MACHINIST 2016

Based on the Interprovincial Program Guide

pg. 12 for Program Structure

Revised: August 2013
Version #4.0
Foreword

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Interprovincial Program Guide (IPG) as the national curriculum for the occupation of Machinist.

Jurisdictions have long recognized the benefit of pooling resources in the development and maintenance of apprenticeship training standards. A successful example of this is the Interprovincial Standards Red Seal Program itself. Essential to the establishment of standards is the development of suitable training systems and programs which enable tradespeople to acquire certification based on these standards. While certification is the responsibility of Apprenticeship administrators throughout Canada, the development and delivery of technical training is the responsibility of jurisdictions.

In 1999, work to develop common training for apprenticeship programs within the Atlantic Provinces began. To date, 22 Curriculum Standards have been developed through the Atlantic Standards Partnership (ASP) project to assist programming staff and instructors in the design and delivery of technical training. Similarly, the CCDA embarked on a process for the development of national IPGs for the Boilermaker, Carpenter and Sprinkler System Installer trades. At its January 2005 strategic planning session, the CCDA identified developing common training standards as one of the key activities in moving towards a more cohesive apprenticeship system.

With the support of Human Resources and Skills Development Canada (HRSDC), several provinces and territories have partnered to build on the ASP and the CCDA processes to further develop IPGs to be used across the country. This partnership will create efficiencies in time and resources and promote consistency in training and apprentice mobility.
Acknowledgements

The CCDA and the IPG Committee wishes to acknowledge the contributions of the following industry and instructional representatives who participated in the development of the Machinist Interprovincial Program Guide (IPG) in 2007.

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Félicien Arseneau</td>
<td>New Brunswick</td>
</tr>
<tr>
<td>Ray Duguay</td>
<td>New Brunswick</td>
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<tr>
<td>Nancy Hervé</td>
<td>Nova Scotia</td>
</tr>
<tr>
<td>Christopher James</td>
<td>Manitoba</td>
</tr>
<tr>
<td>Steve Jubinville</td>
<td>Prince Edward Island</td>
</tr>
<tr>
<td>Winston Manuel</td>
<td>Newfoundland and Labrador</td>
</tr>
<tr>
<td>Jake Shaw</td>
<td>Prince Edward Island</td>
</tr>
</tbody>
</table>

In addition to the individuals noted above, various federal, provincial and territorial representatives contributed to the development of this document.

In 2011, the IPG was nationally reviewed and updated to ensure adequate coverage of the trade as outlined in the 2010 National Occupational Analysis (NOA).

In 2012, the province of Nova Scotia collaborated with the Nova Scotia Community College and the Machining Association of Nova Scotia (M.A.N.S.) to ensure that all national outcomes identified in the IPG are covered in the apprenticeship training program, and to add Nova Scotia-specific content, including practical learning activities.
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## PROGRAM CONTENT

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According to the Canadian Apprenticeship Forum, the IPG is: "a list of validated technical training outcomes, based upon those sub-tasks identified as common core in the NOA, and validated by industry in the provinces and territories as incorporating the essential tasks, knowledge and skills associated with a given trade."

Learning outcomes contained in the IPG represent the minimum common core content for the development of jurisdictional training standards and outlines. IPGs are developed based on the NOAs and extensive industry consultation. The IPG is intended to assist program development staff in the design of jurisdictional plans for training. Each jurisdiction has the flexibility to add additional content.

The IPG was deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. It details units of training, unit outcomes and objectives. It does not impose a delivery model or teaching format.

Jurisdictions and/or training providers will select and develop delivery materials and techniques that accommodate a variety of learning styles and delivery patterns. The IPG does not dictate study materials, textbooks or learning activities to be used in delivery.

The IPG document includes a recommended levelling structure to facilitate mobility for apprentices moving from one jurisdiction to another. Because of difference in jurisdictional regulations and program durations, levels are offered as suggestions only.

**Structure**

The IPG is divided into units. The unit codes are used as a means of identification and are not intended to convey the order of delivery. Prerequisites have not been detailed. Each unit consists of Learning Outcomes and Objectives and Content.

The Learning Outcomes are the specific performances that must be evaluated. Wording of the learning outcomes, "Demonstrate knowledge of...", acknowledges the broad spectrum of ways in which knowledge can be shown. It is at the discretion of each jurisdiction to determine the manner in which learning outcomes are evaluated; theoretically, practically or a combination of both.
The Objectives and Content for the unit details the information to be covered in order to achieve the performances specified in the Learning Outcomes. These objectives can be either theoretical or practical in nature, based on the requirements identified through the industry consultation process. The learning activities used to cover the objectives are at the discretion of the jurisdiction; however, practically worded objective statements have been used where industry indicated a need for the apprentices to receive exposure to performing the task or skill outlined while attending technical training. For example, this exposure could be done through instructor demonstration or individual or group performance of the skill or task. This practical training will help to reinforce the theoretical component of the technical training.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided. The content listed within the IPG document is not intended to represent an inclusive list; rather, it is included to illustrate the intended direction for the objective. Content may be added or extended in jurisdictional training plans as required.

Jurisdictions are free to deliver the IPG units one at a time or concurrently, provided that all Learning Outcomes are met. The IPG does not indicate the amount of time to be spent on a particular unit as the length of time required to deliver the Learning Outcomes successfully will depend upon the learning activities and teaching methods used.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJUST</td>
<td>To put in good working order; regulate; bring to a proper state or position.</td>
</tr>
<tr>
<td>APPLICATION</td>
<td>The use to which something is put and/or the circumstance in which you would use it.</td>
</tr>
<tr>
<td>CHARACTERISTIC</td>
<td>A feature that helps to identify, tell apart, or describe recognizably; a distinguishing mark or trait.</td>
</tr>
<tr>
<td>COMPONENT</td>
<td>A part that can be separated from or attached to a system; a segment or unit.</td>
</tr>
<tr>
<td>DEFINE</td>
<td>To state the meaning of (a word, phrase, etc.).</td>
</tr>
<tr>
<td>DESCRIBE</td>
<td>To give a verbal account of; tell about in detail.</td>
</tr>
<tr>
<td>EXPLAIN</td>
<td>To make plain or clear; illustrate; rationalize.</td>
</tr>
<tr>
<td>IDENTIFY</td>
<td>To point out or name objectives or types.</td>
</tr>
<tr>
<td>INTERPRET</td>
<td>To translate information from observation, charts, tables, graphs, and written material.</td>
</tr>
<tr>
<td>MAINTAIN</td>
<td>To keep in a condition of good repair or efficiency.</td>
</tr>
<tr>
<td>METHOD</td>
<td>A means or manner of doing something that has procedures attached to it.</td>
</tr>
<tr>
<td>OPERATE</td>
<td>How an object works; to control or direct the functioning of.</td>
</tr>
<tr>
<td>PROCEDURE</td>
<td>A prescribed series of steps taken to accomplish an end.</td>
</tr>
<tr>
<td>PURPOSE</td>
<td>The reason for which something exists or is done, made or used.</td>
</tr>
</tbody>
</table>
Glossary of Terms (continued)

TECHNIQUE  Within a procedure, the manner in which technical skills are applied.

TEST  v. To subject to a procedure that ascertains effectiveness, value, proper function, or other quality.

n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.

TROUBLESHOOT  To follow a systematic procedure to identify and locate a problem or malfunction and its cause.
Essential Skills Profiles

Essential Skills are the skills needed for work, learning and life. They provide the foundation for learning all the other skills that enable people to evolve within their jobs and adapt to workplace change.

Over the past several years, the Government of Canada has conducted research examining the skills people use at work. From this research, Essential Skills Profiles have been developed for various occupations.

For more information regarding Essential Skills and to access Essential Skills Profiles for specific occupations, visit HRSDC’s Essential Skills website at:

# Profile Chart

## OCCUPATIONAL SKILLS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Course Code</th>
<th>Course Name</th>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCH-100</td>
<td>Safety</td>
<td>MCH-105</td>
<td>Hoisting, Lifting and Rigging</td>
<td>MCH-110</td>
<td>Basic Drawings</td>
</tr>
<tr>
<td>MCH-125</td>
<td>Hand Threading</td>
<td>MCH-135</td>
<td>Fluids and Coolants</td>
<td>MCH-240</td>
<td>Mechanical Components</td>
</tr>
<tr>
<td>MCH-250</td>
<td>Heat Treatment</td>
<td>MCH-305</td>
<td>Material Testing</td>
<td>MCH-245</td>
<td>Introduction to Welding</td>
</tr>
<tr>
<td>MCH-420</td>
<td>Reconditioning</td>
<td></td>
<td></td>
<td>MCH-400</td>
<td>Job Planning</td>
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## TOOLS

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<th>Course Name</th>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCH-120</td>
<td>Hand and Power Tools</td>
<td>MCH-230</td>
<td>Power Saws</td>
<td>MCH-140</td>
<td>Drills and Drill Presses</td>
</tr>
<tr>
<td>MCH-215</td>
<td>Cutting Machine Tools</td>
<td>MCH-320</td>
<td>Reciprocating Machines</td>
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## LAYOUT AND MEASUREMENT

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</thead>
<tbody>
<tr>
<td>MCH-115</td>
<td>Precision Measurement I</td>
<td>MCH-210</td>
<td>Precision Measurement II</td>
<td>MCH-130</td>
<td>Basic Layout</td>
</tr>
<tr>
<td>MCH-405</td>
<td>Quality Inspection</td>
<td></td>
<td></td>
<td>MCH-340</td>
<td>Precision Layout</td>
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## LATHES

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<th>Course Name</th>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCH-150</td>
<td>Introduction to Conventional Lathes</td>
<td>MCH-155</td>
<td>Basic Conventional Lathe Operation</td>
<td>MCH-160</td>
<td>Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MCH-220</td>
<td>Advanced Conventional Lathe Operation</td>
</tr>
<tr>
<td>MCH-225</td>
<td>Taper Turning</td>
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## MILLING MACHINES

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<th>Course Code</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MCH-315</td>
<td>Gears and Gear Cutting</td>
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Profile Chart (continued)

<table>
<thead>
<tr>
<th>GRINDERS</th>
<th>MCH-325</th>
<th>MCH-330</th>
<th>MCH-335</th>
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<tbody>
<tr>
<td>MCH-145 Introduction to</td>
<td>Abrasive</td>
<td>Surface</td>
<td>Cylindrical</td>
</tr>
<tr>
<td>Grinding Machines</td>
<td>Finishing</td>
<td>Grinders</td>
<td>Grinders</td>
</tr>
<tr>
<td>MCH-325 Abrasive Finishing</td>
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<tr>
<td>MCH-330 Surface Grinders</td>
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<tr>
<td>MCH-335 Cylindrical Grinders</td>
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<th>COMPUTER NUMERICAL CONTROL (CNC) MACHINES</th>
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<tr>
<td>MCH-410 Computer Numerical Control (CNC)</td>
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<tr>
<td>Machine-Tools</td>
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</table>
# Program Structure – Nova Scotia Apprenticeship Program

The courses listed below are required technical training in the Nova Scotia Machinist Apprenticeship Program.

