods appropriate to specific project contexts, e.g. retrofits versus new residential construction.

Sub-task

4.02 Reads/interprets structural plans and specifications.

Supporting Knowledge and Abilities

4.02.01 Knowledge of blueprints (architectural, mechanical, electrical, etc.), details, and specifications.

4.02.02 Knowledge of methods for solving construction problems due to obstructions (e.g. working around beams, joists, etc.).

4.02.03 Ability to use blueprints as a practical resource for planning and coordinating RHVAC projects

4.02.04 Ability to consult/coordinate with other trades and jobsite personnel (e.g. contractor) to ensure installation reflects expertise from all related experts

Sub-task

4.03 Confirms compatibility of new equipment with existing system.

Supporting Knowledge and Abilities

4.03.01 Knowledge of equipment's physical dimensions and performance capabilities.

4.03.02 Ability to analyze/recognize limitations imposed by existing equipment (e.g. costs/benefits of utilizing existing ductwork in a retrofit project context)

4.03.03 Ability to select equipment based on calculations, manufacturer-provided information, and equipment availability

Sub-task

4.04 Calculates CFM requirements for heating/cooling.

Supporting Knowledge and Abilities

4.04.01 Knowledge of modifications that may be required as a consequence of inadequate duct sizing

4.04.02 Knowledge of the effects of new equipment on existing system

4.04.03 Knowledge of important specifications including static pressure re. noise generation, velocity of air, etc)

4.04.04 Knowledge of *Manual J*

4.04.05 Knowledge of procedure, relationships and implications among CFM calculations

4.04.06 Ability to perform, interpret, and verify trade-related calculations using appropriate equipment

Sub-task

4.05 Performs duct-sizing.

Supporting Knowledge and Abilities

4.05.01 Knowledge of equivalent-length method for determining duct sizing

4.05.02 Knowledge of use of ductulator for determining duct sizing

4.05.03 Knowledge of modifications in duct-sizing *re.* variations in materials and design (e.g. flex-duct *vs*. conventional insulation)

4.05.04 Ability to select and use appropriate sizing method per specific project materials and design

4.05.05 Ability to identify, recognize and make allowances for system changes as necessary (e.g. resizing of system)

Task 5 Designs air-distribution, including air-volume requirements.

Sub-task

5.01	**Zones the duct system.**	**Supporting Knowledge and Abilities**	
		5.01.01	Knowledge of available equipment and accessories
		5.01.02	Knowledge of air volume required per zone
		5.01.03	Knowledge of relevant codes and standards required to install zoning including controls and accessories, e.g. zone dampers
		5.01.04	Knowledge of procedure for installation of electrical controls
		5.01.05	Ability to read/understand electrical schematics and manufacturer's specs
		5.01.06	Ability to comply with procedure for installation of all zoning components

Sub-task

5.02	**Selects grills, registers, and diffusers.**	**Supporting Knowledge and Abilities**	
		5.02.01	Knowledge of CFM, velocity, and throw distance
		5.02.02	Knowledge of operational characteristics of particular grills, registers, diffusers, dampers noise suppressors, and other system components
		5.02.03	Ability to interpret job specifications re: selection of product offering required design, style, and functional features

Task 6 Coordinates installation schedule on project jobsite.

Sub-task

6.01	**Prepares inventory of all project materials, tools, and equipment.**	**Supporting Knowledge and Abilities**	
		6.01.01	Knowledge of original project specifications and documentation

	6.01.02	Knowledge of codes and conventions re: technical documentation and their use
	6.01.03	Knowledge of project timetables (e.g. timing/sequence of sub-trades involvement)
	6.01.04	Ability to interpret project document re: materials take-off preparation and other purposes
	6.01.05	Ability to modify materials take-off based on special requirements (e.g. venting for high-efficiency)

Sub-task

6.02	**Confirms delivery and availability and availability of special-order products.**	**<u>Supporting Knowledge and Abilities</u>**
	6.02.01	Knowledge of typical project scheduling requirements and constraints
	6.02.02	Knowledge of suppliers, wholesalers, manufacturers, e.g., products, hours of operation, shipping policies, etc.
	6.02.03	Ability to respond to specific project scheduling requirements and constraints, e.g. regional or local market limitations
	6.02.04	Ability to coordinate and communicate with other trades re. scheduling/procedural changes related to product availability
	6.02.05	Ability to verify and communicate with client re. the appropriateness of product substitutions

Sub-task

6.03 Complies with requirements re: permit and regulations

Supporting Knowledge and Abilities

6.03.01	Knowledge of special hazards and precautions associated with on-site installation scheduling (e.g. allocating sufficient time to ensure safe performance of project tasks)
6.03.02	Knowledge of time-sensitive and/or time-limited permit and regulatory requirements
6.03.03	Knowledge of inspection requirements and procedures
6.03.04	Ability to communicate with inspector(s) re: project procedure and schedule.

