



8856

MILLING OPERATIONS II
(12B)

40S/40E/40M

A Machining Technology Course

8856: MILLING OPERATIONS II (12B)

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Course Description

Students further develop the skills and knowledge necessary to select, operate, and maintain tools, as well as to perform calculations, interpret engineering drawings, work set-up, and machine material in a safe, efficient, and responsible manner through the application of practical projects related to the milling machine. Emphasis is placed upon the set-up of the milling machine accessories and work-holding devices, the dividing head, and rotary table, to assist in the machining of accurate parts. Exploration of how to troubleshoot machining problems when they occur is introduced. Opportunity may also be taken to further introduce CNC milling machines and CNC theory.

Goal 1: Describe and apply appropriate **health and safety** practices as they relate to the **maintenance of a safe workplace**.

GLO 1.1: Create and maintain a **safe working environment** in machining technology.

- SLO 12B.1.1.1 Identify safety and health requirements. (A1.1)
- SLO 12B.1.1.2 Identify personal protective equipment (PPE) and PPE procedures. (A1.2)
- SLO 12B.1.1.3 Identify appropriate safety procedures for working with electricity. (A1.3)
- SLO 12B.1.1.4 Identify appropriate safety procedures to reduce fire hazards. (A1.4)
- SLO 12B.1.1.5 Identify ergonomically correct procedures to avoid injury (e.g., stress, strain). (A1.5)
- SLO 12B.1.1.6 Identify hazard recognition and control. (A1.6)
- SLO 12B.1.1.7 Describe the hazards of confined-space entry. (A1.7)
- SLO 12B.1.1.8 Identify first aid/cardiopulmonary resuscitation (CPR). (A1.8)
- SLO 12B.1.1.9 Identify safety requirements as they apply to the WHMIS. (A1.9)
- SLO 12B.1.1.10 Describe the identification and control of specified hazards. (A1.10)
- SLO 12B.1.1.11 Identify types of personal protective equipment (PPE), and describe their applications. (A2.1)
- SLO 12B.1.1.12 Describe the procedures used to care for and maintain PPE. (A2.2)

- SLO 12B.1.1.13 Identify types of fire extinguishing equipment, and describe their applications and procedures for use. (A2.3)
- SLO 12B.1.1.14 Identify workplace hazards, and describe safe work practices and equipment. (A2.4)
- SLO 12B.1.1.15 Identify and interpret workplace safety and health regulations. (A2.4)
- SLO 12B.1.1.16 Identify hazards, and describe safe work practices pertaining to fluids and coolants. (A8.2)
- SLO 12B.1.1.17 Identify hazards, and describe safe work practices pertaining to hand and power tools. (B1.1)
- SLO 12B.1.1.18 Demonstrate understanding and adherence to safe work procedures/job hazards analysis documents for each piece of equipment, tool, and consumable that they use.
- SLO 12B.1.1.19 Demonstrate understanding and adherence to safe practices and procedures for facilities, processes, tools, and equipment found in machining technology.
- SLO 12B.1.1.20 Discuss worker's responsibility to refuse unsafe work.
- SLO 12B.1.1.21 Demonstrate use of personal protective equipment (PPE) and adherence to PPE procedures used in machining technology.
- SLO 12B.1.1.22 Demonstrate the safe use of compressed air.
- SLO 12B.1.1.23 Practise appropriate cleaning and maintenance of the machining technology area and equipment for the promotion of a safe work/learning environment.
- SLO 12B.1.1.24 Practise appropriate safe behaviour to ensure personal safety, as well as the safety of others.
- SLO 12B.1.1.25 Develop safe habits.
- SLO 12B.1.1.26 Demonstrate a safe, clean, organized, and uncluttered work area.
- SLO 12B.1.1.27 Explain the purpose/importance and use of accident report forms.
- SLO 12B.1.1.28 Identify hazards, and describe safe work practices pertaining to conventional milling machines. (E1.2)
- SLO 12B.1.1.29 Practise safe set-up/operation of milling machines.

GLO 1.2: Demonstrate knowledge of the **Trade Safety Awareness Manual**.
(www.gov.mb.ca/tce/apprent/apprentice/trade_safety/)

No applicable SLOs.

Goal 2: Understand **terminology, abbreviations, symbols, and acronyms** related to machining technology.

GLO 2.1: Understand **terminology, abbreviations, symbols, and acronyms** related to machining technology.

- SLO 12B.2.1.1 Define metallurgical terminology, abbreviations, symbols, and acronyms.
- SLO 12B.2.1.2 Define terminology, abbreviations, symbols, and acronyms associated with grinding machines. (F1.1)
- SLO 12B.2.1.3 Define terminology, abbreviations, symbols, and acronyms associated with basic precision measurement. (C1.1)
- SLO 12B.2.1.4 Define terminology, abbreviations, symbols, and acronyms associated with drawings. (A6.1).

Goal 3: Understand **technical drawings**.

