



---

# **Heating, Refrigeration and Air Conditioning Techniques Program Standard**

**The approved program standard for the  
Heating, Refrigeration and Air  
Conditioning Techniques program of  
instruction leading to an Ontario College  
Certificate delivered by Ontario Colleges  
of Applied Arts and Technology.  
(MTCU funding code 45500)**

**Ministry of Training, Colleges and Universities  
June 2008**

## Permission to Reproduce

Permission is hereby granted to the following institutions to reproduce this document, in whole or in part, in print or by electronic means, for the following specific purposes, subject to the conditions that follow:

1. By an Ontario college of applied arts and technology for the purposes of implementation of the program standard within a college program, including for the purpose of informing students, potential students, program advisory committees, or others about programs of study.
2. By an educational institution or school, for the purpose of informing prospective college students about programs of study at Ontario colleges of applied arts and technology.

### **Conditions:**

1. Every reproduction must be marked “© 2008, Queen’s Printer for Ontario” at the beginning of the document or any part of it that is reproduced.
2. No other uses may be made of the document.
3. The document may not be reproduced for sale.
4. The Ministry may revoke the permission to reproduce at any time.

For permission to copy this document, in whole or in part, for other purposes or by other institutions, please contact

Ministry of Training, Colleges and Universities  
Programs Branch, Program Standards and Evaluation Unit

[psu@ontario.ca](mailto:psu@ontario.ca)

Inquiries regarding specific Heating, Refrigeration and Air Conditioning Techniques programs offered by colleges of applied arts and technology in Ontario should be directed to the relevant college.

© 2008, Queen’s Printer for Ontario

ISBN 978-1-4249-7249-4 (PDF)

# Acknowledgements

The Ministry of Training, Colleges and Universities acknowledges with thanks the significant contribution of the many individuals and organizations who participated in the development of this program standard. In particular, the Ministry of Training, Colleges and Universities would like to acknowledge the important roles of:

- all individuals and organizations who participated in the consultations;
- the coordinators of Heating, Refrigeration and Air Conditioning Techniques Programs for their assistance throughout the project, and the project officer who led the development of the vocational standard, Bill Fallis, seconded faculty member from George Brown College.

# Table of Contents

<b>I.</b>	<b>Introduction</b> .....	1
	Development of System-Wide Program Standards .....	1
	Program Standards .....	1
	The Expression of Program Standards as Vocational Learning Outcomes .....	2
	The Presentation of the Vocational Learning Outcomes .....	2
	The Development of a Program Standard.....	2
	Updating the Program Standard.....	3
<b>II.</b>	<b>Vocational Standard</b> .....	4
	Preamble .....	4
	Synopsis of the Vocational Learning Outcomes.....	5
	The Vocational Learning Outcomes .....	6 - 12
<b>III.</b>	<b>Essential Employability Skills</b> .....	13
	Context.....	13
	Skill Categories.....	13
	Application and Implementation .....	14 - 15
<b>IV.</b>	<b>General Education Requirement</b> .....	16
	Requirement.....	16

# I. Introduction

*This document is the Program Standard for the Heating, Refrigeration and Air Conditioning Techniques program of instruction leading to an Ontario College Certificate delivered by Ontario colleges of applied arts and technology (MTCU funding code 45500).*

## Development of System-Wide Program Standards

In 1993, the Government of Ontario initiated program standards development with the objectives of bringing a greater degree of consistency to college programming offered across the province, broadening the focus of college programs to ensure graduates have the skills to be flexible and to continue to learn and adapt, and providing public accountability for the quality and relevance of college programs.

The Program Standards and Evaluation Unit of the Ministry of Training, Colleges and Universities has responsibility for the development, review, and approval of system-wide standards for programs of instruction at Ontario colleges of applied arts and technology.