BLOCK C

INSTALLING RESIDENTIAL HVAC SYSTEMS

Trends: *Increased integration of utilities-sector specialization. There is a trend toward installing systems that are more versatile and sophisticated using zones and controls to increase client comfort. New systems have enhanced electronic components for system self-diagnosis and to maintain fault histories. Computer interface controls and touch tone phone systems can communicate with house systems. Heating equipment is becoming more compact while cooling equipment is becoming larger. Installations are focused on achieving greater levels of efficiencies.*

Task 7 Prepares RHVAC-project jobsite for system installation.

Sub-task

7.01 Dismantles/removes existing equipment..

Supporting Knowledge and Abilities

7.01.01	Knowledge of tools, equipment, and techniques for dismantling/removing RHVAC systems/components
7.01.02	Knowledge of employer policies re: salvage, recycling, and disposal of RHVAC systems/components
7.01.03	Ability to remove existing RHVAC equipment/components per client preferences, employer policies, and regulatory requirements (e.g. disposal of refrigerants)

Sub-task

7.02 Lays out materials in direction of flow.

Supporting Knowledge and Abilities

7.02.01	Knowledge o f project plans and specifications
7.02.02	Knowledge of assembly procedures and standards
7.02.03	Knowledge of existing site conditions and features

7.02.04	Ability to use measuring tools and other resources to complete layout
7.02.05	Ability to visualize completed project utilizing direct observation of site, familiarity with other projects, and recognition of physical constraints/obstructions
7.02.06	Ability to verify/document on-site availability of all equipments and components
7.02.07	Ability to analyze and satisfy requirements for project modification

Task 8 Installs home heating equipment.

Sub-task

8.01 Installs sheet metal components for home heating.

Supporting Knowledge and Abilities

8.01.01	Knowledge of special hazards and precautions associated with sheet metal installation re: home heating systems
8.01.02	Knowledge of sheet metal heating components, products, accessories, and fasteners for home heating systems (e.g. hangers)
8.01.03	Knowledge of sheet metal installation procedures *per* industry standards
8.01.04	Knowledge of project-specific clearances and other code requirements
8.01.05	Ability to follow plans and comply with specifications
8.01.06	Ability to adjust, modify, and re-form sheet metal components *per* available tools and jobsite conditions
8.01.07	Ability to coordinate with other trades and project personnel

	8.01.08	Ability to apply industry standards to project-specific sheet metal requirements

Sub-task

8.02	**Installs chimneys, breeching, and venting for home heating.**	**Supporting Knowledge and Abilities**
	8.02.01	Knowledge of special hazards and precautions (e.g. hoisting; working at heights; etc.)
	8.02.02	Knowledge of detailed code requirements re: venting
	8.02.03	Knowledge of varieties, types, styles, and branding of venting products
	8.02.04	Knowledge of conditions requiring special provision for venting and insulation
	8.02.05	Ability to perform RHVAC tasks at heights using ladders, ladder jacks, etc.

Sub-task

8.03	**Installs piping and tubing for home heating.**	**Supporting Knowledge and Abilities**
	8.03.01	Knowledge of applicable codes, standards, and trade conventions governing piping/tubing practices
	8.03.02	Knowledge of hazards and precautions (e.g. burn hazards, pressure-test protocols, etc.)
	8.03.03	Knowledge of piping/tubing practices and techniques
	8.03.04	Ability to perform pipe-work measurement, sizing, connecting, cutting, threading, etc.
	8.03.05	Ability to protect pipe against freezing and other adverse impacts *per* manufacturer specifications and industry standards

	8.03.06	Ability to recognize when combustion air is required to ensure compliance with code(s) and standards

Sub-task

8.04	**Ties in low-voltage controls and high-voltage power supply to heating unit.**	**Supporting Knowledge and Abilities**
	8.04.01	Knowledge of wiring standards, regulations, and codes *per* permit requirements
	8.04.02	Knowledge of electrical principles
	8.04.03	Knowledge of electrical hazards and precautions
	8.04.04	Knowledge of electrical testing equipment
	8.04.05	Ability to interpret codes and specifications re: supply voltage, current, etc.
	8.04.06	Ability to interpret electrical and other schematic drawings, including line- and ladder-type diagrams
	8.04.07	Ability to perform RHVAC-related electrical diagnostic procedures

8.05	**Installs isolation equipment for home heating.**	**Supporting Knowledge and Abilities**
	8.05.01	Knowledge of isolation-equipment products and manufacturer specifications
	8.05.02	Knowledge of costs/benefits and advantages of isolation-equipment installation for home heating
	8.05.03	Knowledge of preferred techniques for minimizing sound-transfer

8.05.04	Ability to specify and to consult with clients about costs/benefits and advantages of isolation-equipment installation.
8.05.05	Ability to select and install specialty products, including acoustic duct-liners, high-temperature flexible duct-connectors, thermal/acoustic insulation (interior/exterior) associated with ductwork, etc.

Task 9 Installs home cooling equipment.

