Ontario College of Teachers

Ordre des enseignantes et des enseignants de l'Ontario

Additional Qualification Course Guideline Teaching Manufacturing Technology - Precision Machining

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Schedule F
Teachers' Qualifications Regulation

December 2014

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Additional Qualification Course Guideline

1. Introduction

The guideline for Teaching Manufacturing Technology - Precision Machining is organized using the following framework.

Diagram 1: Guideline Organization

Teachers are able to take the Additional Qualification course: Teaching Manufacturing Technology - Precision Machining if they hold a technological education qualification at Grades 9 and 10 or Grades 11 and 12 in the broad-based area of Teaching Manufacturing Technology.

The Additional Qualification Course: Teaching Manufacturing Technology - Precision Machining employs a critical, pedagogical lens to explore in holistic and integrated manner theoretical foundations, development of learners, program planning and implementation, instructional practices, assessment and evaluation, the learning environment and ethical considerations related to teaching and learning.

The Ontario College of Teachers recognizes that candidates working in the publicly funded school system, independent/private institutions or First Nations schools will have a need to explore topics and issues of particular relevance to the context in which they work or may work.

Critical to the implementation of this course is the creation of positive learning experiences that reflect care, diversity and equity. This course supports the enhancement of professional knowledge, ethical practice, leadership and ongoing learning.

The French language and the English language communities will also need to implement these guidelines to reflect the unique contextual dimensions and needs of each community. Each of these language communities will explore the guideline content from distinct perspectives and emphasis. This flexibility will enable both language communities to implement Teaching Manufacturing Technology - Precision Machining as understood from a variety of contexts.

The Teaching Manufacturing Technology - Precision Machining additional qualification course guideline provides a conceptual framework for providers and instructors to develop and facilitate the Teaching Manufacturing Technology - Precision Machining course. The guideline framework is intended to be a fluid, holistic and integrated representation of key concepts associated with Teaching Manufacturing Technology - Precision Machining.

2. Regulatory Context

The College is the self-regulating body for the teaching profession in Ontario. The College's responsibility related to courses leading to additional qualifications includes the following:

- to establish and enforce professional standards and ethical standards applicable to members of the College
- to provide for the ongoing education of members of the College
- to accredit additional qualification courses or programs and more specifically,

  The program content and expected achievement of persons enrolled in the program match the skills and knowledge reflected in the College's Standards of Practice for the Teaching Profession and the Ethical Standards for the Teaching Profession and in the program guidelines issued by the College.

(*Accreditation of Teacher Education Programs Regulation*, Part IV, Subsection 24).

Additional qualifications for teachers are identified in the *Teachers' Qualifications Regulation*. This regulation includes courses/programs that lead to Additional Qualifications, the Principal's Qualifications and the Supervisory Officer's Qualifications. A session of a course leading to an additional qualification shall consist of a minimum of 125 hours as approved by the Registrar. Accredited additional qualification courses reflect the *Ethical Standards for the Teaching Profession,* the *Standards of Practice for the Teaching Profession* and the *Professional Learning Framework for the Teaching Profession.*

The course developed from this guideline is open to candidates who meet the entry requirements identified in the *Teachers' Qualifications Regulation*.

Successful completion of the course leading to the Additional Qualification: Teaching Manufacturing Technology - Precision Machining, listed in Schedule F of the *Teachers' Qualifications Regulation* is recorded on the Certificate of Qualification and Registration. Successful completion of three schedule F courses within a specific broad-based technology area will be deemed to be equivalent to one specialist or honour specialist qualification for purposes of entry into the principal's qualification or the supervisory officer qualification. (O. Reg. 176/10 S.49 (4) and (5))

In this document, all references to candidates are to teachers enrolled in the additional qualification course. References to students indicate those enrolled in school programs.

3. Foundations of Professional Practice

The *Foundations of Professional Practice* conveys a provincial vision of what it means to be a teacher in Ontario. This vision lies at the core of teacher professionalism. The *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* (Appendix 1) are the foundation for the development and in the realization of the Additional Qualification course. These nine standards, as principles of professional practice, provide the focus for ongoing professional learning and are the foundation for the development and implementation of the Additional Qualification Course: Teaching Manufacturing Technology - Precision Machining. In addition, the

Professional Learning Framework for the Teaching Profession is underpinned by the standards, articulates the principles on which effective teacher learning is based and acknowledges a range of options that promote continuous professional learning. The ongoing enhancement of informed professional judgment, which is acquired through the processes of lived experience, inquiry, and reflection, is central to the embodiment of the standards and the Professional Learning Framework within this AQ course and professional practice.

The *Ethical Standards of the Teaching Profession* and the *Standards of Practice for the Teaching Profession* serve as guiding frameworks that underpin professional knowledge, skills and experiences that teachers require in order to teach effectively within and contribute to an environment that fosters *respect, care, trust* and *integrity.*

Teacher-Education Resources

The College has developed resources to support the effective integration of the standards within Additional Qualification courses and programs. These teacher education resources explore the integration of the standards within professional practice through a variety of educative, research and inquiry-based processes. This guideline has been designed to reflect the *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession*and the *Professional Learning Framework for the Teaching Profession.*These resources can be found on the College web site (www.oct.ca). These resources support the development of professional knowledge and professional judgment through reflective practice. The lived experiences of Ontario educators are illuminated in the resources and serve as AQ course support for teacher education.