## Program Standards

Program standards apply to all similar programs of instruction offered by colleges across the province. Each program standard for a postsecondary program includes the following elements:

- **Vocational standard** (the vocationally specific learning outcomes which apply to the program of instruction in question),
- **Essential employability skills** (the essential employability skills learning outcomes which apply to all programs of instruction), and
- **General education requirement** (the requirement for general education in postsecondary programs of instruction).

Collectively, these elements outline the essential skills and knowledge that a student must reliably demonstrate in order to graduate from the program.

Individual colleges of applied arts and technology offering the program of instruction determine the specific program structure, delivery methods, and other curriculum matters to be used in assisting students to achieve the outcomes articulated in the standard. Individual colleges also determine whether additional local learning outcomes will be required to reflect specific local needs and/or interests.

## The Expression of Program Standards as Vocational Learning Outcomes

Vocational learning outcomes represent culminating demonstrations of learning and achievement. They are not simply a listing of discrete skills, nor broad statements of knowledge and comprehension. In addition, vocational learning outcomes are interrelated and cannot be viewed in isolation of one another. As such, they should be viewed as a comprehensive whole. They describe performances that demonstrate that significant integrated learning by graduates of the program has been achieved and verified.

Expressing standards as vocational learning outcomes ensures consistency in the outcomes for program graduates, while leaving curriculum matters such as the specific program structure and delivery methods to the discretion of individual colleges.

## The Presentation of the Vocational Learning Outcomes

The **vocational learning outcome** statements set out the culminating demonstration of learning and achievement that the student must reliably demonstrate before graduation.

The **elements of the performance** statements for each outcome define and clarify the level and quality of performance necessary to meet the requirements of the vocational learning outcome. However, it is the performance of the vocational learning outcome itself on which students are evaluated. The elements of performance are indicators of the means by which the student may proceed to satisfactory performance of the vocational learning outcome. The elements of performance do not stand alone but rather in reference to the vocational learning outcome of which they form a part.

## The Development of a Program Standard

In establishing the standards development initiative, the Government determined that all postsecondary programs of instruction should include vocational skills coupled with a broader set of essential skills. This combination is considered critical to ensuring that college graduates have the skills required to be successful both upon graduation from the college program and throughout their working and personal lives.

A program standard is developed through a broad consultation process involving a range of stakeholders with a direct interest in the program area, including employers, professional associations, universities, secondary schools, and program graduates working in the field, in addition to students, faculty, and administrators at the colleges themselves. It represents a consensus of participating stakeholders on the essential learning that all program graduates should have achieved.

## Updating the Program Standard

The Ministry of Training, Colleges and Universities will undertake regular reviews of the vocational learning outcomes for this program to ensure that the Heating, Refrigeration and Air Conditioning Techniques Program Standard remains appropriate and relevant to the needs of students and employers across the Province of Ontario. To confirm that this document is the most up-to-date release, contact the ministry:

[psu@ontario.ca](mailto:psu@ontario.ca)

## II. Vocational Standard

*All graduates of Heating, Refrigeration and Air Conditioning Techniques programs of instruction must have achieved the 7 vocational learning outcomes listed in the following pages, in addition to achieving the essential employability skills learning outcomes and meeting the general education requirement.*

### Preamble

The Heating, Refrigeration and Air Conditioning Techniques program provides students with basic theoretical knowledge and fundamental practical training under controlled conditions to assist in the installation, servicing, and maintenance of heating, refrigeration, and air conditioning systems. Upon successful completion of the program, the graduate will receive an Ontario College Certificate.

The vocational learning outcomes include a range of basic skills for those interested in pursuing work in the heating, refrigeration, and air conditioning industry. Graduates, who achieve the appropriate gaseous fuel certification by the regulating authority, may obtain employment as fuel equipment installers, fuel burner cleaners, and building or facilities maintenance technicians. Other graduates may be employed in sales, or commence entry-level apprentices, e.g., sheet metal or refrigeration. Even though the program offers training in the heating, refrigeration, and air conditioning industry, this training is at a basic level. Apprenticeship is required after graduation for those who wish to work in the trades. Gas/oil technician certification is required after graduation for those who wish to work as a gas or oil burner technician.