Sub-task

9.01	**Installs sheet metal components for home cooling.**	**Supporting Knowledge and Abilities**
	9.01.01	Knowledge of special hazards and precautions associated with sheet metal installation re: home cooling systems
	9.01.02	Knowledge of sheet metal components, products, accessories, and fasteners for home cooling systems (e.g. hangers)
	9.01.03	Knowledge of sheet metal installation procedures *per* home-cooling industry standards
	9.01.04	Knowledge of project-specific clearances and other code requirements (e.g. required separation between coil and top of heat exchanger), condensate drain requirements
	9.01.05	Knowledge of special requirements re: sheet metal heating vs. cooling (e.g. installation of evaporator coil)
	9.01.06	Knowledge of air velocity, static air pressures, etc.
	9.01.07	Ability to follow plans and comply with specifications

	9.01.08	Ability to adjust, modify, and re-form sheet metal components *per* available tools and jobsite conditions
	9.01.09	Ability to adjust fan-speed to accommodate air-flow requirements
	9.01.10	Ability to coordinate with other trades and project personnel
	9.01.11	Ability to apply industry standards to project-specific sheet metal requirements

Sub-task

9.02	**Installs refrigerant pipe/ tubing, and associated components for home cooling.**	**<u>Supporting Knowledge and Abilities</u>**
	9.02.01	Knowledge of regulations, industry standards, and manufacturer specifications re: home-cooling
	9.02.02	Knowledge of brazing techniques and products (e.g. selection of silver solder, composition of brazing alloy, etc.)
	9.02.03	Knowledge of special hazards/precautions re: refrigerant pipe work (e.g. pressurized gases)
	9.02.04	Knowledge of pipe products/components and their application, including sizing; oil-return requirements, filter dryers, Thermostatic Expansion (TX) valves, insulation, etc.
	9.02.05	Knowledge of metallurgical principles
	9.02.06	Knowledge of recovery techniques, evacuation principles, and special requirements (e.g. documentation *per* MOPIA protocols)
	9.02.07	Knowledge of WHMIS, including use of Materials Safety Data Sheets (MSDS)

	9.02.08	Ability to braze
	9.02.09	Ability to bend pipe
	9.02.10	Ability to install hangers, clamps, protection devices, including insulation to reduce heat gain and to achieve noise reduction
	9.02.11	Ability to pressure-test *per* industry standards and manufacturer specifications (e.g. interpretation of MSDS re: nitrogen-pressure testing)
	9.02.12	Ability to protect pipe against freezing and other adverse impacts *per* manufacturer specifications and industry standards

Sub-task

9.03	**Ties in low-voltage controls and high-voltage supply power to cooling unit.**	**<u>Supporting Knowledge and Abilities</u>**
	9.03.01	Knowledge of wiring standards, regulations, and codes *per* permit requirements
	9.03.02	Knowledge of electrical principles
	9.03.03	Knowledge of electrical hazards and precautions
	9.03.04	Knowledge of electrical testing equipment
	9.03.05	Ability to interpret codes and specifications re: supply voltage, current, etc.
	9.03.06	Ability to interpret electrical and other schematic drawings, including line and ladder type
	9.03.07	Ability to perform RHVAC-related electrical diagnostic procedures.

Sub-task

9.04	**Installs isolation equipment for home cooling**	**Supporting Knowledge and Abilities**	
		9.04.01	Knowledge of isolation-equipment products and manufacturer specifications
		9.04.02	Knowledge of costs/benefits and advantages of isolation-equipment installation for home cooling
		9.04.03	Knowledge of preferred techniques for minimizing sound-transfer
		9.04.04	Ability to specify and to consult with clients about costs/benefits and advantages of isolation-equipment installation.
		9.04.05	Ability to select and install specialty products, including acoustic duct-liners, compressor blankets, sound blankets, condenser units/ exterior-installation brackets, neoprene flex connectors, thermal/acoustic insulation (interior/exterior) associated with ductwork, etc.

Sub-task

9.05	**Installs ductless split air-conditioning and heat pump systems.**	**Supporting Knowledge and Abilities**	
		9.05.01	Knowledge of system benefits and limitations
		9.05.02	Knowledge of system characteristics and components, conventions/practices re: system pipe work requirements and manufacturer specifications
		9.05.03	Ability to install, service, and maintain air conditioning systems associated with duct less split systems per accepted refrigeration standards and practices.

Task 10 Installs RHVAC specialty systems.

Sub-task

10.01	**Installs heat pumps including geo-thermal and air-to-air types.**	**Supporting Knowledge and Abilities**	
		10.01.01	Knowledge of comparison/contrasts re: open (well-to-well) vs. closed-loop systems
		10.01.02	Knowledge of special hazards, precautions, and regulations re. trenching and excavations, glycol and other potentially hazardous materials, etc.
		10.01.03	Knowledge of requirements re. environmental protection and water stewardship.
		10.01.04	Knowledge of grouting techniques and compounds
		10..01.05	Knowledge of the principles governing air- and fuel-flow within a heat-pump system
		10.01.06	Knowledge of comparative benefits of. heat-pump systems versus traditional systems
		10.01.07	Ability to assess soil conditions re. selection of grouting products
		10.01.08	Ability to adapt heat-pump installation procedure to reflect local code requirements, site conditions and project specifications
		10.01.09	Ability to assess rates of return from investment in heat pumps.