4. Conceptual Framework

The design, course content and implementation of the Additional Qualification Course Guideline: Teaching Manufacturing Technology - Precision Machining support effective teacher education practices. These course guideline components provide a conceptual framework for the development of a holistic, integrated, experiential and inquiry-based course. The following conceptual framework supports and informs professional knowledge, judgment and practices within the Additional Qualification Course: Teaching Manufacturing Technology - Precision Machining.

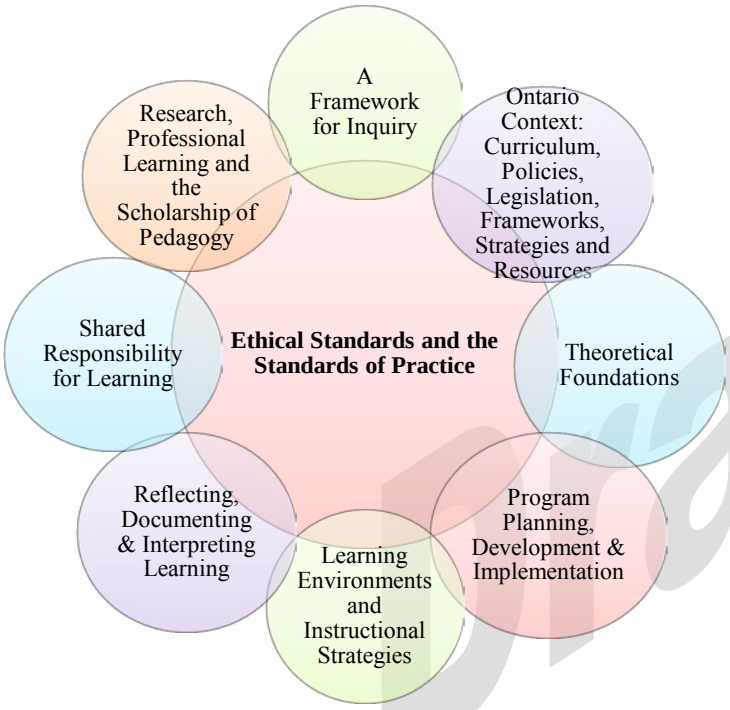

Diagram 2: Conceptual Framework for Teaching Manufacturing Technology - Precision Machining

A. The *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession*:

The *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* represent a collective vision of professional practice. At the heart of a strong and effective teaching profession is a commitment to students and their learning. Members of the Ontario College of Teachers, in their position of trust, demonstrate responsibility in their relationships with students, parents, guardians, colleagues, educational partners, other professionals, the environment and the public.

The holistic integration of the standards within all course components supports the embodiment of the collective vision of the teaching profession that guides professional knowledge, learning, and practice. The following principles and concepts support this holistic integration within the AQ course.

- understanding and embodying care, trust, respect and integrity

- fostering commitment to students and student learning
- integrating professional knowledge
- enriching and developing professional practice
- supporting leadership in learning communities
- engaging in ongoing professional learning.

Through professional dialogue, collaborative reflection and an ethical culture, course candidates will continue to critically inquire into and refine professional practice and ethical culture through the lens of the *Standards of Practice for the Teaching Profession*.

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B. A Framework for Inquiry

The *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* are embedded throughout the Additional Qualification course guideline.

This Additional Qualification course supports critical reflective inquiry and dialogue informed by the following:

- analyzing, interpreting and implementing Ontario's curriculum, district school board policies, frameworks, strategies and guidelines related to the Broad Based Technology
- developing awareness of First Nations, Métis and Inuit ways of knowing and perspectives
- extending theoretical understanding to design, implement and assess practices and/or programs
- implementing pedagogical strategies and assessment and evaluation practices that are linked to expectations, meet the individual needs of students, and promote student learning
- creating holistic learning environments conducive to the intellectual, social, emotional, physical, linguistic, cultural, spiritual and moral development of students
- working collaboratively with school personnel, parents/guardians, caregivers, the community, local business and industry as it relates to Teaching Manufacturing Technology - Precision Machining

- exercising leadership in accessing a variety of resources, including technological resources, within and beyond the educational system to enhance and support student learning
- refining professional practice through ongoing collaborative inquiry, dialogue and reflection
- modelling ethical practices and addressing ethical issues
- critically exploring and integrating environmentally sustainable practices
- fostering responsible, active environmental citizenship
- collaboratively developing and sustaining professional learning communities for enhancing professional knowledge and supporting student learning
- fostering leadership in the integration of information and communication technology to enhance teaching and learning
- critically exploring innovative strategies to create and sustain safe, healthy, equitable and inclusive learning environments that honour and respect diversity and foster student learning
- understanding the importance of critically examining qualitative and quantitative research related to professional practice
- critically exploring strategies to understand, gain insight into and support learners' well-being and mental health needs
- working collaboratively with interdisciplinary school teams to develop and implement Individual Education Plans (IEPs) of students
- exploring strategies that contribute to a culture that promotes openness to innovation and change
- demonstrating an awareness of emerging technologies related to Teaching Manufacturing Technology - Precision Machining
- demonstrating an awareness of health and safety risks associated with Teaching Manufacturing Technology - Precision Machining
- applying knowledge and skills to create and maintain a safe learning environment that addresses program needs: curriculum, material handling, tool handling and equipment storage, supervision, safety standards and practices that are respectful of the environment
- demonstrating technological literacy related to Teaching Manufacturing Technology - Precision Machining

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- writing technical reports and creating and managing portfolios
- demonstrating mathematical literacy in Teaching Manufacturing Technology - Precision Machining
- demonstrating an understanding of business management and entrepreneurial practices related to Teaching Manufacturing Technology - Precision Machining
- inquiring into practice through reflection, active engagement and collaboration
- understanding the various professional practices and career opportunities in Teaching Manufacturing Technology - Precision Machining
- critically exploring the relationship between education, mental health and well-being
- identifying ways to modify expectations, instructional strategies and assessment practices in Teaching Manufacturing Technology - Precision Machining.