## Synopsis of the Vocational Learning Outcomes Heating, Refrigeration and Air Conditioning Techniques Program

*The graduate has reliably demonstrated the ability to*

- 1. relate effectively to heating, refrigeration, and air conditioning supervisors, coworkers, and customers.**
- 2. work safely and in accordance with all applicable acts, regulations, legislation, and codes to ensure personal and public safety.**
- 3. select and use hand tools and operate test equipment for their intended purposes.**
- 4. solve routine heating, refrigeration, and air conditioning problems and perform calculations by applying the fundamentals of mathematics and physics.**
- 5. read, develop, and interpret various drawings and utilize the information to follow the proper sequence of operations for heating, refrigeration, air conditioning systems, and associated components.**
- 6. assist in the installation and start-up operations of heating, refrigeration, and air conditioning systems under the supervision of a certified technician.**
- 7. identify strategies for ongoing personal and professional development, that will lead to enhanced work performance and career opportunities, and keep pace with industry changes.**

*Note:* The vocational learning outcomes have been numbered as a point of reference; numbering does not imply prioritization, sequencing, nor weighting of significance.

## The Vocational Learning Outcomes

1. *The graduate has reliably demonstrated the ability to*  
**relate effectively to heating, refrigeration, and air conditioning supervisors, coworkers, and customers.**

### Elements of the Performance

- communicate clearly and concisely in written, graphic, and oral forms;
- respond effectively to customers' questions both in oral and written forms;
- apply a basic knowledge of customer relations and diplomacy when interacting with customers;
- clarify and complete tasks assigned by supervisors;
- prepare accurate technical reports and invoices;
- provide accurate and appropriate information to customers on sales options and services available on related equipment.

2. *The graduate has reliably demonstrated the ability to*

**work safely and in accordance with all applicable acts, regulations, legislation, and codes to ensure personal and public safety.**

### **Elements of the Performance**

- comply with environmental, health and safety legislation, and related codes and regulations; e.g., Workplace Hazardous Material Information System (WHMIS);
- comply with installation codes and government regulations pertaining to heating and cooling equipment;
- comply with regulatory and licensing requirements as well as company policies when completing the installation of heating, refrigeration, and air conditioning systems and associated components;
- conduct safety inspections of the workplace to detect, report, and correct where possible, hazardous conditions;
- complete written documentation for work orders and regulatory forms to ensure due diligence of required regulations and codes;
- inspect equipment and systems, conduct tests, and compile and compare data in accordance with standard formats and procedures;
- comply with occupational codes of conduct and expectations related to appearance and hygiene.

3. *The graduate has reliably demonstrated the ability to*

**select and use hand tools and operate test equipment for their intended purposes.**

#### **Elements of the Performance**

- select among basic heating, refrigeration, and air conditioning tools, and use them for their intended purposes in a safe manner;
- operate selected hand and power tools used in the installation and maintenance of heating, refrigeration, air conditioning systems, and components;
- select proper fasteners used in the installation and maintenance of heating, refrigeration, air conditioning systems, and components and employ them for their intended purposes in a safe manner;
- select and operate electrical measuring instruments required to start-up refrigeration and air conditioning systems;
- use refrigerant pressure measuring devices and temperature measuring instruments required to install or start-up a mechanical cooling system;
- use specialized instruments to ensure that heating, refrigeration, and air conditioning systems are operating correctly and efficiently.