Sub-task

10.02	**Installs hydronic heating systems, including the hot-water, forced-air, and in-floor varieties.**	**Supporting Knowledge and Abilities**	
		10.02.01	Knowledge of hot water coil-performance re: air/fluid flows, flow rates, temperature rise, pump capacities, etc.

10.02.02	Knowledge of special hazards and precautions re: installation of hydronic hearing systems (e.g. burns, explosions, etc.)
10.02.03	Knowledge of insulation requirements
10.02.04	Knowledge of thermodynamics, hydraulics, and other relevant, applied scientific concepts (e.g. enthalpy, entropy, heat transfer, sensible/latent heat, etc.)
10.02.05	Knowledge of system fluids, including their variety, and physical/chemical properties (e.g. viscosity, specific heat/gravity, etc)
10.02.06	Knowledge of heat impacts on containment materials (e.g. expansion joints)
10.02.07	Ability to select fluids, materials and equipment appropriate to conform with project-specific hydronic heating system requirements

Sub-task

10.03	**Installs passive cooling systems.**	**<u>Supporting Knowledge and Abilities</u>**
10.03.01		Knowledge of heat-transfer characteristics of passive cooling systems and their fluid/gaseous contents
10.03.02		Knowledge of the defining comparisons/ contrasts between passive and other cooling systems (e.g. humidity control)
10.03.03		Knowledge of change and continuity in the design of passive cooling systems, including pressures required to optimize system operation
10.03.04		Knowledge of types of passive cooling systems

10.03.05	Ability to perform RHVAC project work in wet conditions
10.03.06	Ability to manipulate isolation/service valves to permit removal and cleaning of individual coils, pumps, and associated system components
10.03.07	Ability to locate/use documentation and other relevant information sources re: older or outdated systems and practices

Sub-task

10.04 Installs dual-fuel systems. **<u>Supporting Knowledge and Abilities</u>**

10.04.01	Knowledge of heat transfer within dual-fuel heating systems (e.g. high-heat restrictions)
10.04.02	Knowledge of distinguishing characteristics and of comparisons/contrasts between dual-fuel and other heating systems, (e.g. wood-electrical and/or geo-electric equipment versus others; BTU per watt versus BTU per lb. determinations, etc.)
10.04.03	Knowledge of fuels, fuel-capacities, and fuel compatibilities re: dual-fuel systems (e.g. propane)
10.04.04	Knowledge of equipment compatibility
10.04.05	Knowledge of past and present dual-fuel systems, including oil/electric, solid fuel, solar, wood/oil, wood/electric, and other variations
10.04.06	Knowledge of codes, regulations and standards applicable to dual-fuel systems (e.g. WETT, the *Oil Burner Act*, etc.)
10.04.07	Knowledge of variation in chimney and venting requirements

10.04.08	Knowledge of special hazards and precautions associated with dual fuel systems (e.g., asbestos, fuel oil, lifting/hoisting and materials handling operations; sooting of chimneys, back pressures in buildings, etc)
10.04.09	Ability to work with specialty materials associated with dual-fuel systems technology (e.g. firebrick, refractory cements/ grouts, etc.)
10.04.10	Ability to install/and service special-requirement safeties and controls for dual-fuel systems
10.04.11	Ability to adapt practices as a function of particular fuels and equipment conditions
10.04.12	Ability to locate/use documentation and other relevant information sources re: older or outdated systems and practices

Sub-task

10.05	**Install sheet metal components and control circuits for electric furnaces.**	**Supporting Knowledge and Abilities**
	10.05.01	Knowledge of roles, responsibilities, and restrictions associated with electric furnace installations (e.g. electrical license restrictions)
	10.05.02	Knowledge of sheet metal components and installation practices
	10.05.03	Knowledge of control circuits and installation practices
	10.05.04	Ability to coordinate project with availability of other trades and with permit issuing authorities
	10.05.05	Ability to install sheet metal and control circuit and components in accordance with industry standards

Task 11 Installs indoor-air quality (IAQ) equipment.

Sub-task

11.01	**Installs heat-recovery ventilators (HRVs) and energy-recovery ventilators (ERVs).**	**Supporting Knowledge and Abilities**
	11.01.01	Knowledge of ventilation codes and regulations
	11.01.02	Knowledge of control -circuit wiring
	11.01.03	Knowledge of defining comparisons/contrasts re: ERVs versus HRVs
	11.01.04	Knowledge of sizing and capacity requirements

11..01.05	Ability to balance air flows associated with IAQ-equipment installation
11.01.06	Ability to establish termination points
11.01.07	Ability to determine when HRV versus ERV installation is appropriate