<table>
<thead>
<tr>
<th>Nova Scotia Course No.</th>
<th>Nova Scotia Course Name</th>
<th>Nova Scotia Prerequisites</th>
<th>Interprovincial Program Guide (IPG) Content To Be Covered</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>IPG Units</td>
</tr>
<tr>
<td><strong>New Level 1 (7 Weeks)</strong></td>
<td></td>
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<td>Pg. #</td>
</tr>
<tr>
<td>MENT-1801</td>
<td>Integrated Milestone</td>
<td>None</td>
<td>MENT-1801 Workplace Mentoring I (NS Specific)</td>
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<tr>
<td>MCHA-1842</td>
<td>Safety, Tools and Equipment</td>
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<td>MCH-100 Safety</td>
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<td>MCH-105 Hoisting, Lifting and Rigging</td>
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<td>MCH-120 Hand and Power Tools</td>
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<td>MCH-135 Fluids and Coolants</td>
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<td>MCH-230 Power Saws</td>
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<td>MCH-235 Contour Bandsaws</td>
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<td>MCHA-1845</td>
<td>Drills and Drill Presses / Grinders</td>
<td>MCHA-1842</td>
<td>MCH-140 Drills and Drill Presses</td>
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<td>MCH-145 Introduction to Grinding Machines</td>
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<td>MCH-240 Mechanical Components</td>
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<td>38</td>
</tr>
<tr>
<td>MCHA-1833</td>
<td>Basic Layout / Drawings</td>
<td>None</td>
<td>MCH-130 Basic Layout</td>
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<td>MCH-110 Basic Drawings</td>
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<td>MCH-115 Precision Measurement I</td>
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<td>MCHA-1001 Introduction to Quality (NS Specific)</td>
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<td>MCHA-1004 Geometric Dimensioning and Tolerancing (NS Specific)</td>
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<tr>
<td>Nova Scotia Course No.</td>
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<td>Nova Scotia Prerequisites</td>
<td>Interprovincial Program Guide (IPG) Content To Be Covered</td>
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<tr>
<td>MCHA-1844</td>
<td>Lathes, Lathe Operation and Taper Turning (2 weeks)</td>
<td>MCHA-1842, 1845, 1833</td>
<td>MCH-150 Introduction to Conventional Lathes</td>
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<tr>
<td></td>
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<td>MCH-155 Basic Conventional Lathe Operation</td>
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<td>MCH-160 Conventional Lathe Drilling, Boring, Reaming, Tapping &amp; Die Threading</td>
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<td>MCH-125 Hand Threading</td>
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<td>MCH-225 Taper Turning</td>
</tr>
<tr>
<td>MCHA-1837</td>
<td>Milling Machines and Operation (2 weeks)</td>
<td>MCHA-1842, 1845, 1833</td>
<td>MCH-165 Introduction to Milling Machines</td>
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<tr>
<td></td>
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<td>MCH-310 Horizontal/Universal Milling Machine Operation</td>
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<td><strong>New Level 2 (4 Weeks)</strong></td>
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</tr>
<tr>
<td>MCHA-1813</td>
<td>Advanced Lathe Operations</td>
<td>MCHA-1842, 1845, 1833</td>
<td>MCH-220 Advanced Conventional Lathe Operation</td>
</tr>
<tr>
<td>MCHA-1841</td>
<td>Specialty Machinable Materials</td>
<td>MCHA-1842, 1845, 1833, 1840</td>
<td>MCH-300 Machinable Materials (cover non-metallic &amp; specialty only)</td>
</tr>
<tr>
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<td>MCHA-1002 Power Transmission and Lubrication (NS Specific)</td>
</tr>
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<td>Nova Scotia Course No.</td>
<td>Nova Scotia Course Name</td>
<td>Nova Scotia Prerequisites</td>
<td>Interprovincial Program Guide (IPG) Content To Be Covered</td>
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<tr>
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<td>IPG Units</td>
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<tr>
<td><strong>New Level 3 (6 Weeks)</strong></td>
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</tr>
<tr>
<td>MCHA-1829</td>
<td>Material Selection &amp; Heat Treatment / Carbide Tooling</td>
<td>MCHA-1842, 1845, 1833, 1840</td>
<td>MCH-300</td>
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<td>MCH-320</td>
</tr>
<tr>
<td>MCHA-1816</td>
<td>Planning, Measuring and Precision Layout</td>
<td>MCHA-1842, 1845, 1833, 1840</td>
<td>MCH-400</td>
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<td>MCH-205</td>
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<td>MCH-245</td>
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<td>Spur Gears</td>
<td>MCHA-1842, 1845, 1833, 1814, 1816</td>
<td>MCH-315</td>
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<td>MCHA-1822</td>
<td>Bevel, Helical and Worm Gears</td>
<td>MCHA-1842, 1845, 1833, 1837, 1814, 1815, 1816</td>
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<td>Grinders and Abrasives</td>
<td>MCHA-1842, 1845, 1833, 1837, 1814</td>
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<td>MCH-335</td>
</tr>
<tr>
<td>MCHA-1838</td>
<td>Precision Measurement / Jigs and Fixtures</td>
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<td>MCH-210</td>
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<td>MCHA-1003</td>
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<tr>
<td>Nova Scotia Course No.</td>
<td>Nova Scotia Course Name</td>
<td>Nova Scotia Prerequisites</td>
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<td>MENT-1802</td>
<td>Integrated Milestone</td>
<td>MENT-1801</td>
<td>MENT-1802 Workplace Mentoring II (NS Specific)</td>
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<tr>
<td>MCHA-1839</td>
<td>Quality Inspection and Reconditioning</td>
<td>MCHA-1842, 1845, 1833, 1837, 1840, 1841, 1816, 1829, 1837, 1838</td>
<td>MCH-405 Quality Inspection</td>
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<td>MCH-420 Reconditioning</td>
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<tr>
<td>MCHA-1821</td>
<td>CNC Programming</td>
<td>MCHA-1842, 1845, 1833, 1837, 1814, 1843</td>
<td>MCH-415 Computer Numerical Control (CNC) Operation (cover codes and basic programming only)</td>
</tr>
<tr>
<td>MCHA-1846</td>
<td><strong>CNC Operation</strong></td>
<td>MCHA-1842, 1845, 1833, 1837, 1814, 1843</td>
<td>MCH-410 Computer Numerical Control (CNC) Machine-Tools</td>
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<td></td>
<td>new course and course #</td>
<td></td>
<td>MCH-415 Computer Numerical Control (CNC) Operation (cover machine set-up and operation)</td>
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<tr>
<td>MCHA-1830</td>
<td>Program Review</td>
<td>Entire Program</td>
<td>MCHA-1830 Program Review (NS Specific)</td>
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</table>

_Nova Scotia Machinist Apprenticeship Program: All Courses are Required._
<table>
<thead>
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<th>NOA Sub-task</th>
<th>IPG Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1 – Organizes work.</td>
<td></td>
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</tr>
<tr>
<td>1.01 Interprets documentation.</td>
<td>MCH-110 Basic Drawings</td>
<td>MCH-205 Advanced Drawings</td>
</tr>
<tr>
<td></td>
<td>MCH-400 Job Planning</td>
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<tr>
<td>1.02 Plans sequence of operation.</td>
<td>MCH-400 Job Planning</td>
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<tr>
<td>1.03 Maintains safe work environment.</td>
<td>MCH-100 Safety</td>
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</tr>
<tr>
<td>1.04 Uses personal protective equipment (PPE) and safety equipment.</td>
<td>MCH-100 Safety</td>
<td></td>
</tr>
<tr>
<td>1.05 Uses hoisting, lifting and rigging equipment.</td>
<td>MCH-105 Hoisting, Lifting and Rigging</td>
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</tr>
<tr>
<td>Task 2 – Processes workpiece material.</td>
<td></td>
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</tr>
<tr>
<td>2.01 Selects workpiece material.</td>
<td>MCH-300 Machinable Materials</td>
<td></td>
</tr>
<tr>
<td>2.02 Performs layout.</td>
<td>MCH-130 Basic Layout</td>
<td>MCH-340 Precision Layout</td>
</tr>
<tr>
<td>2.03 Marks workpiece for identification.</td>
<td>MCH-130 Basic Layout</td>
<td>MCH-300 Machinable Materials</td>
</tr>
<tr>
<td>2.04 Performs basic heat treatment.</td>
<td>MCH-250 Heat Treatment</td>
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<tr>
<td>2.05 Tests workpiece materials.</td>
<td>MCH-250 Heat Treatment</td>
<td>MCH-305 Material Testing</td>
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<tr>
<td></td>
<td>MCH-405 Quality Inspection</td>
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<tr>
<td>2.06 Deburrs workpiece.</td>
<td>MCH-120 Hand and Power Tools</td>
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</tr>
<tr>
<td>2.07 Sketches parts.</td>
<td>MCH-110 Basic Drawings</td>
<td></td>
</tr>
<tr>
<td>Task 3 – Maintains machines and tooling.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.01 Cleans machines.</td>
<td>MCH-135 Fluids and Coolants</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
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<tr>
<td></td>
<td>MCH-200 Vertical Milling Machine Operation</td>
<td>MCH-310 Horizontal/Universal Milling Machine Operation</td>
</tr>
<tr>
<td>3.02 Lubricates machines.</td>
<td>MCH-135 Fluids and Coolants</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
</tr>
<tr>
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<td>MCH-200 Vertical Milling Machine Operation</td>
<td>MCH-310 Horizontal/Universal Milling Machine Operation</td>
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<tr>
<td>Task 3</td>
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<tr>
<td>3.03</td>
<td>Sharpens tooling.</td>
<td>MCH-150</td>
</tr>
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<td></td>
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<td>MCH-215</td>
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<td>3.04</td>
<td>Applies cutting fluids and coolants.</td>
<td>MCH-135</td>
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<tr>
<td></td>
<td></td>
<td>MCH-155</td>
</tr>
<tr>
<td>3.05</td>
<td>Troubleshoots equipment.</td>
<td>MCH-155</td>
</tr>
<tr>
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<td></td>
<td>MCH-200</td>
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<td></td>
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<td>MCH-310</td>
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<td></td>
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<td>MCH-330</td>
</tr>
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<td></td>
<td>MCH-335</td>
</tr>
<tr>
<td>3.06</td>
<td>Maintains machine alignment.</td>
<td>MCH-155</td>
</tr>
<tr>
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<td></td>
<td>MCH-200</td>
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<tr>
<td>3.07</td>
<td>Maintains inspection equipment.</td>
<td>MCH-115</td>
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<td>MCH-405</td>
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</table>