4. *The graduate has reliably demonstrated the ability to*

**solve routine heating, refrigeration, and air conditioning problems and perform calculations by applying the fundamentals of mathematics and physics.**

#### **Elements of the Performance**

- perform routine heating, refrigeration, and air conditioning calculations by applying the fundamentals of mathematics (e.g., heat gain and heat loss);
- select the appropriate size and materials of combustion fuel pipes and vents by proper utilisation of pipe and vent sizing selection tables;
- solve routine heating, refrigeration, and air conditioning problems by applying the fundamentals of physics (e.g., basic concepts of the refrigeration cycle and the components required to create an air conditioning system);
- solve routine heating, refrigeration, and air conditioning problems by applying the fundamentals of chemistry (e.g., knowledge of properties, characteristics, and safe handling of hydro-carbon fuels and refrigerants);
- solve problems involving current flow in DC and AC circuits by applying electrical theory and laws (e.g., series, parallel and series/parallel circuits, and meters);
- apply electrical and mechanical knowledge to assist in the installation of heating, refrigeration, air conditioning systems, and components.

5. *The graduate has reliably demonstrated the ability to*

**read, develop, and interpret various drawings and utilize the information to follow the proper sequence of operations for heating, refrigeration, air conditioning systems, and associated components.**

#### **Elements of the Performance**

- apply principles of linear and angular measurement, architectural and engineering scales, and standard symbols and abbreviations in the basic interpretation of drawings and blueprints;
- interpret basic system installation drawings, and wiring, piping, control, and flow diagrams, as provided in installation manuals, manufacturing literature and training documents;
- read a set of blueprints for the installation of duct work, hydronic piping, refrigerant, and fuel piping;
- record accurate measurements from basic construction blueprints;
- hand sketch orthographic and isometric drawings for the installation of air conditioning systems;
- read and extract information for the installation of ducts, and heating and refrigerant piping;
- read and interpret electrical wiring diagrams.

6. *The graduate has reliably demonstrated the ability to*

**assist in the installation and start-up operations of heating, refrigeration, and air conditioning systems under the supervision of a certified technician.**

#### **Elements of the Performance**

- apply basic operating principles for the installation of heating, air conditioning, refrigeration systems, and components;
- assist in the performance of combustion efficiency tests;
- use proper procedures required to assist in the start up of mechanical cooling and heating systems;
- assist in the installation of accessories for heating, refrigeration, and air conditioning systems;
- participate in the installation of equipment and systems.

7. *The graduate has reliably demonstrated the ability to*

**identify strategies for ongoing personal and professional development that will lead to enhanced work performance and career opportunities, and keep pace with industry changes.**

#### **Elements of the Performance**

- apply problem solving skills for specific knowledge acquisition and skill development;
- take responsibility for one's job related performance, both as an individual and as a member of a team;
- identify training courses, workshops, and programs at private, public, and industrial institutions to enhance employment opportunities in the field of heating, refrigeration, and air conditioning;
- engage in activities that include critical reflection and self evaluation to promote professional competence;
- articulate learning strategies and plan learning activities to improve one's skill level and to expand one's skill base;
- act in a responsible manner that incorporates due diligence;
- use effective time management and organizational skills to complete heating, refrigeration and air conditioning projects.



## III. Essential Employability Skills

*All graduates of Heating, Refrigeration, and Air Conditioning Techniques programs of instruction must have reliably demonstrated the essential employability skills learning outcomes listed on the following pages, in addition to achieving the vocational learning outcomes and meeting the general education requirement.*

### Context

Essential Employability Skills (EES) are skills that, regardless of a student's program or discipline, are critical for success in the workplace, in day-to-day living, and for lifelong learning.

The teaching and attainment of these EES for students in, and graduates from, Ontario's colleges of applied arts and technology are anchored in a set of three fundamental assumptions:

- these skills are important for every adult to function successfully in society today;
- our colleges are well equipped and well positioned to prepare graduates with these skills;
- these skills are equally valuable for all graduates, regardless of the level of their credential, whether they pursue a career path, or they pursue further education.

### Skill Categories

To capture these skills, the following six categories define the essential areas where graduates must demonstrate skills and knowledge.