Sub-task

11.02 Installs central exhaust systems and exhaust fans.

Supporting Knowledge and Abilities

11.02.01	Knowledge of ventilation codes and regulations
11.02.02	Knowledge of sizing and capacity requirements
11.02.03	Knowledge of controls
11.02.04	Knowledge of products, mfg. specifications
11.02.05	Knowledge of special hazards and precautions, (e.g. depressurization, make-up air, condensation characteristics, etc.)
11.02.06	Ability to establish termination points and other layout criteria
11.02.07	Ability to interpret size, layout and operational characteristics according to manufacturer's specifications
11.02.08	Ability to select and install controls required to optimize system function
11.02.09	Ability to balance exhaust and make-up air per code requirements
11.02.10	Ability to ensure compliance re. fresh air and combustion air requirements per code

Sub-task

11.03	**Installs IAQ accessories.**	**Supporting Knowledge and Abilities**
	1.03.01	Knowledge of IAQ accessories, including humidifiers, high-efficiency filters, etc.
	11.03.02	Knowledge of special hazards and precautions, including volatile organic compounds (VOCs), off-gases, particulates, fumes, mould, mildew, etc.
	11.03.03	Ability to select appropriate IAQ accessories (e.g. HEPA vs. other filters; high-efficiency particulate aspirator, etc

Task 12 Installs operational and safety controls for system.

Sub-task

12.01	**Installs single-zone and/or multi-zone systems.**	**Supporting Knowledge and Abilities**
	12.01.01	Knowledge of installation requirements re: electrical control circuits and air-balancing
	12.01.02	Knowledge of available multi-zone packages for residential application
	12.01.03	Ability to compare and contrast benefits as a function of package choice
	12.01.04	Ability to select and install appropriate packages

Sub-task

12.02	**Installs control system components, devices, and accessories.**	**Supporting Knowledge and Abilities**
	12.02.01	Knowledge of components, devices, and accessories (e.g. humidistats, dehumidistats, timers, thermostats, switches, safeties, etc.)

12.02.02 Knowledge of variation in engineering of devices (e.g. mercury bulb versus digital)

12.02.03 Ability to compare and contrast benefits re: selection of particular components, device, and/or accessory

12.02.04 Ability to program, service and maintain control-system components

Task 13 Commissions RHVAC system.

Sub-task

13.01 Performs heating/cooling system start-up checks.

Supporting Knowledge and Abilities

13.02.01 Knowledge of criteria, protocols, and technical procedures for start-up checks, including manufacturer specifications, limits, heat rise/anticipation, controls, gas pressure, amperage draw, sequence of operation, etc.

13.02.02 Knowledge of required checks, including re: electrical, furnace, and air-conditioning components

13.02.03 Ability to select and use the requisite testing equipment to verify functionality and safe operation of individual controls

13.02.04 Ability to interpret manufacturer specifications regarding start-up in relation to warranty –verification requirements

Sub-task

13.02 Tests, adjusts, and balances the installed RHVAC system.

Supporting Knowledge and Abilities

13.02.01 Knowledge of house as a system,

13.02.02 Knowledge of caulking and sealing products, procedures, and standards

13.02.03	Knowledge of protocols and criteria for ensuring system balance
13.02.04	Knowledge of tools and techniques to perform measurement and diagnostics
13.02.05	Knowledge of industry standards for observation and analysis of measurable system characteristics (e.g. capacities, volumes, velocities, rates, etc.)
13.02.06	Ability to apply caulking, sealing, and insulation products
13.02.07	Ability to verify compliance of adjusted system per manufacturer specifications and industry standards re. balance, air exchange re. National Building Code, etc.
13.02.08	Ability to use testing tools and equipment required for system-balancing
13.02.09	Ability to work with complex units of measurement per industry standards and specifications

Sub-task

13.03	**Orients customer/client re: RHVAC system user-interface and inputs.**	**Supporting Knowledge and Abilities**
13.03.01		Knowledge of system and customer interface/inputs
13.03.02		Knowledge of common issues and concerns (e.g. comparison/contrast between old and new systems' controls, limitations/advantages of new system, etc.)
13.03.03		Ability to communicate/verify client understanding of all warranty, maintenance, and product-data information, including use of thermostats, night/vacation set-backs, location of filters, diagnostic codes (indicators), etc.

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13.03.04	Ability to address common and customer-specific issues in lay terms

BLOCK D

MAINTAINING RESIDENTIAL HVAC SYSTEMS

Trends: *There is an increasing trend toward the use of planned maintenance, long-term maintenance schedules and increase customer service related to maintenance activities. Planned maintenance has become the focus once installations occur. As a result, technicians are required to be more flexible to meet customer needs and schedules. Increased use of technologies make it possible to plan service calls far in advance for joint convenience. Pressures to provide 7/24 service options have led to extended or alternate work hours for those working in the industry.*

Task 14 Performs planned ('preventive') maintenance.

