



Mechanical Techniques Program Standard

**The approved program standard for
Mechanical Techniques program of
instruction leading to an Ontario College
Certificate delivered by Ontario Colleges
of Applied Arts and Technology.
(MTCU funding code 41007)**

**Ministry of Training, Colleges and Universities
September 2010**

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ISBN 978-1-4435-4706-2 (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 co-ordinators of Mechanical Techniques Programs for their assistance throughout the project, the project officer who led the development of the vocational standard, Paul Johnson, seconded faculty member from Confederation College and Mireille Deshaies from La Cité collégiale.

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I. Introduction

This document is the Program Standard for the Mechanical Techniques program of instruction leading to an Ontario College Certificate delivered by Ontario colleges of applied arts and technology (MTCU funding code 41007).

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 have 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 to the discretion of individual colleges curriculum matters such as the specific program structure and delivery methods.

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** 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 Mechanical 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, please contact the ministry:

psu@ontario.ca

II. Vocational Standard

All graduates of the Mechanical Techniques program of instruction must have achieved the ten 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

Graduates of the Mechanical Techniques program have demonstrated the foundational mechanical skills required to carry out mechanical and manufacturing functions in production and processing environments. Graduates have demonstrated achievement of vocational learning outcomes that relate to the mechanical and manufacturing fields.

Graduates of the Mechanical Techniques program have developed skills and safe working practices in the use of machinery, tools and measuring equipment and instruments to support the production and repair of mechanical components. They will apply skills in oral and written communication, documentation, teamwork, troubleshooting, technical measurements, as well as computer and information technology applications to support mechanical and manufacturing activities.

Graduates of the Mechanical Techniques program work in a broad range of employment settings in the manufacturing industries (e.g., aerospace and defence, automotive, building products, fabricated metal products, machinery, primary metal, railway equipment, as well as shipbuilding and industrial marine) and natural resource industries (e.g., agricultural, energy, forestry, mining and petrochemical). The graduates' activities could range from machine operators to set-up workers, or they may combine their education and training with an apprenticeship in a variety of specialized trades, such as CAD/CAM-draftsperson, CNC Programmer, General Machinist, Industrial Mechanic (Millwright), Metal Fabricator, Mould or Die Finisher, Mould Maker and Tool & Die Maker.

To be employed in certain skilled trades, workers must have a Certificate of Qualification. This certificate states that they have completed the specified training period in the workplace and training institution (e.g., an Ontario College of Applied Arts and Technology) and passed the relevant provincial or territorial qualification exam that assesses their knowledge of their skilled trade.

Opportunities for graduates to pursue further occupational or educational qualifications are available through apprenticeship training, whereby graduates may be granted credits towards certification. Students wishing to continue their studies to obtain advanced skills and complete an Ontario College Diploma (e.g., Mechanical Technician or Mechanical Engineering Technician) should contact individual colleges for details.

Synopsis of the Vocational Learning Outcomes Mechanical Techniques (Ontario College Certificate)

The graduate has reliably demonstrated the ability to

- 1. complete all work in compliance with current legislation, standards, regulations and guidelines.**
- 2. contribute to the application of quality control and quality assurance procedures to meet organizational standards and requirements.**
- 3. comply with current health and safety legislation, as well as organizational practices and procedures.**
- 4. support sustainability* best practices in workplaces.**
- 5. use current and emerging technologies* to support the implementation of mechanical and manufacturing projects.**
- 6. troubleshoot and solve standard mechanical problems by applying mathematics and fundamentals of mechanics.**
- 7. contribute to the interpretation and preparation of mechanical drawings and other related technical documents.**
- 8. perform routine technical measurements accurately using appropriate instruments and equipment.**
- 9. assist in manufacturing, assembling, maintaining and repairing mechanical components according to required specifications.**
- 10. select, use and maintain machinery, tools and equipment for the installation, manufacturing and repair of basic mechanical components.**

** See glossary*

Note: The 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*
complete all work in compliance with current legislation, standards, regulations and guidelines

Elements of the Performance

- complete all work within the legal and ethical guidelines relevant to the mechanical industry
- comply with industry standards and regulations as required (e.g., American National Standards Institute (ANSI), ASTM International (ASTM), Canadian Standards Association (CSA), International Organization for Standardization (ISO) or Technical Standards and Safety Authority (TSSA))
- complete all work in accordance with organizational practices and procedures
- comply with regulatory requirements when completing the installation, maintenance and repair of mechanical components
- support organizational policies that strengthen an inclusive, equitable, respectful, safe and co-operative workplace environment
- support employer-employee contractual obligations within collective agreements
- accept responsibility and be accountable for one's actions

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

contribute to the application of quality control and quality assurance procedures to meet organizational standards and requirements.