**Task 4 – Performs hand processes.**

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<th>Task 4</th>
<th>Description</th>
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<tbody>
<tr>
<td>4.01</td>
<td>Files workpiece.</td>
<td>MCH-120</td>
<td>Hand and Power Tools</td>
</tr>
<tr>
<td>4.02</td>
<td>Saws workpiece.</td>
<td>MCH-230</td>
<td>Power Saws</td>
</tr>
<tr>
<td>4.03</td>
<td>Performs hole-making operations.</td>
<td>MCH-160</td>
<td>Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading</td>
</tr>
<tr>
<td>4.04</td>
<td>Performs threading operations.</td>
<td>MCH-125</td>
<td>Hand Threading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCH-160</td>
<td>Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCH-220</td>
<td>Advanced Conventional Lathe Operation</td>
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<tr>
<td>4.05</td>
<td>Installs thread inserts.</td>
<td>MCH-125</td>
<td>Hand Threading</td>
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<tr>
<td></td>
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<td>MCH-420</td>
<td>Reconditioning</td>
</tr>
<tr>
<td>4.06</td>
<td>Broaches workpiece.</td>
<td>MCH-240</td>
<td>Mechanical Components</td>
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<td>MCH-320</td>
<td>Reciprocating Machines</td>
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<tr>
<td>4.07</td>
<td>Performs pressing operations.</td>
<td>MCH-120</td>
<td>Hand and Power Tools</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCH-420</td>
<td>Reconditioning</td>
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<tr>
<td>4.08</td>
<td>Bends workpiece.</td>
<td>MCH-245</td>
<td>Introduction to Welding</td>
</tr>
<tr>
<td>4.09</td>
<td>Finishes workpiece.</td>
<td>MCH-325</td>
<td>Abrasive Finishing</td>
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**Task 5 – Refurbishes components.**

<table>
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<th>Task 5</th>
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<tbody>
<tr>
<td>5.01</td>
<td>Disassembles components.</td>
<td>MCH-420</td>
<td>Reconditioning</td>
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<td>Subtask</td>
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<tr>
<td>5.02</td>
<td>Analyzes components.</td>
<td>MCH-420 Reconditioning</td>
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<tr>
<td>5.03</td>
<td>Assembles components.</td>
<td>MCH-420 Reconditioning</td>
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<td>Task 6 – Sets up drill presses.</td>
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<tr>
<td>6.01</td>
<td>Selects drill press types.</td>
<td>MCH-140 Drills and Drill Presses</td>
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</tr>
<tr>
<td>6.02</td>
<td>Plans drill press sequence.</td>
<td>MCH-140 Drills and Drill Presses</td>
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<tr>
<td>6.03</td>
<td>Selects drill press speeds and feeds.</td>
<td>MCH-140 Drills and Drill Presses</td>
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<tr>
<td>6.04</td>
<td>Sets up jigs, fixtures and work holding devices for drill presses.</td>
<td>MCH-420 Reconditioning</td>
<td></td>
</tr>
<tr>
<td>6.05</td>
<td>Sets up tooling for drill presses.</td>
<td>MCH-140 Drills and Drill Presses</td>
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<tr>
<td>Task 7 – Operates drill presses.</td>
<td></td>
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<tr>
<td>7.01</td>
<td>Drills holes using a drill press.</td>
<td>MCH-140 Drills and Drill Presses</td>
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<tr>
<td>7.02</td>
<td>Cuts countersinks, counterbores, chamfers, spot faces using drill press.</td>
<td>MCH-140 Drills and Drill Presses</td>
<td></td>
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<tr>
<td>7.03</td>
<td>Performs tapping using a drill press.</td>
<td>MCH-140 Drills and Drill Presses</td>
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<tr>
<td>7.04</td>
<td>Finishes holes using a drill press.</td>
<td>MCH-140 Drills and Drill Presses</td>
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<tr>
<td>Task 8 – Sets up conventional lathes.</td>
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<tr>
<td>8.01</td>
<td>Selects conventional lathe types.</td>
<td>MCH-150 Introduction to Conventional Lathes</td>
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<tr>
<td>8.02</td>
<td>Plans sequence of operations for conventional lathes.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
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<tr>
<td>8.03</td>
<td>Sets up work holding devices for conventional lathes.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
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</tr>
<tr>
<td>8.04</td>
<td>Sets up tooling for conventional lathes.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
<td></td>
</tr>
<tr>
<td>8.05</td>
<td>Sets up conventional lathe accessories.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
<td></td>
</tr>
<tr>
<td>8.06</td>
<td>Sets up workpiece on conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
<td></td>
</tr>
<tr>
<td>8.07</td>
<td>Selects conventional lathe speeds and feeds.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
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<tr>
<td>8.08</td>
<td>Sets up eccentrics on conventional lathes.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
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<tr>
<td>Task 9 – Operates conventional lathes.</td>
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<tr>
<td>9.01</td>
<td>Turns external surfaces using a conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
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<tr>
<td>9.02</td>
<td>Bores holes using a conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
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<td></td>
<td>MCH-160 Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading</td>
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<tr>
<td>Task</td>
<td>Description</td>
<td>Notes</td>
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<tr>
<td>9.03</td>
<td>Faces surfaces using a conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
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<tr>
<td>9.04</td>
<td>Turns tapers on a conventional lathe.</td>
<td>MCH-225 Taper Turning</td>
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<tr>
<td>9.05</td>
<td>Knurls using a conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
<td></td>
</tr>
<tr>
<td>9.06</td>
<td>Parts off workpiece using a conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
<td></td>
</tr>
<tr>
<td>9.07</td>
<td>Drills using a conventional lathe.</td>
<td>MCH-160 Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading</td>
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<tr>
<td>9.08</td>
<td>Reams holes using a conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation, MCH-160 Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading</td>
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</tr>
<tr>
<td>9.09</td>
<td>Cuts grooves using a conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation</td>
<td></td>
</tr>
<tr>
<td>9.10</td>
<td>Cuts threads using a conventional lathe.</td>
<td>MCH-155 Basic Conventional Lathe Operation, MCH-220 Advanced Conventional Lathe Operation</td>
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</tr>
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</table>

**Task 10 – Sets up conventional milling machines.**

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<tr>
<th>Task</th>
<th>Description</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>10.01</td>
<td>Selects conventional milling machine types.</td>
<td>MCH-165 Introduction to Milling Machines</td>
</tr>
<tr>
<td>10.02</td>
<td>Plans milling sequence.</td>
<td>MCH-200 Vertical Milling Machine Operation, MCH-310 Horizontal/Universal Milling Machine Operation</td>
</tr>
<tr>
<td>10.03</td>
<td>Sets up work holding devices for conventional milling machines.</td>
<td>MCH-200 Vertical Milling Machine Operation, MCH-310 Horizontal/Universal Milling Machine Operation</td>
</tr>
<tr>
<td>10.05</td>
<td>Sets up milling accessories.</td>
<td>MCH-200 Vertical Milling Machine Operation, MCH-310 Horizontal/Universal Milling Machine Operation</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td>Machine</td>
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<td>------</td>
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<tr>
<td>10.06</td>
<td>Sets up workpiece on a conventional milling machine.</td>
<td>MCH-200</td>
</tr>
</tbody>
</table>