Sub-task

14.01 Negotiates/interprets arrangements for system maintenance.

Supporting Knowledge and Abilities

14.01.01	Knowledge of company maintenance programs and manufacturer warranties
14.01.02	Knowledge of documentation related to warranty agreements with client(s)
14.01.03	Knowledge of computer use re. customer data, equipment history, etc.
14.01.04	Ability to communicate/explain system maintenance schedules and agreement to clients
14.01.05	Ability to coordinate work schedule with client needs and schedule appointments
14.01.06	Ability to obtain and record required customer data and equipment service history

Sub-task

14.02 Interprets inspection results re: warranty entitlements,

Supporting Knowledge and Abilities

14.02.01	Knowledge of company maintenance check list at it applies to warranty entitlements
14.02.02	Knowledge of manufacturer's warranty requirements and limitations specific to brands/models
14.02.03	Knowledge of common problems specific to some equipment, e.g. recalls or manufacturers' defects
14.02.04	Ability to analyze warranty entitlements as they relate to specific inspection results
14.02.05	Ability to communicate inspection results within guidelines of warranty agreement
14.02.06	Ability to confirm customer complaints and identifies discrepancies, if any.
14.02.07	Ability to assess cause and effect, e.g. lack of maintenance, dirty filter due to motor overloads and failure, physical damage caused by impact, vibration, water, etc.
14.02.08	Ability to identify and communicate time frames and levels of urgency
14.02.09	Ability to perform warranty repair as per manufacturer's specifications

Sub-task

14.03	**Explains options re: compliance with warranty requirements.**	**<u>Supporting Knowledge and Abilities</u>**
		14.03.01 Knowledge of common compliance expectations related to company and manufacturer warranties
		14.03.02 Knowledge of OEM parts and suitable universal parts

14.03.03	Ability to communicate compliance options and verify product warranty eligibility
14.03.04	Ability to verify customer's warranty registration/stats.
14.03.05	Ability to verify equipment maintenance history
14.03.06	Ability to assess related costs pertaining to repairs where warranty does not apply
14.03.07	Ability to explain warranty policies and address customer concerns

Sub-task

14.04 Offers and sells service/maintenance agreements.

Supporting Knowledge and Abilities

14.04.01	Knowledge of company's maintenance agreement programs and their costs and benefits including duration and limitations of coverage
14.04.02	Ability to communicate benefits and costs of long term service agreements (e.g. Benefits, requirements, costs, discounts, etc.)
14.04.03	Ability to complete warranty documents and collect premiums
14.04.04	Ability to sell/up sell service agreements to meet customer requirements

Sub-task

14.05 Completes and shares documentation re: new service/maintenance agreements.

Supporting Knowledge and Abilities

14.05.01	Knowledge of company service/maintenance agreements and requirements

14.05.02 Knowledge of all related documentation and service contracts

14.05.03 Ability to communicate documentation expectations and confirm accuracy of completed documents

14.05.04 Ability to complete paperwork, e.g. acquire necessary signatures, copies, payments, etc.

Task 15 Provides emergency (unscheduled) maintenance service.

Sub-task

15.01 Completes and forwards warranty claims.

Supporting Knowledge and Abilities

15.01.01 Knowledge of warranty protocols, procedures, and technical requirements, e.g. product-specific protocol regarding returns, reimbursements, etc.

15.01.02 Knowledge of company policy re: warranty claims procedure

15.01.03 Ability to identify, compile, and interpret all relevant/requisite information re: claims

Sub-task

15.02 Performs diagnostics.

Supporting Knowledge and Abilities

15.02.01 Knowledge of equipment repair history.

15.02.02 Knowledge of general diagnostic procedures and criteria

15.02.03 Knowledge of special hazards/precautions re: emergency maintenance assignments

15.02.04 Ability to perform complete assessments using “cause and effect” principles

15.02.05 Ability to apply general procedures/criteria to project conditions

	15.02.06	Ability to gather and interpret diagnostic information, including customer complaints
	15.02.07	Ability to document and explain diagnostic results to customer (and employer.)

Sub-task

15.03	**Determines/recommends remedial action, including notifications re: shut-off requirements.**	**Supporting Knowledge and Abilities**
	15.03.01	Knowledge of components' operation and function
	15.03.02	Knowledge of replacement parts, including universal versus original equipment and original equipment manufacturer (OEM) parts
	15.03.03	Ability to assess diagnostic information and apply all safety considerations, e.g., shut-off

Sub-task

15.04	**Assess costs/availability of parts/repairs.**	**Supporting Knowledge and Abilities**
	15.04.01	Knowledge of variations re: cost, quality, and suitability among parts supplied by different manufacturers
	15.04.02	Knowledge of compatibility of parts supplied by different manufacturers
	15.04.03	Ability to source parts using crossover tables/charts and other technical information sources
	15.04.04	Ability to estimate time required for repair(s).

Sub-task

15.05	**Performs repair.**	**Supporting Knowledge and Abilities**

15.04.01	Knowledge of component function
15.04.02	Knowledge of safety-controls operation
15.03.03	Knowledge of hazards, precautions, and technical procedures for performing temporary repairs
15.05.04	Knowledge of the sequence of equipment operations
15.05.05	Ability to modify and bypass faulty components temporarily without creating hazards

Task 16 Analyzes existing and/or changing system conditions.