- Communication
- Numeracy
- Critical Thinking & Problem Solving
- Information Management
- Interpersonal
- Personal

## Application and Implementation

In each of the six skill categories, there are a number of defining skills, or sub skills, identified to further articulate the requisite skills identified in the main skill categories. The following chart illustrates the relationship between the skill categories, the defining skills within the categories, and learning outcomes to be achieved by graduates from all postsecondary programs of instruction that lead to an Ontario College credential.

EES may be embedded in General Education or vocational courses, or developed through discrete courses. However these skills are developed, all graduates with Ontario College credentials must be able to reliably demonstrate the essential skills required in each of the six categories.

<b>SKILL CATEGORY</b>	<b>DEFINING SKILLS: Skill areas to be demonstrated by graduates:</b>	<b>LEARNING OUTCOMES: The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to:</b>
COMMUNICATION	<ul style="list-style-type: none"> <li>• Reading</li> <li>• Writing</li> <li>• Speaking</li> <li>• Listening</li> <li>• Presenting</li> <li>• Visual literacy</li> </ul>	<ol style="list-style-type: none"> <li>1. <i>communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.</i></li> <li>2. <i>respond to written, spoken, or visual messages in a manner that ensures effective communication.</i></li> </ol>
NUMERACY	<ul style="list-style-type: none"> <li>• Understanding and applying mathematical concepts and reasoning</li> <li>• Analyzing and using numerical data</li> <li>• Conceptualizing</li> </ul>	<ol style="list-style-type: none"> <li>3. <i>execute mathematical operations accurately.</i></li> </ol>
CRITICAL THINKING & PROBLEM SOLVING	<ul style="list-style-type: none"> <li>• Analysing</li> <li>• Synthesising</li> <li>• Evaluating</li> <li>• Decision making</li> <li>• Creative and innovative thinking</li> </ul>	<ol style="list-style-type: none"> <li>4. <i>apply a systematic approach to solve problems.</i></li> <li>5. <i>use a variety of thinking skills to anticipate and solve problems.</i></li> </ol>

<b>SKILL CATEGORY</b>	<b>DEFINING SKILLS: Skill areas to be demonstrated by graduates:</b>	<b>LEARNING OUTCOMES: The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to:</b>
INFORMATION MANAGEMENT	<ul style="list-style-type: none"> <li>• Gathering and managing information</li> <li>• Selecting and using appropriate tools and technology for a task or a project</li> <li>• Computer literacy</li> <li>• Internet skills</li> </ul>	<p>6. <i>locate, select, organize, and document information using appropriate technology and information systems.</i></p> <p>7. <i>analyze, evaluate, and apply relevant information from a variety of sources.</i></p>
INTERPERSONAL	<ul style="list-style-type: none"> <li>• Team work</li> <li>• Relationship management</li> <li>• Conflict resolution</li> <li>• Leadership</li> <li>• Networking</li> </ul>	<p>8. <i>show respect for the diverse opinions, values, belief systems, and contributions of others.</i></p> <p>9. <i>interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.</i></p>
PERSONAL	<ul style="list-style-type: none"> <li>• Managing self</li> <li>• Managing change and being flexible and adaptable</li> <li>• Engaging in reflective practices</li> <li>• Demonstrating personal responsibility</li> </ul>	<p>10. <i>manage the use of time and other resources to complete projects.</i></p> <p>11. <i>take responsibility for one's own actions, decisions, and consequences.</i></p>

## IV. General Education Requirement

*All graduates of Heating, Refrigeration, and Air Conditioning Techniques program must have met the general education requirement described below, in addition to achieving the vocational and essential employability skills learning outcomes.*

### Requirement

The General Education Requirement for programs of instruction is stipulated in the Credentials Framework (Appendix A in the Minister's Binding Policy Directive *Framework for Programs of Instruction*).

While the inclusion of General Education is locally determined for programs of instruction leading to either a college certificate or an Ontario College Certificate, it is recommended that graduates of the Ontario College Certificate programs have been engaged in learning that incorporates some breadth beyond the vocational field of study.