**Task 11 – Operates conventional milling machines.**

<p>| Task 11.01 | Mills surfaces using a conventional milling machine. | MCH-200 | Vertical Milling Machine Operation | MCH-310 | Horizontal/Universal Milling Machine Operation |
| Task 11.02 | Mills profiles and pockets using a conventional milling machine. | MCH-200 | Vertical Milling Machine Operation | MCH-310 | Horizontal/Universal Milling Machine Operation |
| Task 11.03 | Mills slots, grooves and keyways using a conventional milling machine. | MCH-200 | Vertical Milling Machine Operation | MCH-310 | Horizontal/Universal Milling Machine Operation |
| Task 11.05 | Drills holes using a conventional milling machine. | MCH-200 | Vertical Milling Machine Operation | MCH-315 | Gears and Gear Cutting |
| Task 11.06 | Reams holes using a conventional milling machine. | MCH-200 | Vertical Milling Machine Operation | MCH-310 | Horizontal/Universal Milling Machine Operation |
| Task 11.09 | Bores holes using a conventional milling machine. | MCH-200 | Vertical Milling Machine Operation |</p>
<table>
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<th>Task 12 – Sets up power saws.</th>
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<tbody>
<tr>
<td>12.01 Selects power saw types.</td>
</tr>
<tr>
<td>12.02 Selects saw blades.</td>
</tr>
<tr>
<td>12.03 Installs saw blades.</td>
</tr>
<tr>
<td>12.04 Selects power saw speeds and feeds.</td>
</tr>
<tr>
<td>12.05 Makes power saw adjustments.</td>
</tr>
<tr>
<td>12.06 Sets up workpiece on power saw.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task 13 – Operates power saws.</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.01 Saws straight and angle cuts.</td>
</tr>
<tr>
<td>13.02 Cuts irregular shapes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task 14 – Sets up precision grinding machines.</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.01 Selects precision grinding machine types.</td>
</tr>
<tr>
<td>14.02 Plans grinding sequence.</td>
</tr>
<tr>
<td>14.03 Sets up work holding devices for precision grinding machines.</td>
</tr>
<tr>
<td>14.04 Mounts grinding wheel.</td>
</tr>
<tr>
<td>14.05 Sets up grinding accessories.</td>
</tr>
<tr>
<td>14.06 Sets up workpiece on precision grinding machines.</td>
</tr>
<tr>
<td>14.07 Selects precision grinding machine speeds and feeds.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Task 15 – Operates precision grinding machines.</th>
</tr>
</thead>
<tbody>
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<td>15.01 Grinds flat surfaces using a surface grinder.</td>
</tr>
<tr>
<td>15.02 Grinds profiles.</td>
</tr>
<tr>
<td>15.03 Grinds internal and external cylindrical and tapered surfaces.</td>
</tr>
<tr>
<td>15.04 Grinds tools and cutters.</td>
</tr>
<tr>
<td>15.05 Finishes holes using a honing machine.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task 16 – Performs basic CNC programming.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.01 Reviews process documentation.</td>
</tr>
<tr>
<td>16.02 Calculates coordinates for tool path.</td>
</tr>
<tr>
<td>16.03 Creates basic program.</td>
</tr>
<tr>
<td>Task 16</td>
</tr>
<tr>
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<tr>
<td>16.04</td>
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<tr>
<td>16.05</td>
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</tbody>
</table>

**Task 17 – Sets up CNC machine-tools.**

| Task 17 | | | | |
|---|---|---|---|
| 17.01 | Selects tooling and tool holders for CNC machine-tools. | MCH-410 | Computer Numerical Control (CNC) Machine-Tools |
| 17.02 | Sets up tooling and tool holders for CNC machine-tools. | MCH-415 | Computer Numerical Control (CNC) Operation |
| 17.03 | Sets up workpiece on CNC machine-tool. | MCH-415 | Computer Numerical Control (CNC) Operation |
| 17.04 | Establishes work datum. | MCH-415 | Computer Numerical Control (CNC) Operation |
| 17.05 | Verifies program. | MCH-415 | Computer Numerical Control (CNC) Operation |

**Task 18 – Operates CNC machine-tools.**

| Task 18 | | | | |
|---|---|---|---|
| 18.01 | Adjusts offsets. | MCH-415 | Computer Numerical Control (CNC) Operation |
| 18.02 | Monitors machining processes. | MCH-415 | Computer Numerical Control (CNC) Operation |
| 18.03 | Interrupts program cycle. | MCH-415 | Computer Numerical Control (CNC) Operation |
| 18.04 | Restarts program cycle. | MCH-415 | Computer Numerical Control (CNC) Operation |
Level 1
MENT-1801  Workplace Mentoring I  
(Nova Scotia Unit of Instruction)

Learning Outcomes:
- Identify and explain strategies for learning workplace skills.
- Demonstrate strategies to assist in learning skills in the workplace.

Objectives and Content:
1. Describe the importance of your own experiences.
2. Identify the partners involved in apprenticeship.
3. Describe the shared responsibilities for workplace learning.
4. Determine your own learning preferences and explain how these relate to learning new skills.
5. Describe the importance of different types of skills in the workplace.
6. Describe the importance of essential skills in the trade.
7. Identify different ways of learning.
8. Identify your learning preferences.
9. Identify different learning needs and strategies to meet learning needs.
10. Identify techniques for effective communication.
11. Identify strategies to assist in learning a skill.

Resource:
- Recommended resource to use in the delivery of this unit: www.apprenticeship.nscc.ca/mentoring/apprentice.htm
MCH-100  Safety

Learning Outcomes:

- Demonstrate knowledge of safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to safety.

Objectives and Content:

1. Identify types of personal protective equipment (PPE) and describe their applications.

2. Describe the procedures used to care for and maintain PPE.

3. Identify types of fire extinguishing equipment and describe their applications and procedures for use.

4. Identify workplace hazards and describe safe work practices and equipment.
   i) personal
   ii) shop/facility
      - energy state awareness (electrical and mechanical)
      - lockout / tag out
      - ventilation/fumes
      - fire
   iii) environment
      - discharge/spills
      - material waste

5. Identify and interpret workplace safety and health regulations.
   i) federal
      - Material Safety Data Sheets (MSDS)
      - Workplace Hazardous Material Information System (WHMIS)
   ii) provincial/territorial
      - Occupational Health and Safety (OHS)
MCH-105  Hoisting, Lifting and Rigging

Learning Outcomes:

- Demonstrate knowledge of hoisting, lifting and rigging equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of basic hosting, lifting and rigging techniques.

Objectives and Content:

1. Define terminology associated with hoisting, lifting and rigging.

2. Identify hazards and describe safe work practices pertaining to hoisting, lifting and rigging.

3. Identify codes and regulations pertaining to rigging, hoisting and lifting.
   i) training and certification requirements

4. Identify types of rigging equipment and accessories and describe their applications, limitations and procedures for use.
   i) ropes
   ii) slings
   iii) chains
   iv) hooks
   v) spreader bars
   vi) shackles

5. Identify and interpret hand signals used for hoisting and lifting.

6. Identify types of hoisting and lifting equipment and accessories and describe their applications, limitations and procedures for use.

7. Describe the considerations when rigging material/equipment for lifting.
   i) load characteristics
   ii) equipment and accessories
   iii) environmental factors
   iv) anchor points
   v) sling angles
8. Describe the procedures used to inspect, maintain and store hoisting, lifting and rigging equipment.
MCH-120  Hand and Power Tools

Learning Outcomes:

- Demonstrate knowledge of hand tools, their applications, maintenance and procedures for use.
- Demonstrate knowledge of power tools, their applications, maintenance and procedures for use.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to hand and power tools.

2. Identify types of hand tools and describe their applications and procedures for use.
   i) vices
   ii) hammers
   iii) screw drivers
   iv) wrenches
   v) pliers
   vi) punches
   vii) stamps
   viii) hacksaws
   ix) files
   x) scrapers
   xi) deburring tools
   xii) chisels
   xiii) taps
   xiv) dies
   xv) arbor presses
   xvi) extractors

3. Describe the procedures used to inspect, maintain and store hand tools.
4. Identify types of power tools and equipment and describe their applications and procedures for use.
   i) electrical
   ii) cordless
   iii) hydraulic
   iv) pneumatic

5. Describe the procedures used to inspect, maintain and store power tools and equipment.
MCH-135  
Fluids and Coolants

Learning Outcomes:

- Demonstrate knowledge of cutting fluids, their applications and procedures for use.
- Demonstrate knowledge of coolants, their applications and procedures for use.
- Demonstrate knowledge of lubricants, their applications and procedures for use.
- Demonstrate knowledge of solvents, their applications and procedures for use.

Objectives and Content:

1. Define terminology associated with fluids and coolants.

2. Identify hazards and describe safe work practices pertaining to fluids and coolants.
   i) personal
   ii) shop/facility
   iii) environmental

3. Interpret regulations pertaining to the use of fluids and coolants.

4. Identify types of fluids and coolants and describe their purpose, characteristics and applications.
   i) cutting fluids
   ii) coolants
   iii) lubricants
   iv) solvents

5. Describe the procedures used to apply and maintain lubricants.

6. Describe the procedures for mixing, maintaining and adjusting coolants.

7. Describe the procedures used to apply cutting fluids and coolants.

8. Describe the procedures used to handle, store and dispose of fluids and coolants.
   i) cutting fluids
   ii) coolants
iii) lubricants
iv) solvents
Learning Outcomes:

- Demonstrate knowledge of power saws, their applications, maintenance and procedures for use.

Objectives and Content:

1. Define terminology associated with power saws.

2. Identify hazards and describe safe work practices pertaining to power saws.

3. Identify types of saws and attachments and describe their applications.
   i) vertical
   ii) horizontal
   iii) reciprocating/power hacksaws
   iv) cold circular
   v) abrasive cutoff

4. Identify types of sawing operations and describe their associated procedures.

5. Identify types of blades and describe their parameters, applications and installation procedures.

6. Identify potential problems during sawing operations and describe their causes and remedies.

7. Calculate speed and feed requirements.

8. Describe the procedures used to inspect and maintain power saws.
MCH-235  Contour Bandsaws

Learning Outcomes:

- Demonstrate knowledge of contour bandsaws, their applications, maintenance and procedures for use.

Objectives and Content:

1. Define terminology associated with contour bandsaws.

2. Identify hazards and describe safe work practices pertaining to contour bandsaws.

3. Identify the components and accessories of contour bandsaws and describe their characteristics and applications.

4. Identify types of blades and describe their characteristics and applications.

5. Describe the procedures used to set up and operate contour bandsaws.
   i) irregular shapes
   ii) internal/external contours

6. Calculate speed and feed requirements.

7. Describe the procedures used to butt weld bandsaw blades.

8. Describe the procedures used to inspect and maintain contour bandsaws.

9. Calculate the length of blade.
MCH-140  Drills and Drill Presses

Learning Outcomes:

- Demonstrate knowledge of drills and drill presses, their applications, maintenance and procedures for use.