Sub-task

16.01 Assesses risks/hazards and other key concerns for whole system.

Supporting Knowledge and Abilities

16.01.01	Knowledge of potential risks/hazards related to system operation, e.g. heat exchangers, chimney cracks/blockages, etc.
16.01.02	Knowledge of optimal performance of system compared with current conditions
16.01.03	Knowledge of the effect of negative pressure caused by exhaust and solid fuel appliances as they related to back drafting of natural draft equipment
16.01.04	Knowledge of legislative requirements as per NBC 9.32.3 or CSA-F326
16.01.05	Ability to simulate the worst possible condition for system failure
16.01.06	Ability to measure and record deficiencies, e.g. hi or low humidity, mold, mildew, pet dander, bacteria, gasses and off gasses.
16.01.07	Ability to assess customer concerns re. inadequate comfort issues.

Sub-task

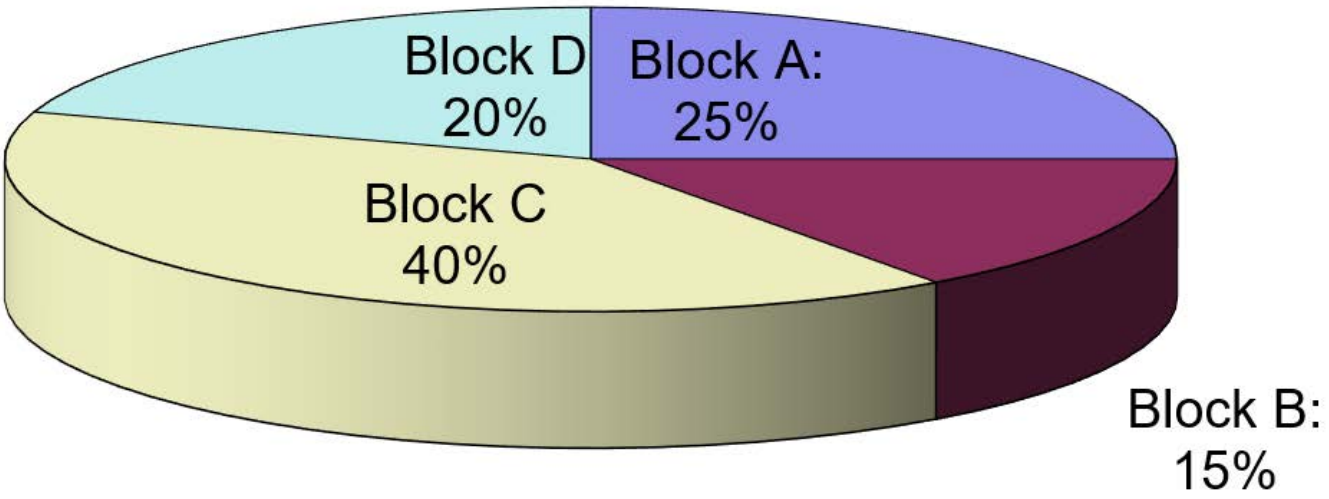
16.02	**Initiates corrective action based on assessments and recommendations.**	**Supporting Knowledge and Abilities**
		16.02.01 Knowledge of options related to corrective actions to ensure optimal system operation
		16.02.02 Knowledge of equipment capacities for proper sizing (CFM)
		16.02.03 Knowledge of air balancing and electrical control wiring to interlock equipment
		16.02.04 Knowledge of appropriate documentation to initiate corrective action, e.g. ordering of repairs/parts, etc.
		16.02.05 Ability to coordinate and schedule system maintenance to address concerns
		16.02.06 Ability to assemble and install components
		16.02.07 Ability to educate/guide customer re. remedial options

APPENDIX "A"

Titles of Blocks

Block A	Occupational Skills	25%
Block B	Planning RHVAC Systems	15%
Block C	Installing RHVAC Systems	40%
Block D	Maintaining RHVAC Systems	20%

* The percentages reflect the average amount of time workers within the occupation spend performing these tasks on a yearly basis.