C. Ontario Context: Curriculum, Policies, Legislation, Frameworks, Strategies and Resources

The Additional Qualification Course: Teaching Manufacturing Technology - Precision Machining is aligned with current Ontario curriculum, relevant legislation, government policies, frameworks, strategies and resources. These documents inform and reflect the development and implementation of the Additional Qualification Course: Teaching Manufacturing Technology - Precision Machining and can be viewed at www.edu.gov.on.ca.

Course candidates are also encouraged to critically explore the policies, practices and resources available at school and board levels that inform teaching and learning related to Teaching Manufacturing Technology - Precision Machining.

D. Theoretical Foundations of Teaching Manufacturing Technology - Precision Machining

- understanding theories of student development (social, emotional, physical, intellectual, linguistic, cultural, spiritual and moral)

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- understanding Ontario curriculum, resources and government policies, frameworks and strategies related to Teaching Manufacturing Technology - Precision Machining
- understanding learning theories and the particular learning needs of the adolescent in the Intermediate and Senior Divisions
- critically exploring a variety of conceptual frameworks related to Teaching Manufacturing Technology - Precision Machining
- reflecting on teaching practice and engaging in professional dialogue regarding the relationship between theory and practice
- integrating the *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* as the foundation for teacher professionalism within the Additional Qualification Course: Teaching Manufacturing Technology - Precision Machining
- critically exploring the significance of relevant legislation including the Ontario Human Rights Code, Ontarians with Disabilities Act, and the Accessibility for Ontarians with Disabilities Act (AODA) and associated responsibilities within professional practice
- recognizing teachers' legal obligations and ethical responsibilities according to current provincial legislation
- critically inquiring into the dimensions associated with creating and sustaining safe learning environments
- critically exploring holistic and inclusive educational programs that build on learners' abilities and empower them to reach their learning goals
- critically exploring problem solving processes, methods and approaches as they relate to Teaching Manufacturing Technology - Precision Machining
- critically exploring the fundamental technological concepts in Teaching Manufacturing Technology - Precision Machining.

E. Program Planning, Development and Implementation

- applying the *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* to inform a program planning framework
- critically exploring the influence of society's diverse and changing nature on student learning and well-being

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- deepening understanding of program planning, development, implementation strategies and frameworks related to Teaching Manufacturing Technology - Precision Machining
- deepening understanding of differentiated instruction, universal design and the tiered approach in program planning, development and implementation
- critically exploring learning resources (for example, print, visual, digital) that support student learning
- understanding the types of secondary school pathways (including apprenticeship, college, university, workplace) and their relationship to students' post-secondary goals and career opportunities
- critically exploring how students' lived experiences, development, strengths, interests and needs can inform program planning, development and implementation
- integrating culturally responsive pedagogy within program planning and development
- critically exploring strategies that support learners' well-being and mental health needs
- planning instructional strategies that integrate students' learning styles, strengths and experiences
- demonstrating leadership in implementing local and provincial guidelines and policies that support safe and effective learning environments
- inspecting and reporting on the learning environment, facilities, equipment needs, resources and state of maintenance and repair for delivering Teaching Manufacturing Technology - Precision Machining
- applying the theoretical foundations of Teaching Manufacturing Technology - Precision Machining by incorporating the broad-based pedagogical approach that embeds problem solving and the fundamental technological concepts
- identifying the safe, ethical and legal use of technology in Teaching Manufacturing Technology - Precision Machining programs
- critically exploring and integrating multiple formal and informal assessment methods and data to inform program planning and support student learning.

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F. Learning Environments and Instructional Strategies

- creating and sustaining positive, ethical, equitable, accepting and safe learning environments
- critically exploring strategies for fostering a collaborative community of empowered learners
- fostering engaging, trusting and inviting learning environments that promote student voice, leadership, critical inquiry and self-regulation
- critically exploring a variety of instructional strategies to support student learning
- developing strategies to create a positive and collaborative learning environment to support student learning
- cultivating safe, ethical and respectful practices in the use of technology in purposeful and legal ways
- integrating information and communication technologies that support student learning
- providing leadership in adapting instruction to meet the needs of all learners
- critically exploring strategies that engage students as active citizen in supporting environmental, social and economic sustainability
- using pedagogies that reflect the professional identity of educators as described in the *Ethical Standards for the Teaching Profession* and the *Standards of Practice for the Teaching Profession* and in the *Foundations of Professional Practice*
- creating inclusive learning environments that reflect the ethical standards and standards of practice
- implementing safe and effective management of a variety of technical learning environments
- planning, organizing and implementing effective health, safety, sanitation and environmental standards in the Teaching Manufacturing Technology - Precision Machining facility
- demonstrating an understanding of facility design and maintenance practices as per industry standards

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- understanding and complying with workplace health and safety legislation and standards related to Teaching Manufacturing Technology - Precision Machining.

G. Reflecting, Documenting and Interpreting Learning

- collaboratively integrating fair and equitable, transparent, valid and reliable assessment and evaluation methods that honour the dignity, emotional wellness and cognitive development of all students
- critically exploring and collaboratively integrating assessment, evaluation and reporting practices that align with the principles and processes of Ontario's curriculum, frameworks and policy documents
- using assessment for the following three purposes: to provide feedback to students and to adjust instruction (assessment for learning); to develop students' capacity to be independent, autonomous learners (assessment as learning); to make informed judgements about the quality of student learning (assessment of learning)
- critically exploring the use of baseline data as well as current assessment data to reflect on how the students are progressing and the effectiveness of the learning strategies used.