Objectives and Content:

1. Define terminology associated with drills and drill presses.

2. Identify hazards and describe safe work practices pertaining to drills and drill presses.

3. Identify types of drills and describe their applications.

4. Identify types of drill presses and describe their components and applications.
   i) sensitive
   ii) upright
   iii) radial arm
   iv) magnetic

5. Identify drill press accessories and describe their applications and procedures for use.
   i) jigs and fixtures
   ii) work holding devices
   iii) tool holding devices

6. Describe the procedures used to set up and perform drill press operations.
   i) drilling
   ii) counterboring
   iii) countersinking
   iv) tapping
   v) reaming

7. Describe the procedures used to inspect, maintain and store drilling equipment and accessories.

8. Describe the procedures used to sharpen drill bits.
9. Describe the considerations to determine speed, feed and depth of cut for drill press operations.

Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Sharpen a drill bit.

Note: Practical learning activities are required for in-class delivery only, not online.
MCH-145 Introduction to Grinding Machines

Learning Outcomes:

- Demonstrate knowledge of grinding machines, their applications and procedures for use.
- Demonstrate knowledge of offhand (bench) grinding operations.
- Demonstrate knowledge of special (form) grinding operations.

Objectives and Content:

1. Define terminology associated with grinding machines.
2. Identify hazards and describe safe work practices pertaining to grinding machines.
3. Identify types of work holding devices and describe their applications.
4. Identify types of grinding machines and accessories and describe their applications.
   i) pedestal
   ii) surface
   iii) cylindrical
   iv) centreless
   v) tool and cutter grinder
5. Describe the procedures used to select and dress grinding wheels.
6. Describe the procedures used to perform offhand (bench) grinding operations.
7. Describe the procedures used to perform special (form) grinding operations.

Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:
- Select and dress a grinding wheel.

Note: Practical learning activities are required for in-class delivery only, not online.
MCH-240  Mechanical Components

Learning Outcomes:

- Demonstrate knowledge of mechanical components, their applications and procedures for use.

Objectives and Content:

1. Define terminology associated with mechanical components.

2. Identify hazards and describe safe work practices pertaining to mechanical components.

3. Identify types of fasteners, retainers and locators and describe their characteristics and applications.
   i) bonds
   ii) nuts
   iii) dowel pins
   iv) washers
   v) studs
   vi) snap rings

4. Identify head styles of threaded fasteners and describe their characteristics and applications.

5. Identify techniques used to torque fasteners and describe their associated procedures.

6. Identify nut and bolt designs and describe their characteristics and applications.

7. Identify grades of nuts and bolts and describe their characteristics and applications.

8. Identify types of keys, keyseats and keyways and describe their characteristics and applications.
   i) square
   ii) woodruff
   iii) flat/rectangular
iv) gib
v) taper

9. Explain the principles of stepped keys.

10. Describe the procedures used to hand broach a keyway.

11. Identify types of bearings and bushings and describe their characteristics and applications.
MCH-130 Basic Layout

Learning Outcomes:

- Demonstrate knowledge of basic layout and its use.
- Demonstrate knowledge of basic layout tools and equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of the procedures used to perform a basic layout.

Objectives and Content:

1. Define terminology associated with basic layout.

2. Identify types of basic layout tools, equipment and accessories and describe their applications and procedures for use.
   i) surface tables
   ii) angle plates
   iii) scribers
   iv) dividers and trammels
   v) hermaphrodite calipers
   vi) squares
   vii) gauges
   viii) rulers

3. Identify types of layout media/solutions and describe their applications.


5. Describe the procedures used to read and transfer sizes from a drawing.

6. Describe the procedures used to perform a basic layout.

7. Identify methods used to mark workpieces for identification and describe their associated procedures.

8. Describe the procedures used to inspect, maintain and store layout tools and equipment.
Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Instructor demonstration.

Note: Practical learning activities are required for in-class delivery only, not online.
MCH-110    Basic Drawings

Learning Outcomes:

- Demonstrate knowledge of basic drawings and their applications.
- Demonstrate knowledge of interpreting and extracting information from drawings.

Objectives and Content:

1. Define terminology associated with drawings.
   i) nominal size
   ii) limits
   iii) tolerance
   iv) allowance
   v) scale
   vi) symmetry

2. Identify types of basic drawings and sketches and describe their purpose.

3. Interpret and extract information from drawings.
   i) lines
   ii) projections
   iii) dimensions
   iv) notes
   v) lay/surface finish symbols
   vi) welding symbols

4. Explain the principles of orthographic projection.

5. Describe basic sketching techniques.
**MCH-115  Precision Measurement I**

**Learning Outcomes:**

- Demonstrate knowledge of basic precision measurement and its use.
- Demonstrate knowledge of basic precision measuring instruments, their applications and procedures for use.

**Objectives and Content:**

1. Define terminology associated with basic precision measurement.

2. Describe the imperial and metric measuring systems and the procedures used to perform conversions for machining operations.

3. Describe the procedures used to read basic precision measuring instrument scales.

4. Identify types of precision measuring instruments and describe their applications and procedures for use.
   i) micrometers
   ii) vernier calipers
   iii) dial indicators
   iv) gauges

5. Describe the procedures used to perform basic calibration of measuring instruments.

6. Describe procedures used to inspect, maintain and store basic precision measuring instruments.

**Learning Activities**

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:
- Instructor demonstration.

Note: Practical learning activities are required for in-class delivery only, not online.
Learning Outcomes:

- Demonstrate knowledge of quality systems, their purpose and applications.

Objectives and Content:

1. Define terminology associated with quality management.

2. Identify documentation pertaining to quality.
   i) standards
   ii) manuals
   iii) audits

3. Identify types of quality systems and describe their purpose.
   i) quality control
   ii) quality assurance
      - policies
      - procedures
      - work orders and instructions
      - control documents and records

4. Explain the value of quality improvement.
   i) statistical process control (introduction)
   ii) continuous improvement plans
   iii) customer requirements/satisfaction

Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Apprentices create a quality policy.
- Use industry documentation for projects.

Note: Practical learning activities are required for in-class delivery only, not online.
MCHA-1004  Geometric Dimensioning and Tolerancing  
(Nova Scotia Unit of Instruction)

Learning Outcomes:

- Demonstrate knowledge of geometric dimensions and tolerancing and its use.

Objectives and Content:

1. Define terminology associated with geometric dimensioning and tolerancing.

2. Interpret geometric dimensioning and tolerancing information found on drawings.
   i) symbols and terms
   ii) datums
   iii) tolerances
       - general
       - form and profile
       - orientation and run out
       - location

3. Identify dimensioning specification systems and describe their characteristics and applications.

4. Describe the procedures used to prepare to take measurements using geometric dimensioning and tolerancing.

5. Describe the procedures used to record results from measurements.

6. Describe the procedures used to verify that dimensions conform to specifications.
MCH-150  Introduction to Conventional Lathes

Learning Outcomes:

- Demonstrate knowledge of conventional lathes, their accessories, attachments and applications.
- Demonstrate knowledge of lathe tools and their applications.

Objectives and Content:

1. Define terminology associated with conventional lathes.

2. Identify types of conventional lathes and describe their operating principles and applications.

3. Identify the components and controls of conventional lathes and describe their purpose and operation.

4. Identify conventional lathe accessories and attachments and describe their applications.

5. Identify types of tool holding devices and describe their applications.

6. Identify types of work holding devices and describe their applications.
   i) four jaw chuck
   ii) three jaw chuck
   iii) face plate
   iv) between centers

7. Identify types of conventional lathe tools and describe their characteristics and applications.
   i) turning
   ii) boring
   iii) threading
   iv) grooving
   v) facing
   vi) knurling
   vii) parting off
   viii) reaming
ix) tool post grinding
x) drilling

8. Describe the procedures used to sharpen conventional lathe cutting tools.

9. Describe the procedures used to grind cutting tool angles.
MCH-155  Basic Conventional Lathe Operation

Learning Outcomes:

- Demonstrate knowledge of conventional lathes, their maintenance and procedures for use.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to conventional lathes.
2. Describe the considerations to determine speed, feed and depth of cut for conventional lathe operations.
3. Calculate speed, feed and depth of cut.
4. Identify potential set-up problems and describe their causes and remedies.
5. Describe the procedures used to set up lathes.
6. Describe the procedures used to mount and adjust rests.
7. Identify cutting fluids and coolants used during lathe operations.
8. Identify the considerations and requirements for selecting tools and accessories for specific operations.
9. Describe the procedures used to adjust and maintain conventional lathes.
10. Describe the procedures used to align lathe centres.
11. Describe the procedures used to perform basic conventional lathe operations.
   i) turning
   ii) boring
   iii) threading
   iv) grooving
   v) facing
   vi) knurling
vii) parting off
viii) reaming
ix) drilling

12. Describe the procedures used to set up eccentrics on conventional lathes.

13. Identify techniques used to troubleshoot conventional lathe operations and describe their associated procedures.

14. Describe the procedures used to inspect and maintain conventional lathes.

**Learning Activities**

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Capstone project recommended for Level 1 (see Unit #310 Horizontal/Universal Milling Machine Operation).
MCH-160 Conventional Lathe Drilling, Boring, Reaming, Tapping and Die Threading

Learning Outcomes:

- Demonstrate knowledge of conventional lathe drilling, boring, reaming, tapping and die threading operations.

Objectives and Content:

1. Describe the procedures used for spotting and drilling work on a conventional lathe.

2. Identify types of boring tools and describe their applications and procedures for use.

3. Describe the procedures used for boring work on a conventional lathe.

4. Identify types of machine reamers and describe their applications and procedures for use.

5. Describe the procedures used for reaming work on a conventional lathe.

6. Identify types of machine taps and dies and describe their applications and procedures for use.

7. Describe the procedures used for tapping on a conventional lathe.

8. Describe the procedures used for die threading on a conventional lathe.

9. Describe the procedures used for counterboring and countersinking work on a conventional lathe.

10. Describe speed, feed and depth of cut for conventional lathe operations.
    i) reaming
    ii) drilling
    iii) tapping
    iv) die threading
    v) counterboring
Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Capstone project recommended for Level 1 (see Unit #310 Horizontal/Universal Milling Machine Operation).
MCH-125       Hand Threading

Learning Outcomes:

- Demonstrate knowledge of basic threads and fits and their applications.
- Demonstrate knowledge of the procedures used to measure and gauge threads.