APPENDIX "B"
DACUM Chart – Task Profile Chart

Block A OCCUPATIONAL SKILLS	**Task 1 Communicates with others regarding project.**	Subtask 1.01 Advises clients about current technologies and product options.	Subtask 1.02 Consults with project team and/or subtrades re: project requirements.	Subtask 1.03 Provides workplace skills-coaching and other… support to apprentices.	Subtask 1.04 Prepares and uses technical documentation.
	Task 2 Uses tools and equipment.	Subtask 2.01 Selects/uses/maintains hand/ power tools and equipment.	Subtask 2.02 Selects/uses/maintains tools/equipment for charging, evacuating and storage.	Subtask 2.03 Selects/uses/maintains electronic/other tools for measuring and RHVAC diagnostics.	Subtask 2.04 Uses computer equipment.
		Subtask 2.05 Uses oxy-fuel, air-fuel, and compressed-gas equipment.	Subtask 2.06 Selects/uses/maintains equipment for rigging, hoisting and project-site access	Subtask 2.07 Stocks and operates service/installation truck.	
	Task 3 Installs/repairs/ maintains systems *per* codes, compliance standards…	Subtask 3.01 Installs/repairs/ maintains electrical components and accessories…	Subtask 3.02 Installs/repairs/ maintains gas and other piping components…	Subtask 3.03 Installs/repairs/maintains potable water heaters.	Subtask 3.04 Installs/repairs/ maintains sheet metal components, accessories….
		Subtask 3.05 Adapts RHVAC work practices for projects requiring specialty systems			
Block B PLANNING RHVAC SYSTEMS	**Task 4 Determines equipment requirements for RHVAC projects.**	Subtask 4.01 Performs heat gain/loss calculations.	Subtask 4.02 Reads/interprets structural plans and specifications.	Subtask 4.03 Confirms compatibility of new equipment with existing system.	Subtask 4.04 Calculates CFM requirements for heating/cooling.
		Subtask 4.05 Performs duct sizing.			
	Task 5 Designs air distribution, including air-volume requirements.	Subtask 5.01 Zones the duct system.	Subtask 5.02 Selects grills, registers, and diffusers.		
	Task 6 Coordinates installation on project jobsite.	Subtask 6.01 Prepares inventory of all necessary project materials, tools, and equipment..	Subtask 6.02 Confirms delivery and availability of special-order products.	Subtask 6.03 Complies with requirements re: permits and regulations.	
Block C INSTALLING RHVAC SYSTEMS	**Task 7 Prepares RHVAC-project jobsite for system installation.**	Subtask 7.01 Dismantles/removes existing equipment.	Subtask 7.02 Lays out materials in direction of flow.		
	Task 8 Installs home heating equipment.	Subtask 8.01 Installs sheet metal components for home heating.	Subtask 8.02 Installs chimneys, breeching and venting for home heating.	Subtask 8.03 Installs piping and tubing for home heating.	Subtask 8.04 Ties in low-voltage controls and high voltage power to heating unit.
		Subtask 8.05 Installs isolation equipment for home heating.			

Block C **INSTALLING RHVAC SYSTEMS** *(continued)*	**Task 9** **Installs home cooling equipment.**	Subtask 9.01 Installs sheet metal components for home cooling.	Subtask 9.02 Installs refrigerant pipework, tubing and assoc. components for home cooling.	Subtask 9.03 Ties in low-voltage controls and high-voltage power supply to cooling unit.	Subtask 9.04 Installs isolation equipment for home cooling.
		Subtask 9.05 Installs ductless split air-conditioning and heat-pump systems.			
	Task 10 **Installs RHVAC specialty systems.**	Subtask 10.01 Installs heat pumps, including geothermal and air-to-air varieties.	Subtask 10.02 Installs hydronic heating systems, incl. hot-water, forced-air, and in-floor varieties.	Subtask 10.03 Installs passive cooling systems.	Subtask 10.04 Installs dual-fuel systems.
		Subtask 10.05 Installs sheet metal components and control circuits for electric furnaces.			
	Task 11 **Installs indoor-air quality (IAQ) equipment.**	Subtask 11.01 Installs heat-recovery ventilators (HRVs) and energy-recovery ventilators (ERVs).	Subtask 11.02 Installs central exhaust systems and exhaust fans.	Subtask 11.03 Installs IAQ accessories	
	Task 12 **Installs operational and safety controls for system.**	Subtask 12.01 Installs single-zone and/or multi-zone systems.	Subtask 12.02 Installs control system components, devices, and accessories.		
	Task 13 **Commissions RHVAC system.**	Subtask 13.01 Performs heating/cooling system start-up checks.	Subtask 13.02 Tests/adjusts and balances the installed RHVAC system.	Subtask 13.03 Orients customer/client re: RHVAC system user-interface and inputs..	
Block D **MAINTAINING RHVAC SYSTEMS**	**Task 14** **Performs planned ('preventive') maintenance.**	Subtask 14.01 Negotiates/interprets arrangements for system maintenance.	Subtask 14.02 Interprets inspection results re: warranty entitlements.	Subtask 14.03 Explains options re: compliance with warranty requirements	Subtask 14.04 Offers and sells service/maintenance agreements.
		Subtask 14.05 Completes and shares documentation re: new service/maintenance			
	Task 15 **Provides emergency (unscheduled) maintenance service.**	Subtask 15.01 Completes and forwards warranty claims.	Subtask 15.02 Performs diagnostics.	Subtask 15.02 Determines/ recommends remedial action, incl. notifications *per* shut-off requirements.	Subtask 15.04 Assess costs/availability of parts.
		Subtask 15.05 Performs repair.			
	Task 16 **Analyzes existing and/or changing system conditions.**	Subtask 16.01 Analyzes risks/hazards and other key concerns for whole system.	Subtask 16.02 Initiates corrective action based on assessments and recommendations		