H. Shared Responsibility for Learning

- critically exploring and collaboratively integrating a variety of effective communication and engagement strategies for authentic collaboration with parents/guardians, school/board personnel and community agencies
- critically exploring and engaging in strategies and opportunities for professional collaboration that supports student learning and well-being
- collaboratively designing programs that address biases, discrimination and systemic barriers in order to support student learning, well-being and inclusion
- fostering and sustaining a positive, inclusive educational culture in which all perspectives are encouraged, valued and heard
- understanding and respecting the importance of shared responsibility and partnership as conveyed in the standards and the Foundations of Professional Practice

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- developing strategies to establish links between the school community, industry and the Teaching Manufacturing Technology - Precision Machining program
- critically exploring sector-specific learning opportunities in other curriculum areas
- critically exploring professional collaboration within interdisciplinary teams to support student learning, self-advocacy and transitions.

I. Research, Professional Learning and the Scholarship of Pedagogy

- critically exploring past, present and evolving practices in Teaching Manufacturing Technology - Precision Machining
- critically exploring professional practice through ongoing inquiry into theory and pedagogy/andragogy
- engaging in professional learning through research, scholarship and leadership
- integrating research and the scholarship of pedagogy/andragogy into teaching practice
- collaborating in research and the scholarship of pedagogy/andragogy
- critically exploring knowledge-creation and mobilization as professional practice.

5. Instructional Practice in the Additional Qualification Course: Teaching Manufacturing Technology – Precision Machining

Candidates will collaboratively develop with course instructors the specific learning inquiries, learning experiences, and forms of assessment and evaluation that will be used throughout the course.

In the implementation of this Additional Qualification course, instructors use strategies that are relevant, meaningful and practical in providing candidates with learning experiences about instruction, pedagogy and assessment and evaluation. These include but are not limited to: experiential learning, small group

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interaction; action research; presentations; independent inquiry; problem solving; collaborative learning and direct instruction.

Instructors model the *Ethical Standards of the Teaching Profession* and the *Standards of Practice for the Teaching Profession*, honour the principles of adult learning, recognize candidates' experience and prior learning and respond to individual needs. Important to the course are opportunities for candidates to create support networks and receive feedback from colleagues and instructors and share the products of their learning with others. Opportunities for professional reading, reflection, dialogue and expression are also integral parts of the course.

Instructors model effective instructional and assessment strategies that can be replicated or adapted in a variety of classroom settings.

A. Experiential Learning

Candidates will be provided with opportunities to engage in experiential learning related to key concepts and aspects of Teaching Manufacturing Technology - Precision Machining as collaboratively determined by both the instructor and course candidates. The intent of the experiential learning opportunities is to support the application and integration of practice and theory within the authentic context of teaching and learning. Candidates will also engage in critical reflection and analysis of their engagement in experiential learning opportunities related to Teaching Manufacturing Technology - Precision Machining. The professional judgment, knowledge and pedagogy of candidates will be enhanced and refined through experiential learning and inquiry.

The College's standards resources help to support experiential learning through various forms of professional inquiry.

6. Assessment and Evaluation of Candidates

At the beginning of the course, candidates will collaboratively develop with course instructors the specific learning inquiries, learning experiences, and forms of assessment and evaluation that will be used throughout the course. Instructors will provide opportunities for regular feedback regarding candidates' progress throughout the course.

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A balanced approach to candidate assessment and evaluation is used. It includes the combination of candidate self and peer assessment, as well as instructor evaluation. The assessment and evaluation strategies reflect effective, collaborative and inquiry-based practices. A variety of assessment approaches will be used that enable candidates to convey their learning related to course inquiries. The course provides opportunities for both formative and summative assessment and evaluation.

Central to candidates enrolled in Additional Qualification courses is the opportunity to be engaged in relevant and meaningful inquiries. Assignments, artefacts and projects enable candidates to make connections between theory and practice. At the same time, assignments must allow candidates flexibility, choice and individual inquiry opportunities.

Part of the evaluation process may include a major independent project or action research component over the duration of the course. This project is an opportunity for candidates to illustrate a high level of professional knowledge, communication skills, pedagogy, ethical practices and instructional leadership. Similarly, if a portfolio assignment is used it will also include reflections and analysis of a candidate's learning over time.

A final culminating experience in the course is recommended. This experience may take the form of a written assessment, a research paper, a performance, an inquiry project or a product that is original, meaningful and practical.

The following list of assessment strategies which are reflective of experiential learning is not exhaustive; it is intended to serve as a guide only.

a) Performance assessment: designing a sample unit which includes a culminating activity and appropriate assessment and evaluation tools, incorporates a variety of technologies and resources relevant to the study of Teaching Manufacturing Technology - Precision Machining, and is based on Ministry of Education expectations

b) Written assignment: reflecting critically on issues arising from articles, publications, research and/or other resources related to the teaching or practice to Teaching Manufacturing Technology - Precision Machining

c) Presentation: developing a digital story, presenting an issue related to the teaching and learning related to Teaching Manufacturing Technology - Precision Machining

d) Portfolio: creating a portfolio of practical resources, artefacts, photographs and recording critical reflections for one or several components related to Teaching Manufacturing Technology - Precision Machining

e) Action research: engaging in action research by reflecting and acting upon a specific inquiry into teaching practice related to Teaching Manufacturing Technology - Precision Machining

f) Independent project: addressing any aspect of the course that is approved by the instructor

g) Instructional resource: developing a meaningful resource that will support instruction and pedagogy related to the teaching and learning of Teaching Manufacturing Technology - Precision Machining

h) Reflective writing: reflecting on professional practice through journal-writing, or writing a case or vignette that will support instruction and pedagogy related to the teaching and learning of Teaching Manufacturing Technology - Precision Machining

i) Case inquiry: writing or exploring a case related to collaboration and shared partnerships, with parents, colleagues, and community organizations

j) IEP development: collaboratively develop an IEP related to Teaching Manufacturing Technology - Precision Machining with the family, student and school team

k) Facilitating a Learning Experience: developing and implementing an engaging learning experience that reflects differentiated instruction and universal design and the tiered approach.