Objectives and Content:

1. Define terminology associated with threads.
2. Identify hazards and describe safe work practices pertaining to threading.
3. Identify types of threads and describe their purpose and applications.
4. Explain thread fit, classifications and series.
5. Identify types of thread inserts and describe their applications and installation procedures.
6. Describe the importance of thread fit and the use of thread gauges.
7. Identify types of thread failures and describe their causes and remedies.
8. Calculate and select tap drill sizes in metric and imperial.
9. Identify methods used to measure and gauge threads and describe their associated procedures.
10. Describe the procedures used to produce threads using taps and dies.
MCH-225  
Taper Turning

Learning Outcomes:

- Demonstrate knowledge of tapers, their attachments and applications.
- Demonstrate knowledge of taper turning operations.

Objectives and Content:

1. Define terminology associated with taper turning.

2. Identify hazards and describe safe work practices pertaining to taper turning.

3. Identify types of tapers and describe their applications.
   i) Morse
   ii) taper pin
   iii) pipe thread taper
   iv) machine taper

4. Identify types of taper attachments and describe their applications and procedures for use.
   i) plain
   ii) telescopic

5. Calculate dimensions of tapers in imperial and metric.

6. Identify methods used to turn tapers and describe their associated procedures.
   i) taper attachment
   ii) tailstock
   iii) compound rest

7. Identify methods used to check tapers and describe their associated procedures.
   i) plug gauge
   ii) ring gauge
   iii) sine bar
   iv) layout lines
   v) dial indicator
MCH-165   Introduction to Milling Machines

Learning Outcomes:

- Demonstrate knowledge of milling machines, their accessories, attachments and applications.
- Demonstrate knowledge of milling cutting tools and their applications.

Objectives and Content:

1. Define terminology associated with milling machines.

2. Identify hazards and describe safe work practices pertaining to conventional milling machines.

3. Identify types of milling machines and describe their applications.
   i) vertical
   ii) horizontal/universal
   iii) ram and turret
   iv) horizontal boring mill
   v) vertical boring mill

4. Identify the components and controls of milling machines and describe their purpose and operation.

5. Identify types of milling machine accessories and attachments and describe their applications and maintenance.

6. Identify types of tool holding devices and describe their applications.

7. Identify types of work holding devices and describe their applications and maintenance.

8. Identify types of materials used in milling cutter construction and describe their characteristics.

9. Identify types of cutting tools and describe their applications.

10. Describe climb and conventional milling.
MCH-310 Horizontal/Universal Milling Machine Operation

Learning Outcomes:

- Demonstrate knowledge of horizontal/universal milling machines, their set up, maintenance and procedures for use.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to horizontal/universal milling machines.

2. Describe the considerations used to determine speed, feed and depth of cut for horizontal/universal milling machine operations.

3. Calculate speed, feed and depth of cut.

4. Identify potential set up problems and describe their causes and remedies.

5. Describe the procedures used to align workpieces.

6. Describe the procedures used to set up horizontal/universal milling machines to perform basic milling operations.

7. Identify the considerations and requirements for selecting tools and accessories for milling operations.

8. Describe the procedures used to inspect and maintain horizontal/universal milling machines.

9. Describe the procedures used to perform milling operations on horizontal/universal milling machines.
   i) contouring
   ii) surfacing
   iii) keyways and keyseats
   iv) straddle
   v) gang
   vi) T-slot
   vii) end milling
viii) slitting
ix) slotting

10. Identify milling cutter failures and describe their causes and remedies.

11. Identify techniques used to troubleshoot horizontal/universal milling operations and describe their associated procedures.

Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Capstone project recommended for Level 1.
  i) produce a workpiece such as square block with drilled holes
     - apply layout technique
     - turn in a four-jaw chuck
     - mill a key
     - complete documentation for quality assurance
     - apply principles of Geometric Dimensioning and Tolerancing to verify workpiece

Note: Practical learning activities are required for in-class delivery only, not online.
MCH-220       Advanced Conventional Lathe Operation

Learning Outcomes:

- Demonstrate knowledge of contours and forms.
- Demonstrate knowledge of advanced threading and multiple starts.

Objectives and Content:

1. Explain the principles of form turning.

2. Identify the types of form turning tools and describe their characteristics and applications.

3. Describe the procedures used to turn forms.

4. Describe the procedures used to set up, position work and turn eccentrics.

5. Identify types of advanced threads, their purpose, characteristics and applications.
   i) specialty
      - ACME
      - buttress
      - tapered pipe
      - straight pipe
   ii) multiple start

6. Identify methods used to cut multiple start threads and describe their associated procedures.
   i) slotted drive or faceplate
   ii) indexing of the spindle gear
   iii) use of thread-chasing dial
   iv) compound rest method

7. Identify methods used to cut specialty threads and describe their associated procedures.

8. Describe the procedures used to check and measure threads.
Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Capstone project recommended for Level 2 (see Unit #200 Vertical Milling Machine Operation).
MCH-200  Vertical Milling Machine Operation

Learning Outcomes:

- Demonstrate knowledge of vertical milling machines, their set up, maintenance and procedures for use.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to vertical milling machines.

2. Describe the considerations used to determine speed, feed and depth of cut for vertical milling machine operations.

3. Calculate speed, feed and depth of cut.

4. Identify potential set up problems and describe their causes and remedies.

5. Describe the procedures used to align vertical milling machine heads.

6. Describe the procedures used to align workpieces.

7. Describe the procedures used to set up vertical milling machines to perform basic milling operations.

8. Identify the considerations and requirements used for selecting tools and accessories for milling operations.

9. Describe the procedures used to perform milling operations on vertical milling machines.
   i) contouring
   ii) pocketing
   iii) boring
   iv) reaming
   v) grooving
   vi) surfacing
   vii) drilling
   viii) tapping
ix) countersinking
x) counterboring
xi) chamfering
xii) spotfacing
xiii) dovetailing

10. Describe the procedures used to mill profiles using vertical milling machines.

11. Describe the procedures used to perform gear cutting operations on vertical milling machines.

12. Describe the procedures used to inspect and maintain vertical milling machines.

13. Identify types of rotary tables and describe their construction, applications and procedures for use.

14. Identify types of dividing heads and describe their characteristics and applications.

15. Explain the principles and perform calculations involved in indexing.

16. Identify milling cutter failures and describe their causes and remedies.

17. Identify techniques used to troubleshoot vertical milling operations and describe their associated procedures.

**Learning Activities**

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Capstone project recommended for Level 2.
  i) Produce a workpiece, such as round shaft with a Double-start thread and a hex milled on one end using a dividing head and 90° serrations in the centre of the shaft. A mating square block with internal Double-start threads and other precision-machined features are on the sides of the blocks.
  ii) Complete documentation for quality assurance
iii) Apply principles of Geometric Dimensioning and Tolerancing to verify workpiece

Note: Practical learning activities are required for in-class delivery only, not online.
MCH-300 Machinable Materials

Learning Outcomes:

- Demonstrate knowledge of metals and their characteristics.
- Demonstrate knowledge of machinable materials, their applications and procedures for use.

Objectives and Content:

1. Define terminology associated with machinable materials.

2. Identify hazards and describe safe work practices pertaining to machining materials.

3. Describe the properties of metals and their characteristics.
   i) chemical
   ii) physical
   iii) mechanical

4. Identify and interpret markings and documentation relating to material selection.
   i) identification systems
      - American Society of Mechanical Engineering (ASME)
      - ANSI
      - colour coding (manufacturer specific)
      - number
   ii) documentation
      - mill certificates

5. Identify types of machinable materials and describe their characteristics and applications.
   i) metallic
      - ferrous
      - non-ferrous
   ii) non-metallic
   iii) specialty
      - alloys
      - refractory metals
- precious metals

6. Identify types of coolants used with machinable materials and describe the considerations affecting their selection.

7. Explain the operating principles of machining materials.
   i) metallic
   ii) non-metallic
   iii) specialty

8. Describe the procedures used to set up and machine materials.
MCHA-1002 Power Transmission and Lubrication
(Nova Scotia Unit of Instruction)

Learning Outcomes:

- Demonstrate knowledge of bearings, their purpose and use.
- Demonstrate knowledge of power transmission and its components.
- Demonstrate knowledge of preventive maintenance procedures.

Objectives and Content:

1. Define terminology associated with power transmission and lubrication.

2. Identify hazards and describe safe work practices pertaining to bearings.

3. Explain the principles of lubrication.
   i) friction
   ii) wear

4. Identify types of lubricants and describe their properties and applications.
   i) liquids
   ii) solids
   iii) greases
   iv) lubricant additives

5. Identify methods used for applying lubricants and describe their associated procedures.

6. Identify types of bearings and describe their characteristics and applications.
   i) Plain
   ii) Babbit
   iii) Bronze 48
   iv) Rolling element

7. Explain the principles of bearing operation.
   i) plain
   ii) rolling

8. Describe failure patterns of plain bearings and associated maintenance practices.

9. Identify types of power transmission elements and describe their purpose and applications.
i) belt drives  
ii) chain drives  
iii) shaft couplings  
iv) clutches (positive drive, variable speed, centrifugal)  
v) sprockets

10. Describe configurations of power transmission elements and their operation.

11. Identify hazards and describe safe work practices pertaining to power transmission.
   i) elements  
   ii) configurations  
   iii) power transmission drives

12. Describe failure patterns of power transmission elements and associated maintenance practices.

13. Explain the principles and methods of simple alignment and leveling.

14. Describe the procedures used to achieve leveling and simple alignment.
   i) coupling faces  
   ii) shafts

15. Identify types of seals and describe their characteristics, applications and procedures for installation.
   i) mechanical end face seals  
   ii) o-rings  
   iii) gaskets

16. Identify types of packing and describe their applications and procedures for installation.

Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Cut o-ring groove, fabricate and install o-ring.  
- Perform simple alignment of coupling faces and shafts.

Note: Practical learning activities are required for in-class delivery only, not online.
LEVEL 3
MCH-300 Machinable Materials

Learning Outcomes:

- Demonstrate knowledge of the properties of metals.
- Demonstrate knowledge of machinable materials, their applications, safety considerations and procedures for use.