Elements of the Performance

- contribute to production efficiency and effectiveness by assisting in the implementation of quality control systems (e.g., International Organization for Standardization (ISO) series systems—ISO 9000 series, Six Sigma or continuous improvement (kaizen) efforts)
- assist in confirming that mechanical products or services match the intended purpose, including workplace and/or customer expectations
- assist in conducting quality assurance inspections, sampling, testing or audits to verify that materials and products are manufactured according to required specifications
- select, calibrate* and use appropriate measuring instruments to inspect mechanical components
- assist in inspecting, sampling, testing and evaluating for quality control against established standards to uncover defects and carry out the needed corrective measures
- assist in collecting and reporting on quality assurance and quality control data for statistical process control and planning purposes
- assist in recording and reporting compliance with current quality assurance procedures and required specifications
- prepare and maintain current, clear and accurate project-related documents and progress reports in accordance with current organizational practices

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

comply with current health and safety legislation, as well as organizational practices and procedures.

Elements of the Performance

- interpret and apply safety codes, as well as policies and practices and accident prevention procedures
- complete all work in accordance with health and safety legislation
- monitor the workplace for hazards and take appropriate actions to promote a safe working environment
- use personal protective equipment (PPE) and wear appropriate clothing to ensure personal health and safety in workplaces
- promote and apply best practices for a healthy and safe workplace
- follow safe work practices and procedures when using hand and power tools, as well as machine tools and related equipment
- handle all work materials appropriately and safely
- handle, store and dispose of hazardous materials safely in accordance with the Workplace Hazardous Materials Information System (WHMIS) and Transporting of Dangerous Goods (TDG) regulations
- respond appropriately to emergency situations according to organizational practices and procedures

4. *The graduate has reliably demonstrated the ability to*
support sustainability* best practices in workplaces.

Elements of the Performance

- comply with environmental management systems (e.g., International Organization for Standardization (ISO) series systems—ISO 14000 series)
- comply with environmental policies and standards
- apply innovative best practices in workplaces, such as lean and green sustainability* practices and procedures
- recognize and take into account the interrelationships among technology, society, the environment, politics, the economy and mechanical or manufacturing projects
- assist in applying methods for reducing waste, energy consumption and emissions to bring about effective and efficient use of resources
- assist in applying methods for sustainability* when selecting and using materials (e.g., renewable, recyclable or recycled materials)

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

use current and emerging technologies* to support the implementation of mechanical and manufacturing projects.

Elements of the Performance

- acquire and maintain computer skills applicable to current and emerging technologies* to contribute to the preparation of mechanical drawings and other related technical documents
- use current and emerging technologies* to assist in manufacturing and maintaining mechanical components according to required specifications
- access and exchange technical information using the Internet and emerging technologies*
- access, organize and store information and prepare technical documents using an effective electronic file management process

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

troubleshoot and solve standard mechanical problems by applying mathematics and fundamentals of mechanics.

Elements of the Performance

- solve standard technical problems by applying basic mathematics, such as fractions, decimals, algebra and trigonometry
- calculate and convert Imperial and International System of Units (SI) measurement units accurately using both manual methods and digital technology
- assist in analyzing and solving standard technical problems applying fundamentals of mechanics
- troubleshoot standard technical problems using appropriate testing and measurement equipment
- access and select relevant technical information from a variety of sources (e.g., technical manuals, software and other media, the Internet, suppliers or coworkers)
- identify, select and use appropriate methods, tools and techniques to repair mechanical components

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

contribute to the interpretation and preparation of mechanical drawings and other related technical documents.