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7. Demonstrated Knowledge and Skill in Teaching Manufacturing Technology - Precision Machining

Successful candidates will be able to demonstrate technical knowledge and skill in the following:

	Manufacturing Technology Fundamentals	Manufacturing Technology Skills
Manufacturing Business Operations	**Be able to demonstrate an understanding of:** ▪ history of Manufacturing industry (for example, metalworking industry, past and present; industrial revolution) ▪ primary and secondary manufacturing industries and related processes and technologies; ▪ maintenance scheduling and planning charts. **Be able to identify and describe:** ▪ roles and responsibilities of tradespersons working in manufacturing (for example, *Construction Millwrights, Industrial Mechanics, Welders, Pipefitters, and Industrial Electricians;* ▪ differences between union and non-union work and workers.	
Design Process	**Be able to demonstrate an understanding of:** ▪ design processes and how Machinists, Machine Operators, Tool and Die Makers, and Apprentices make use of them	**Be able to demonstrate proficiency in using:** ▪ the design process for product design; ▪ the design process to re-evaluate an existing product and re-design it for ease of manufacture.

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	▪ technical drawings (for example, orthographic, pictorial, isometric, assembly) to convey design ideas. **Be able to list and describe:** ▪ examples of how the design process is used in manufacturing to develop new products, or to improve products, to meet human needs or wants ▪ why technological concepts are important considerations in the design process *(for example, aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems)* ▪ organizations that develop standards for the manufacture of consumer goods *(for example, Canadian Standards Association [CSA], International Organization for Standardization [ISO]*.	**Be able to create and evaluate:** ▪ engineering drawings; working drawings (orthographic, isometric, pictorial); ▪ sketches, CAD drawings, including appropriate information e.g. (geometric dimensioning, tolerancing, section views, symbols and abbreviations); ▪ product specifications through the accurate interpretation of engineering drawings, sketches, and reports; ▪ products, processes, designs and models/prototype. **Be able to use:** ▪ various research methods and strategies to gather, organize, and interpret engineering information from appropriate resources *(for example, technical documents and drawings).* **Be able to create and present:** ▪ research and technical reports; ▪ sketches and rough drawings.
Project Planning and Management	**Be able to demonstrate an understanding of:** ▪ machining procedures for various work-pieces; ▪ production optimization; ▪ efficient part routing and machining operations; ▪ engineering drawings and product and process specifications (including global dimensioning and tolerances).	**Be able to create and evaluate:** ▪ sequenced machining procedure lists; ▪ product samples by prototyping; ▪ preventative maintenance programs. **Be able to demonstrate proficiency in using:** ▪ various research methods and strategies to gather, organize, and interpret engineering information from

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	Be able to identify and describe: ▪ a Machine Operator, Machinist, Tool and Die Maker, Inspector, Programmer, Tool Setter, and Apprentices' role in the manufacturing industry. **Be able to recognize and identify:** ▪ how to optimize individual or mass production systems by improving material flow, productivity and quality control; ▪ volume production processes *(for example, when production runs require conventional machining versus automated machining; high or low volume part production).*	appropriate resources; ▪ the design process to plan and develop products or processes with a focus on process improvement; ▪ engineering drawings and product specifications. **Be able to:** ▪ collaborate with others for creating a detailed manufacturing process for production *(for example, a process plan for part routing)*. **Be able to plan, create and present:** ▪ a production process plan that includes material flow, production layout, quality control, facility layout, routing, appropriate control systems.
Control Systems	**Be able to identify and describe:** ▪ a variety of power and control systems *(for example,, electronic, pneumatic, hydraulic, mechanical).* **Be able to demonstrate an understanding of:** ▪ Computer Numerical Control (CNC) equipment, and cnc programming code *(for example, lathes and mills);* ▪ Computer Aided Manufacturing (CAM) as related to a manufacturing process; ▪ Flexible Manufacturing Systems (FMS) as related to a manufacturing process; ▪ Programmable Logic Controller (PLC) as related to a manufacturing process.	**Be able to safely and appropriately use/operate: (where available)** ▪ Computer Numerical Control (CNC) equipment *(for example, Lathes, and Mills);* ▪ computers to operate and control systems *(for example, quality control, computer numerical control CNC)* in the assembly or fabrication of a product. **Be able to create and present:** ▪ a project that incorporates controls systems to control a manufacturing line (for example, electronic, pneumatic, hydraulic, mechanical; such as sensors, gripping devices, actuators, and cams, levers).