Objectives and Content:

1. Define terminology associated with machinable materials.

2. Identify hazards and safety precautions involved in machining materials.
   i) metallic
   ii) non-metallic
   iii) specialty

3. Describe the properties of metals and their characteristics.
   i) chemical
   ii) physical
   iii) mechanical

4. Identify and interpret markings and documentation relating to material selection.
   i) identification systems
      - ASME
      - ANSI
      - colour coding (manufacturer specific)
      - number
   ii) documentation
      - mill certificates

5. Identify types of machinable materials and describe their characteristics and applications.
   i) metallic
      - ferrous
      - non-ferrous
   ii) non-metallic
   iii) specialty
- alloys
- refractory metals
- precious metals

6. Identify coolants used with machinable materials and describe the factors affecting their selection.

7. Describe the principles and procedures for machining materials.
   i) metallic
   ii) non-metallic
   iii) specialty
MCH-250  Heat Treatment

Learning Outcomes:

- Demonstrate knowledge of basic heat treatment and its applications.

Objectives and Content:


2. Identify hazards and describe safe work practices pertaining to heat treatment.

3. Identify methods used to determine the carbon content of steels.

4. Describe the procedures used to determine properties of metals.
   i) chemical
   ii) physical
   iii) mechanical

5. Identify the processes used in the heat treatment of metals and describe their applications.
   i) annealing
   ii) hardening
   iii) normalizing
   iv) stress-relieving
   v) tempering

6. Identify and interpret technical data used in the heat treatment of metals.
   i) charts
   ii) tables

7. Identify methods used for hardening steel and describe the properties of the steel produced by each.
   i) water hardening
   ii) oil hardening
   iii) air hardening
   iv) case hardening
Identify methods used to heat treat metals and describe their associated procedures and equipment.

i) flame
ii) furnace/oven
iii) induction
MCH-305 Material Testing

Learning Outcomes:

- Demonstrate knowledge of basic material testing and its applications.
- Demonstrate knowledge of material testing procedures.

Objectives and Content:

1. Define terminology associated with material testing.

2. Identify hazards and describe safe work practices pertaining to material testing.

3. Describe the purpose and applications of material testing.
   i) hardness
   ii) composition
   iii) properties

4. Identify types of tests performed on materials and describe their applications.
   i) destructive
      - tensile strength
      - impact
   ii) non-destructive
      - x-ray
      - dye penetrant/liquid penetrant
      - magnetic particle
   iii) spark
   iv) file

5. Identify the machines and scales used to determine material hardness and describe their associated procedures.
   i) Rockwell
   ii) Brinell
MCH-215  Cutting Machine Tools

Learning Outcomes:

- Demonstrate knowledge of cutting machine tools, their applications and procedures for use.
- Demonstrate knowledge of cutting tool geometry and its use.

Objectives and Content:

1. Define terminology associated with cutting machine tools.

2. Identify hazards and describe safe work practices pertaining to cutting machine tools.

3. Explain the principles of chip formation.

4. Identify types of cutting machine tools and describe their characteristics and applications.
   i) indexable insert
   ii) high speed steel (HSS)
   iii) ceramic

5. Explain tool geometry and its purpose.

6. Describe the procedures used to sharpen cutting tools.

7. Interpret the systems for the identification of carbide inserts/coatings and tool holders.
   i) American National Standards Institute (ANSI)
   ii) International System of Units (SI)

8. Describe the effect of carbide cutting tools on speed, feed and depth of cut.

9. Identify types of carbide tool holding devices and describe their applications.

10. Identify carbide tool failures and describe their causes and remedies.
MCH-320  Reciprocating Machines

Learning Outcomes:

- Demonstrate knowledge of slotters, their applications, set up and procedures for use.
- Demonstrate knowledge of broaching and keyseating machines, their applications, set up and procedures for use.

Objectives and Content:

1. Define terminology associated with reciprocating machines.
2. Identify hazards and describe safe work practices pertaining to reciprocating machines.
3. Identify types of slotters and describe their components and applications.
4. Calculate speed and feed requirements.
5. Describe the procedures used to set up and operate slotters.
6. Describe the procedures used to set up and operate shapers.
7. Explain the operating principles of machine broaching and keyseating.
8. Identify types of broaching and keyseating machines and describe their components and applications.
9. Identify types of tooling for broaching and keyseating machines and describe their applications.
10. Describe the procedures used to set up and operate broaching and keyseating machines.
Learning Outcomes:

- Demonstrate knowledge of the procedures used to plan and organize jobs.

Objectives and Content:

1. Identify sources of information relevant to job planning.
   i) documentation
      - work orders/shop orders
      - technical data
      - reference materials
   ii) drawings
   iii) related professionals
   iv) clients
   v) quality standards
      - International Standards Organization (ISO)

2. Interpret and complete relevant trade documentation.

3. Interpret advanced drawing specifications.
   i) tolerance
   ii) finish requirements
   iii) geometric dimensioning and tolerancing

4. Identify the considerations and requirements when planning jobs and job tasks.
   i) materials
   ii) machines and tooling
   iii) sequence of work
   iv) clean-up

5. Calculate cutting time requirements.

6. Identify the considerations and requirements for selecting machines and tooling to complete specified jobs.

7. Calculate materials required to complete specified jobs.
MCH-205 Advanced Drawings

Learning Outcomes:

- Demonstrate knowledge of views of drawings and their applications.
- Demonstrate knowledge of industry symbols and markings and their applications.
- Demonstrate knowledge of geometric dimensions and tolerances and their applications.

Objectives and Content:

1. Identify drawing views and describe their purpose and applications.
   i) isometric
   ii) orthographic
   iii) sectional
   iv) auxiliary

2. Identify and interpret industry symbols and markings and describe their applications.
   i) surface textures
   ii) hidden (phantom) lines
   iii) geometric dimensions and tolerances
   iv) datums
   v) moldings, forgings and castings

3. Explain the principle of geometric dimensioning and tolerancing.
MCH-340  Precision Layout

Learning Outcomes:

- Demonstrate knowledge of precision layout and its applications.
- Demonstrate knowledge of precision layout tools and equipment, their applications, maintenance and procedures for use.

Objectives and Content:

1. Identify precision layout tools and equipment and describe their applications and procedures for use.
   - universal bevel protractor
   - sine bar
   - precision height gauge
   - gauge blocks
   - granite table
   - surface plate

2. Describe the procedures used to perform a precision layout.

3. Calculate sine bar values.

4. Calculate angles, arcs and location from reference point.

5. Describe the procedures used to inspect, maintain and store precision layout tools and equipment.
MCH-245 Introduction to Welding

Learning Outcomes:

- Demonstrate knowledge of basic welding processes used in machining operations and their applications.

Objectives and Content:

1. Define terminology associated with basic welding.

2. Identify hazards and describe safe work practices pertaining to basic welding processes.

3. Interpret codes and regulations pertaining to welding.
   i) training and certification requirements

4. Identify welding processes and describe their characteristics and applications.

5. Identify types of welding equipment and describe their applications.

6. Describe the procedures used to perform basic welding and heating applications.
   i) bending
   ii) tacking

7. Describe the procedures used to perform basic oxy-fuel cutting.

8. Describe the procedures used to inspect and store welding equipment.
MCH-315  Gears and Gear Cutting

Learning Outcomes:

- Demonstrate knowledge of gears and gear cutting.
- Demonstrate knowledge of gear measurement.
- Demonstrate knowledge of gear milling operations.

Objectives and Content:

1. Define terminology associated with gears and gear cutting.

2. Identify hazards and describe safe work practices pertaining to gears and gear cutting.

3. Explain the principles of gears and describe their purpose and operation.

4. Identify types of gears and describe their characteristics and applications.
   i) spur
   ii) helical
   iii) bevel
   iv) worm
   v) rack
   vi) splines

5. Identify methods of gear tooth measurement and describe their associated procedures.

6. Calculate gear cutting requirements.

7. Calculate ratios for simple and compound gears.

8. Identify machines and accessories used to cut gears.

9. Identify types of gear cutting tools and describe their characteristics and applications.

10. Describe the procedures used to set up and produce gears.
Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Cut a spur gear.

Note: Practical learning activities are required for in-class delivery only, not online.
MCH-325  Abrasive Finishing

Learning Outcomes:

- Demonstrate knowledge of abrasives, their applications and procedures for use.
- Demonstrate knowledge of grinding wheels, their applications, maintenance and procedures for use.
- Demonstrate knowledge of abrasive finishing techniques.

Objectives and Content:

1. Define terminology associated with abrasive finishing.
2. Identify hazards and describe safe work practices pertaining to abrasives.
3. Identify types of abrasives and describe their characteristics and applications.
4. Identify types of grinding wheels and describe their characteristics and applications.
5. Identify the considerations and requirements for selecting a grinding wheel for common grinding operations.
   i) abrasive
   ii) grain
   iii) grade
   iv) structure
   v) bond
6. Describe the procedures used to mount and balance grinding wheels.
7. Identify types of wheel dressers and describe their applications.
8. Describe the procedures used to true and dress grinding wheels.
9. Describe the procedures used to inspect, maintain and store grinding wheels.
10. Describe the procedures used to shape or finish a workpiece using abrasive techniques.
11. Identify types of materials and equipment used to lap and hone workpieces.

12. Identify lapping and honing techniques and describe their associated procedures.

13. Identify types of materials and equipment used to buff and polish workpieces.

14. Identify polishing and blending techniques and describe their associated procedures.
MCH-330 Surface Grinders

Learning Outcomes:

- Demonstrate knowledge of surface grinders, their set up, maintenance and procedures for use.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to surface grinding.
2. Describe the considerations used to determine feed and depth of cut for grinding operations.
3. Calculate feed and depth of cut.
4. Describe the procedures used to set up grinders and accessories.
5. Describe the procedures used to align a workpiece.
6. Identify potential set up problems and describe their causes and remedies.
7. Identify types of accessories used for surface grinding operations and describe their applications.
8. Describe the procedures used to adjust and maintain surface grinding machines.
9. Describe the procedures used to perform surface grinding operations.
10. Identify techniques used to troubleshoot surface grinding operations and describe their associated procedures.
11. Identify types of wheel dressers and describe their applications.
12. Describe the procedures used to true and dress grinding wheels.
MCH-335  Cylindrical Grinders

Learning Outcomes:

- Demonstrate knowledge of cylindrical grinders, their set up, maintenance and procedures for use.