Elements of the Performance

- contribute to the interpretation and the preparation of mechanical drawings and other related technical documents for the installation, maintenance and repair of mechanical components
- identify geometric dimensions, tolerances and materials specifications required for manufacturing mechanical components
- use freehand drawing techniques to assist in the preparation of mechanical sketches
- apply current and relevant computer-based drafting techniques to assist in the preparation and modification of mechanical drawings (e.g., Computer-Aided Design (CAD) software)
- read and contribute to the interpretation of bills of materials and revision annotations
- use mechanical terminology correctly and accurately in written and oral communication
- assist in collecting, preparing and organizing relevant information, data, materials and technical documents in accordance with recognized standards (e.g., organizational standards, CSA, ISO)

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

perform routine technical measurements accurately using appropriate instruments and equipment.

Elements of the Performance

- apply fundamentals of physics and materials science (e.g., laws of thermodynamics, Pascal's law, law of elasticity, equilibrium of forces or laws of sound)
- identify the essential elements and functions of basic technical measurements
- select the appropriate units of measurement for specific technical applications
- perform and record accurate and precise measurements using SI and Imperial measuring tools
- perform accurate conversions between SI and Imperial units of measure
- inspect mechanical components at established intervals using appropriate tools and procedures
- measure and record process parameters using the appropriate instruments and equipment (e.g., pressure, force, strain, temperature, flow, motion, speed, level or acoustics)
- calibrate* accurately analog and digital instruments and equipment (e.g., verniers, micrometers, as well as depth and dial gauges)
- use standard layout tools
- observe, record and report in compliance with organizational quality assurance and quality control procedures and required specifications
- handle and maintain measurement instruments and equipment with care according to established procedures and processes

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

assist in manufacturing, assembling, maintaining and repairing mechanical components according to required specifications.

Elements of the Performance

- assess the performance characteristics, limitations, potential and safety aspects of machinery, tools and equipment
- determine required specifications and tolerances to manufacture, assemble, maintain and repair mechanical components
- assist in manufacturing, assembling, maintaining and repairing mechanical components to required specifications using appropriate manufacturing processes
- contribute to the manufacture of mechanical components using computer-aided technology
- select and safely use materials according to organizational procedures

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

select, use and maintain machinery, tools and equipment for the installation, manufacturing and repair of basic mechanical components.

Elements of the Performance

- select and safely use mechanical equipment according to performance properties, potential and limitations
- select and safely use tools for the installation, manufacturing and repair procedures in workplaces
- perform basic set-up procedures using appropriate work-holding devices
- select appropriate tools to perform specific operations
- select, use and maintain machinery, tools and equipment according to established schedules and procedures

Glossary

Calibrate – to check and adjust the accuracy of the measurement of a measuring instrument against an accurate standard.

Emerging Technologies – technologies that are not yet standard but that probably will be adopted in the near term. The expectation is that an emerging technology will come into standard usage when the application of the technology matures.

Sustainability—sustainability encompasses the ethical ideal that calls for optimizing the long-term carrying capacity and vitality of three interdependent systems—environmental, social and economic. In a manufacturing context, sustainability aims to improve the quality of human life, while protecting nature, by engaging in manufacturing processes that are non-polluting, conserve energy and resources and protect ecosystems; benefit employees, consumers and communities; and strengthen enterprises that foster economic growth and prosperity.

III. Essential Employability Skills

All graduates of the Mechanical Techniques program 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.

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

SKILL CATEGORY	DEFINING SKILLS: Skill areas to be demonstrated by graduates:	LEARNING OUTCOMES: The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to:
INFORMATION MANAGEMENT	<ul style="list-style-type: none"> • Gathering and managing information • Selecting and using appropriate tools and technology for a task or a project • Computer literacy • Internet skills 	<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"> • Teamwork • Relationship management • Conflict resolution • Leadership • Networking 	<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"> • Managing self • Managing change and being flexible and adaptable • Engaging in reflective practices • Demonstrating personal responsibility 	<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 their consequences.</i></p>

IV. General Education Requirement

All graduates of the Mechanical Techniques program must have met the general education requirement described on the following pages, 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*).

In programs of instruction leading to either an Ontario College Diploma or an Ontario College Advanced Diploma, it is required that graduates have been engaged in learning that exposes them to at least one discipline outside their main field of study and increases their awareness of the society and culture in which they live and work. This will typically be accomplished by students taking 3 to 5 courses (or the equivalent) designed discretely and separately from vocational learning opportunities.

This general education learning would normally be delivered using a combination of required and elective processes.