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		▪ working knowledge of how to program computer numerical control (CNC) equipment using computer-aided manufacturing software (CAM) to machine component parts.
Material Selection, Conversion and Preparation	**Be able to demonstrate an understanding of:** ▪ threads and fasteners *(screw terminology, types of fasteners, thread cutting, and their purpose);* ▪ shafts *(keys and keyways, shafts, tolerances and fits);* ▪ material conversion processes *(for example,, joining, cutting, forming, fastening, changing structural properties)* ▪ welding, and machining or resizing component parts; ▪ processes for converting the structure of materials *(for example,, heat treating, annealing, tempering,)* ▪ different type of ferrous and non-ferrous materials and their properties *(for example, bronze, brass, alloys, ceramics, carbide, plastics, carbon fibers)* ▪ the study of metallurgy *(for example, material properties, powdered metallurgy)* ▪ machinability of materials, cutter materials, and machine rigidity *(for example, carbide, ceramic, high speed steel, metal removal rate)* ▪ foundry processes *(for example, forging, casting, and welding processes).*	**Be able to evaluate and select for use:** ▪ suitable materials for fabricating products based on design specifications (for example, aluminums, plastics, bronze, brass, various steels, and alloys). **Be able to safely operate and use:** ▪ a variety of tools and equipment for joining, cutting, separating and forming materials *(for example, arc welders, oxy-acetylene torches, plasma cutters, lathes and mills)* ▪ advanced metrology equipment *(for example, gages, micrometers).* **Be able to use equipment to:** ▪ convert the structure of materials *(for example,, heat treating, annealing, steaming, tempering, forging, joining, cutting, separating and forming);* ▪ machine materials manually and/or automatically *(for example, cutting threads, diameters, contours, shoulders, slots, grooves, holes);* ▪ machine parts according to predetermined tolerances; ▪ perform sizing and fitting of shafts, and component parts *(for example, keys, keyways, fits).*

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	Be able to: ▪ describe the principles and practical applications of metallurgy *(for example, hardening, tempering, annealing)* ▪ explain material separation *processes (for example, turning, facing, tapering, grooving - material removal operations).*	**Be able to list, evaluate, select and use:** ▪ suitable materials for fabricating products based on design specifications and product function. **Be able to:** ▪ convert units of measurements and dimensions; ▪ calculate the amount of material required for a given project.
Material Handling Systems	**Be able to demonstrate an understanding of:** ▪ methods used to handle materials within a manufacturing environment *(for example, conveyors, elevators, fork lift, feeder systems, robots, crane systems, safe lifting)* ▪ computer numerical control equipment and controllers.	**Demonstrate an ability to:** ▪ perform minor installation, repair and maintenance on equipment in a manufacturing environment *(for example, conveyors, elevators, fork lift, feeder systems, robots, crane systems).*
Tools, Equipment and Materials	**Be able to demonstrate an understanding of:** ▪ the function, purpose, and operation of machine tools, equipment and technologies *(for example, lathes, mills, grinders, boring mills and welding machines);* ▪ layout processes, tools and related set-up tools *(for example, sine bars, gage blocks, trammels, scribers)* ▪ advanced measuring tools *(for example, levels, vernier height gage, micrometers, calipers, CMM; Coordinate Measuring Machine, including surface finish measurement,);*	**Be able to safely and appropriately select and use/operate:** ▪ machine tools, equipment and technologies (for example, lathes, mills, grinders, CNC tools, welding machines, work holding devices, machine attachments, cutting tools); ▪ CNC tool selection and tool set-up; ▪ advanced measuring tools (for example, *levels, vernier height gages, micrometers, vernier calipers including finish measurement,);* ▪ hand tools and power tools, and bench work *(for example, thread cutting procedures, finishing*

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	▪ manufacturing welding processes/equipment *(for example,, Oxy-acetylene, plasma, arc welding, MIG welding and TIG welding);* ▪ bearings *(friction and anti-fiction, installation and removal, bearing maintenance);* ▪ seals *(static and dynamic);* ▪ gears and gear cutting *(for example, ratios, reduction, types; rack and pinion, spherical, worm, bevel, nomenclature);* ▪ metal cutting technology *(for example, machinability of metals, cutting tools, cutting fluids and machine tool capabilities);* ▪ operation of machine tools, equipment, work holding devices, machine attachments etc.; ▪ work piece set-up processes *(for example, jigs, fixtures, clamping procedures, stacking, clamping);* ▪ computer numerical control equipment and controllers; ▪ appropriate equipment selection and routing process to manufacture parts; ▪ advanced lathe, mill and grinding theory and operations; ▪ precision machining techniques in advanced lathe, milling, jig borer and jig grinder, and CNC; ▪ grinding abrasives, accessories and operations; ▪ advanced bench work.	*procedures and surface finishing processes);* ▪ oxy-acetylene torches, plasma, arc welding, MIG welding and TIG welding (where available); ▪ bearings (installation and removal, bearing maintenance); ▪ seals (static and dynamic). **Be able to apply and use:** ▪ advanced layout tools and procedures; ▪ metrology skills to perform advanced measurement; ▪ precision layout and inspection of a product *(for example, inside and outside micrometers, vernier calipers, dial indicators, height gauge and depth gauge);* ▪ use CAD/CAM software platforms to draw component parts, develop and edit CNC code; ▪ perform tooling maintenance tasks *(for example, includes storage, sharpening, tolerance/size);* ▪ selected speeds and feeds to machine parts; ▪ perform appropriate machine/work piece set up for efficient machining; ▪ perform proper order of operations to machine parts efficiently; ▪ utilize advance metrology tools/equipment to inspect, machine and assembly work pieces; ▪ use automated equipment and machines to manufacture parts *(for example, CNC, CMM, EDM machines, laser, plasma, [where available]) ;*