Objectives and Content:

1. Identify hazards and describe safe work practices pertaining to cylindrical grinding.
2. Describe the considerations used to determine feed and depth of cut for grinding operations.
3. Calculate feed and depth of cut.
4. Describe the procedures used to set up grinders and accessories.
5. Describe the procedures used to align or dial workpieces.
6. Identify potential set up problems and describe their causes and remedies.
7. Identify types of accessories used for cylindrical grinding operations and describe their applications.
8. Describe the procedures used to inspect and maintain cylindrical grinding machines.
9. Describe the procedures used to perform cylindrical grinding operations.
10. Identify techniques used to troubleshoot cylindrical grinding operations and describe their associated procedures.
11. Identify types of wheel dressers and describe their applications.
12. Describe the procedures used to true and dress grinding wheels.
Learning Outcomes:

- Demonstrate knowledge of gauge blocks, their applications and procedures for use.
- Demonstrate knowledge of angular measurement and its use.

Objectives and Content:

1. Identify types and grades of gauge blocks and describe their applications and procedures for use.
   i) metric
   ii) imperial

2. Calculate and perform gauge block build-ups.

3. Identify types of wear blocks and describe their purpose and applications.

4. Explain the principles of angular measurement.

5. Identify universal bevel protractors and describe their applications and procedures for use.

6. Identify sine bars and describe their applications and procedures for use.

7. Identify compound sine plates and describe their applications and procedures for use.

8. Describe procedures used to store and maintain gauge blocks.
MCHA-1003  Jigs and Fixtures  
(Nova Scotia Unit of Instruction)

Learning Outcomes:

- Demonstrate knowledge of the purpose and applications of jigs and fixtures.
- Demonstrate knowledge of the elements and process of jig and fixture design.
- Demonstrate knowledge of the set up and operation of jig grinding machines.
- Demonstrate knowledge of the set up and operation of jig boring machines.

Objectives and Content:

JIG BORING

1. Name the parts of a jig borer and describe the principles of the machine.

2. Describe the accessories and tooling of a jig boring machine and how these relate to:
   i) accuracy
   ii) versatility
   iii) productivity

3. Describe the various types of work holding devices, their applications and limitations.

4. Describe setup and work alignment procedures.

5. Describe locating tools and procedures for their use.

6. Describe procedures used for drilling and boring.

JIG GRINDING MACHINE

7. Name the parts of a jig grinding machine and describe its principles.

8. Describe the accessories and tooling of a jig grinding machine and how these relate to:
   i) accuracy
   ii) versatility
iii) productivity

9. Describe the various types of work holding devices, their applications and limitations.

10. Describe setup and work alignment procedures.

11. Describe locating tools and procedures for their use.

12. Describe procedures used for drilling and grinding.

13. Describe procedures used to verify accuracy.

SPECIALTY HOLDING DEVICES

14. Describe the purpose of tool design as it relates to:
   i) design economy
   ii) objectives
   iii) manufacturing
   iv) planning

15. Describe the types, purpose and applications of jigs and fixtures.

16. Describe the principles of supporting and locating datums in relation to jigs and fixtures.

17. Describe the rules and procedures for locating multiple jigs and fixtures.

18. Describe special clamping accessories, their purpose and procedures for use.

Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Drill holes.
- Bore holes.
- Apply Geometric Dimensioning and Tolerancing.
Note: Practical learning activities are required for in-class delivery only, **not** online.
LEVEL 4
MENT-1802  Workplace Mentoring II  
(Nova Scotia Unit of Instruction)

Learning Outcomes:
- Identify and explain strategies for teaching workplace skills.
- Demonstrate strategies to assist in teaching skills in the workplace

Objectives and Content:
2. Describe the impact of your own experiences in teaching skills.
3. Identify the different roles played by a workplace mentor.
4. Describe the six-step approach to teaching skills.
5. Explain the importance of identifying the point of the lesson.
6. Identify how to choose a good time to present a lesson.
7. Explain the importance of linking the lessons.
8. Identify the components of the skill (the context).
9. Describe considerations for demonstrating a skill.
10. Identify types of skill practice.
11. Describe considerations in setting up opportunities for skill practice.
12. Explain the importance of providing feedback.
13. Identify techniques for giving effective feedback.
15. Identify methods of assessing progress.
16. Explain how to adjust a lesson to different situations.

Resource:
- Recommended resource to use in the delivery of this unit: 
  www.apprenticeship.nscc.ca/mentoring/apprentice.htm
MCH-405  Quality Inspection

Learning Outcomes:

- Demonstrate knowledge of quality inspection and its use.
- Demonstrate knowledge of the Cartesian Coordinate System and its use.
- Demonstrate knowledge of coordinate measuring machines, their applications and procedures for use.

Objectives and Content:

1. Define terminology associated with quality inspection.
   i) basic dimension
   ii) limits
   iii) tolerances
   iv) allowance

2. Identify types of precision gauges used in quality inspection and describe their applications and procedures for use.
   i) fixed
   ii) cylindrical
   iii) ring
   iv) taper
   v) snap
   vi) thread

3. Identify types of precision measuring instruments used in quality inspection and describe their applications and procedures for use.

4. Describe the procedures used to inspect workpieces.

5. Identify types of comparators and describe their applications and procedures for use.
   i) mechanical
   ii) electronic
   iii) optical
   iv) pneumatic

6. Describe the Cartesian Coordinate System, its purpose and applications.
7. Identify types of coordinate measuring machines and describe their components, applications and procedures for use.
MCH-420  Reconditioning

Learning Outcomes:

- Demonstrate knowledge of the procedures used for reconditioning.

Objectives and Content:

1. Identify types of fits, clearances, tolerances and serviceable limits.

2. Identify types of mechanical components and describe their disassembly procedures.
   i) bearings
   ii) seals
   iii) threaded inserts
   iv) adapters/bushings

3. Describe the procedures used to repair or replace mechanical components.

4. Identify types of equipment used in reconditioning and describe their procedures for use.
   i) pullers
   ii) presses

5. Identify types of materials used to fit and reassemble components and describe their applications and procedures for use.
   i) adhesives
   ii) sealants
   iii) lubricants and lubrication systems

6. Describe the procedures used to fit and reassemble components.
MCH-410  Computer Numerical Control (CNC) Machine-Tools

Learning Outcomes:

- Demonstrate knowledge of CNC machine-tools, their accessories, attachments and applications.

Objectives and Content:

1. Define terminology associated with CNC machine-tools.

2. Identify the hazards and describe safe work practices pertaining to CNC machine-tools.

3. Describe the advantages of using CNC machine-tools.

4. Identify CNC axes and describe the relationship between them.

5. Identify types of CNC machine-tools and describe their characteristics and applications.

6. Identify types of accessories and tool changers used with CNC machine-tools and describe their applications.

7. Identify types of tool holders and work holding devices used with CNC machine-tools and describe their applications.

Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Capstone project recommended for Level 4 (see Unit #415 Computer Numerical Control (CNC) Operation).
MCH-415  Computer Numerical Control (CNC) Operation

Learning Outcomes:

- Demonstrate knowledge of basic CNC programming.
- Demonstrate knowledge of CNC machine-tools, their set up, maintenance and procedures for use.

Objectives and Content:

1. Identify CNC control units and describe their purpose.

2. Identify types of basic programming codes and languages and describe their applications.
   i) G-codes
   ii) M-codes
   iii) conversational

3. Identify CNC-related reference points and their location.

4. Describe the procedures used to perform basic CNC programming.
   i) review process documentation
   ii) calculate coordinates for tool path
   iii) create basic program
   iv) input program data into control memory
   v) optimize program

5. Describe the procedures used to set up CNC machines.
   i) send/receive program
   ii) select and set up tooling and tool holder
   iii) dial tools
   iv) set up workpiece
   v) establish work datum
   vi) verify program
6. Describe the procedures used to operate CNC machines.
   i) adjust offsets
   ii) load/unload workpiece
   iii) monitor process
   iv) interrupt program cycle
   v) restart program cycle

7. Describe the procedures used to perform basic preventative maintenance.

Learning Activities

Learning activities are assigned to enhance the apprentice’s ability to meet the objectives of the course. The learning activities outlined in this unit are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Capstone project recommended for Level 4.
  i) write a basic program
  ii) set up a CNC machine
  iii) produce a workpiece
  iv) complete QA documentation
  v) apply Geometric Dimensioning and Tolerancing to verify workpiece

Note: Practical learning activities are required for in-class delivery only, not online.
MCHA-1830  
**Program Review**  
(Nova Scotia Unit of Instruction)

**Learning Outcomes:**

- Upon successful completion of this unit, the apprentice will complete a study plan based on the National Occupational Analysis.

**Objectives and Content:**

1. Identify areas of the program where knowledge of theory is weakest.
2. Identify areas where workplace experience is lacking or weak.
3. Identify resources necessary to address areas of shortfall.
4. Identify timelines to address areas of weakness.

**Suggested Learning Activities:**

1. Conduct a mock certification exam to be used for diagnostic purposes.
2. Review the National Occupational Analysis.
3. Review the Apprentice Logbook.
4. Review the Exam Preparation information found at [www.nsapprenticeship.ca](http://www.nsapprenticeship.ca) under Quick Links, Exam Preparation.
5. Conduct a final mock certification exam.

**Resources:**

These are the recommended resources to use in the delivery of this unit:

- Exam Preparation information, including videos, occupational analyses, exam counseling sheets, practice exams and sample questions, and other study materials and resources, can be found at [www.nsapprenticeship.ca](http://www.nsapprenticeship.ca) under Quick Links, Exam Preparation.
- Apprentice’s personal logbook
- Applicable codes and regulations
- Program texts

**Evaluation:** pass/fail
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