Purpose

The purpose of General Education in the Ontario college system is to contribute to the development of citizens who are conscious of the diversity, complexity and richness of the human experience; who are able to establish meaning through this consciousness; and who, as a result, are able to contribute thoughtfully, creatively and positively to the society in which they live and work.

General Education strengthens students' essential employability skills, such as critical analysis, problem solving and communication, in the context of an exploration of topics with broad-based personal and/or societal importance.

Themes

The themes listed below will be used to provide direction to colleges in the development and identification of courses that are designed to fulfill the General Education Requirement for programs of instructions.

Each theme provides a statement of Rationale and offers suggestions related to more specific topic areas that could be explored within each area. These suggestions are neither prescriptive nor exhaustive. They are included to provide guidance regarding the nature and scope of content that would be judged as meeting the intent and overall goals of General Education.

1. Arts in Society:

Rationale:

The capacity of a person to recognize and evaluate artistic and creative achievements is useful in many aspects of his/her life. Since artistic expression is a fundamentally human activity, which both reflects and anticipates developments in the larger culture, its study will enhance the student's cultural and self-awareness.

Content:

Courses in this area should provide students with an understanding of the importance of visual and creative arts in human affairs, of the artist's and writer's perceptions of the world and the means by which those perceptions are translated into the language of literature and artistic expression. They will also provide an appreciation of the aesthetic values used in examining works of art and possibly, a direct experience in expressing perceptions in an artistic medium.

2. Civic Life:

Rationale:

In order for individuals to live responsibly and to reach their potential as individuals and as citizens of society, they need to understand the patterns of human relationships that underlie the orderly interactions of a society's various structural units. Informed people will have knowledge of the meaning of civic life in relation to diverse communities at the local, national and global level and an awareness of international issues and the effects of these on Canada, as well as Canada's place in the international community.

Content:

Courses in this area should provide students with an understanding of the meaning of freedoms, rights and participation in community and public life, in addition to a working knowledge of the structure and function of various levels of government (municipal, provincial, national) in a Canadian and/or in an international context. They may also provide an historical understanding of major political issues affecting relations between the various levels of government in Canada and their constituents.

3. Social and Cultural Understanding:

Rationale:

Knowledge of the patterns and precedents of the past provide the means for a person to gain an awareness of his or her place in contemporary culture and society. In addition to this awareness, students will acquire a sense of the main currents of their culture and that of other cultures over an extended period of time in order to link personal history to the broader study of culture.

Content:

Courses in this area are those that deal broadly with major social and cultural themes. These courses may also stress the nature and validity of historical evidence and the variety of historical interpretation of events. Courses will provide the students with a view and understanding of the impact of cultural, social, ethnic or linguistic characteristics.

4. Personal Understanding:

Rationale:

Educated people are equipped for life-long understanding and development of themselves as integrated physiological and psychological entities. They are aware of the ideal need to be fully functioning persons: mentally, physically, emotionally, socially, spiritually and vocationally.

Content:

Courses in this area will focus on understanding the individual: his or her evolution; situation; relationship with others; place in the environment and universe; achievements and problems; and his or her meaning and purpose. They will also allow students the opportunity to study institutionalized human social behaviour in a systematic way. Courses fulfilling this requirement may be oriented to the study of the individual within a variety of contexts.

5. Science and Technology:

Rationale:

Matter and energy are universal concepts in science, forming a basis for understanding the interactions that occur in living and non-living systems in our universe. Study in this area provides an understanding of the behaviour of matter that provides a foundation for further scientific study and the creation of broader understanding about natural phenomena

Similarly, the various applications and developments in the area of technology have an increasing impact on all aspects of human endeavour and have numerous social, economic and philosophical implications. For example, the operation of computers to process data at high speed has invoked an interaction between machines and the human mind that is unique in human history. This and other technological developments have a powerful impact on how we deal with many of the complex questions in our society.

Content:

Courses in this area should stress scientific inquiry and deal with basic or fundamental questions of science rather than applied ones. They may be formulated from traditional basic courses in such areas of study as biology, chemistry, physics, astronomy, geology or agriculture. As well, courses related to understanding the role and functions of computers (e.g., data management and information processing) and assorted computer-related technologies should be offered in a non-applied manner to provide students with an opportunity to explore the impact of these concepts and practices on their lives.