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	Be able to: ▪ identify and discuss the use of common hand and power tools (for example, *work holding devices, taps and dies, reamers, scrapers and de-burrs, lapping tools, and compressed air tools);* ▪ describe in detail the function, purpose, and operation of advanced machine manufacturing tools and technologies *(for example, cryogenic treatments, robots, lasers, plasma cutting, multi-task machines, EDM, high-pressure water jet applications);* ▪ identify and describe properties of types of lubrication (for example, grease and oil, cutting fluids) demonstrate understanding of how to perform safe handling of Lubricants *(for example, safe transfer of lubricants and applications).*	▪ utilize CNC programming and machine code to perform machining tasks (where available); ▪ procedures to perform assembly, dis-assembly of component parts; ▪ proper cutting fluids and coolants for production of machined parts ▪ use a variety of tools and equipment for joining, cutting, separating and forming materials (for example, includes lathes, mills, drills, grinders, reamers, taps and dies).
Quality Assurance	**Be able to identify and describe:** ▪ quality assurance standards with reference to Canadian Standards Association (CSA), and International Organization for Standardization (ISO) ▪ quality control systems such as statistical process control (SPC) and(TQM) total quality management ▪ destructive and non-destructive tests to evaluate material.	**Be able to use and/or apply:** ▪ quality inspection and testing procedures in accordance to maintaining design specifications; ▪ perform proper part inspection and documentation.

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Technological Literacy and Numeracy	**Be able to recognize and demonstrate an understanding of:** ▪ appropriate technical language and forms of communications *(for example, geometric tolerancing and abbreviations);* ▪ appropriate tools for documenting, reporting, and presenting ideas and results *(for example, design proposal);* ▪ advanced arithmetic operations used to calculate component part geometry for machining; ▪ how to solve product specification problems using geometric functions; ▪ gear calculations for addendum, dedendum etc.; ▪ occupational calculations *(for example, calculate speeds and feeds).*	**Be able to select and use:** ▪ a variety of communications techniques and tools to present product and/or process designs; ▪ supporting documents including design layouts, and presentation drawings; ▪ appropriate technical language, and forms of communication related to design and fabrication, *(for example, lists of tooling requirements, materials and bill of materials)* ▪ appropriate scientific concepts for product and process design; ▪ charts and formulas to calculate appropriate machine feeds and speeds to machine component parts; ▪ trigonometry/ algebraic operations as appropriate in product design and production. **Be able to create and present:** ▪ research reports and design proposals; ▪ create written routing reports, process plans, tooling charts, order of operations lists. **Be able to demonstrate the ability to:** ▪ determine the meaning of symbols, key terms, and other specific technical writing ▪ correctly communicate the information needed to plan and prepare for the fabrication process *(for example, order of operations, availability of tools, parts and equipment required, scheduling)* ▪ solve product specification problems using

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		geometric functions; ▪ convert metric measurements to English measurements; ▪ apply mathematical and technological literacy skills to interpret product specifications *(for example,, volume, area, density/weight, material requirements, scrap factor)* accurately from engineering drawings, requirements, time requirements.
Engineering Fundamentals and Trade Science	**Be able to identify and describe:** ▪ machine horse power related to machinability of materials; ▪ metallurgy and the physics of metal cutting; ▪ bonding processes *(for example, welding, fusion, spot welding, cementing, ceramics);* ▪ strength of joints, welds, and machinability of welds. **Be able to recognize and demonstrate an understanding of:** ▪ installation and leveling of equipment; ▪ material stress, and stress releasing.	**Be able to apply safe and proper techniques for:** ▪ installation, leveling and shimming to specified tolerances; ▪ equipment anchoring systems; testing of metals and non-ferrous metals.
Technology and The Environment	**Be able to demonstrate an understanding of:** ▪ environmental impact *(negative and positive)* of manufacturing processes *(for example, waste disposal of fluids, recycling of waste product from the manufacturing process)* ▪ renew, reuse and recycle.	**Be able to:** ▪ develop environmentally responsible practices during the design and manufacturing of a product *(for example, minimizing waste, re-cycling of used materials, appropriate discarding of used chemicals, liquids and solvents)*;

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	Be able to identify and describe: ▪ and asses the carbon footprint of a manufactured product.	▪ proper recycling for waste materials from fabrication and manufacturing processes.
Technology and Society	**Be able to describe:** ▪ the social and economic impact of emerging manufacturing technology industries on economy and standard of living *(for example, safety, technical, financial, business, education).* **Be able to explain how:** ▪ globalization of the manufacturing industry affects jobs and society.	**Be able to research and report:** ▪ on the impact of globalization of the manufacturing industry; ▪ on the impact of advanced technologies on the standard of living, and social networking or "mass collaboration".
Health and Safety	**Be able to demonstrate an understanding of:** ▪ legislation and standards related to workplace safety *(for example, Occupational Health and Safety Act OHSA, Workplace Hazardous Materials Information System WHMIS, regulatory organizations such as Workplace Safety and Insurance Board WSIB, and the Industrial Accident Prevention Association IAPA, lockout/tag-out procedures and fire safety);* ▪ handling materials safely and appropriately; ▪ health and safety hazards and injuries associated with workplace conditions (for example, repetitive motion and carpal tunnel syndrome, noise and hearing loss, pinch points); ▪ how ergonomics can affect productivity, product	**Be able to demonstrate:** ▪ good housekeeping practices in the work environment *(for example, cleaning up spills and leaks, keeping areas clean and clear of obstructions, properly organizing tools and equipment);* ▪ the use of proper ventilation and/or filtration systems to control air quality *(for example, to minimize the effects of welding fumes, plastic off-gassing, cutting-fluid misting, and heat treating).* **Be able to:** ▪ use and maintain protective clothing and equipment; ▪ follow proper lockout/tag-out procedures ▪ perform preventative maintenance tasks and procedures; ▪ safely assess machine operations and material

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	quality, employee needs and satisfaction, and identify ergonomic considerations related to workshop layout and set-up *(for example, material handling, ease of movement, lighting, workstation design, organization of tools and equipment);* ▪ lockout/tag-out procedures. **Be able to explain how:** ▪ to assess ways to promote safe and productive work practices; ▪ to recognize and explain personal protective equipment; ▪ appropriate procedures for lifting heavy objects, and repetitive movements; ▪ explain the classes of fires and the types of fire extinguishers; ▪ proper safety protocols around manufacturing and electrical hazards. **Be able to demonstrate an understanding of:** the role of the Ministry of Labour and Environment in an manufacturing setting.	handling procedures; ▪ implement appropriate environmental protection measures; use proper safety practices when performing manufacturing operations.
Career Opportunities	**Be able to demonstrate an understanding:** ▪ of the range of career opportunities within the manufacturing industry *(for example, machinist, tool and die designer, CADCAM, certified technician/technologist, CNC operator, machinist, programmer production, skilled trades*	**Be able to:** ▪ develop pathway plans for a variety of career opportunities related to manufacturing *(for example,, draftsperson, CAD operator, CNC, machinist, tool and die maker, apprenticeships, foreman or*

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	– apprenticeships). **Be able to describe:** ▪ post-secondary programs associated with the manufacturing industry and evaluate the these programs with respect to personal career plans. **Be able to identify and compare:** ▪ secondary school opportunities and pathways *(for example, OYAP, SHSM)* post-secondary education pathways relating to precision machining *(for example,, workplace, apprenticeship, college, specialized certification programs in manufacturing , CNC Programming, CADCAM,).*	*supervisor, welder);* ▪ communicate and present post-secondary education requirements for careers in manufacturing. **Be able to create, assemble and present:** ▪ an up-to-date portfolio that may include pieces of work *(for example,, engineering logs, models/prototypes, cnc programming samples, drawings, design proposals).*

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Appendix 1

The *Ethical Standards for the Teaching Profession*

The *Ethical Standards for the Teaching Profession* represent a vision of professional practice. At the heart of a strong and effective teaching profession is a commitment to students and their learning. Members of the Ontario College of Teachers, in their position of trust, demonstrate responsibility in their relationships with students, parents, guardians, colleagues, educational partners, other professionals, the environment and the public.

The Purposes of the Ethical Standards for the Teaching Profession are:

- to inspire members to reflect and uphold the honour and dignity of the teaching profession
- to identify the ethical responsibilities and commitments in the teaching profession
- to guide ethical decisions and actions in the teaching profession
- to promote public trust and confidence in the teaching profession.

The Ethical Standards for the Teaching Profession are:

Care
The ethical standard of *Care* includes compassion, acceptance, interest and insight for developing students' potential. Members express their commitment to students' well-being and learning through positive influence, professional judgment and empathy in practice.

Respect
Intrinsic to the ethical standard of *Respect* are trust and fair-mindedness. Members honour human dignity, emotional wellness and cognitive development. In their professional practice, they model respect for spiritual and cultural values, social justice, confidentiality, freedom, democracy and the environment.

Trust
The ethical standard of *Trust* embodies fairness, openness and honesty. Members' professional relationships with students, colleagues, parents, guardians and the public are based on trust.

Integrity
Honesty, reliability and moral action are embodied in the ethical standard of *Integrity*. Continual reflection assists members in exercising integrity in their professional commitments and responsibilities.

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The *Standards of Practice for the Teaching Profession*

The *Standards of Practice for the Teaching Profession* provide a framework of principles that describes the knowledge, skills, and values inherent in Ontario's teaching profession. These standards articulate the goals and aspirations of the profession. These standards convey a collective vision of professionalism that guides the daily practices of members of the Ontario College of Teachers.

The Purposes of the Standards of Practice for the Teaching Profession are:

- to inspire a shared vision for the teaching profession
- to identify the values, knowledge and skills that are distinctive to the teaching profession
- to guide the professional judgment and actions of the teaching profession
- to promote a common language that fosters an understanding of what it means to be a member of the teaching profession.

The Standards of Practice for the Teaching Profession are:

Commitment to Students and Student Learning
Members are dedicated in their care and commitment to students. They treat students equitably and with respect and are sensitive to factors that influence individual student learning. Members facilitate the development of students as contributing citizens of Canadian society.

Professional Knowledge
Members strive to be current in their professional knowledge and recognize its relationship to practice. They understand and reflect on student development, learning theory, pedagogy, curriculum, ethics, educational research and related policies and legislation to inform professional judgment in practice.

Professional Practice
Members apply professional knowledge and experience to promote student learning. They use appropriate pedagogy, assessment and evaluation, resources and technology in planning for and responding to the needs of individual students and learning communities. Members refine their professional practice through ongoing inquiry, dialogue and reflection.

Leadership in Learning Communities
Members promote and participate in the creation of collaborative, safe and supportive learning communities. They recognize their shared responsibilities and their leadership roles in order to facilitate student success. Members maintain and uphold the principles of the ethical standards in these learning communities.

Ongoing Professional Learning
Members recognize that a commitment to ongoing professional learning is integral to effective practice and to student learning. Professional practice and self-directed learning are informed by experience, research, collaboration and knowledge.

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