GLO 3.1: Understand **technical drawings**.

- SLO 12B.3.1.1 Produce basic paper-and-pencil sketch of project.
- SLO 12B.3.1.2 Interpret and extract information from drawings. (A6.3)
- SLO 12B.3.1.3 Describe industry methods of showing dimensions and tolerances.
- SLO 12B.3.1.4 Explain the principles of orthographic projection. (A6.4)

Goal 4: Demonstrate **layout and planning**.

GLO 4.1: Demonstrate **planning and layout procedures**.

- SLO 12B.4.1.1 Calculate layout dimensions and reference points. (C3.4)
- SLO 12B.4.1.2 Describe the procedures used to inspect, maintain, and store layout tools and equipment. (C3.8)
- SLO 12B.4.1.3 Use planning worksheets for projects.

GLO 4.2: Demonstrate **layout on projects**.

- SLO 12B.4.2.1 Identify and use tools required to perform advanced layout on milling projects.
- SLO 12B.4.2.2 Perform basic layout. (C3.9)
- SLO 12B.4.2.3 Use Vernier height gauge.

Goal 5: Use measurement and quality control tools.**GLO 5.1: Use measurement and quality control tools.**

- SLO 12B.5.1.1 Demonstrate applications and procedures when inspecting, maintaining, and storing precision measuring instruments. (C1.7)
- SLO 12B.5.1.2 Use digital read-out. (DRO)
- SLO 12B.5.1.3 Use dial indicator.
- SLO 12B.5.1.4 Measure angles.

Goal 6: Identify basic elements of metallurgy.**GLO 6.1: Identify basic elements of metallurgy.**

- SLO 12B.6.1.1 Distinguish metallurgical processes.
- SLO 12B.6.1.2 Describe ferrous and nonferrous metals.
- SLO 12B.6.1.3 Describe the process of steel manufacturing.
- SLO 12B.6.1.4 Describe hardness testing of metals.

Goal 7: Understand tools, equipment, and accessories.**GLO 7.1: Identify tools, equipment, accessories, and work-holding devices.**

- SLO 12B.7.1.1 Identify types of tool-holding devices, and describe their applications. (E1.6)
- SLO 12B.7.1.2 Identify types of work-holding devices, and describe their applications and maintenance. (E1.7)
- SLO 12B.7.1.3 Identify types of materials used in milling cutter construction, and describe their characteristics. (E1.8)
- SLO 12B.7.1.4 Identify types of cutting tools, and describe their applications. (E1.9)
- SLO 12B.7.1.5 No applicable SLO.
- SLO 12B.7.1.6 No applicable SLO.

GLO 7.2: Use tools, equipment, accessories, and work-holding devices.

- SLO 12B.7.2.1 Describe the procedures used to apply and maintain lubricants. (A8.5)
- SLO 12B.7.2.2 Set milling head to perform a milling operation at an angle.
- SLO 12B.7.2.3 Set up dividing head to mill a project.
- SLO 12B.7.2.4 Set up rotary table to mill a project.

- SLO 12B.7.2.5 Use step blocks and clamps as work-holding devices.
- SLO 12B.7.2.6 Machine a keyway on a shaft.
- SLO 12B.7.2.7 Use fly cutter to produce a flat surface.
- SLO 12B.7.2.8 Use indexable insert cutters.
- SLO 12B.7.2.9 Mill a pocket.
- SLO 12B.7.2.10 Mill an internal and an external dovetail.
- SLO 12B.7.2.11 Mill a keyway using a woodruff cutter.
- SLO 12B.7.2.12 Cut a profile using gang milling.
- SLO 12B.7.2.13 Use offset boring chuck to enlarge a hole.

GLO 7.3: Identify techniques used to **troubleshoot** and **predict potential problems**.

- SLO 12B.7.3.1 Identify potential milling machine set-up problems, and describe their causes and solutions.
- SLO 12B.7.3.2 Identify techniques used to troubleshoot milling machine operations, and describe their associated procedures.

Goal 8: Describe and demonstrate the transferable **cross-curricular** knowledge and skills as they pertain to machining technology.

GLO 8.1: Apply **mathematical knowledge and skills** related to machining technology.

- SLO 12B.8.1.1 Solve problems involving fractions and decimals.
- SLO 12B.8.1.2 Solve problems involving metric and imperial measure.
- SLO 12B.8.1.3 Solve problems involving length, perimeter, circumference, volume, area, mass, angles, ratio, and percentage.
- SLO 12B.8.1.4 Convert between imperial and metric measurements.
- SLO 12B.8.1.5 Use formulas to accurately calculate data for use in machining operations.
- SLO 12B.8.1.6 Accurately calculate and measure parts and angles.
- SLO 12B.8.1.7 Perform mathematical calculations, conversions, and measurements, as required for the project.
- SLO 12B.8.1.8 Calculate for the dividing or indexing head to produce various machining operations.
- SLO 12B.8.1.9 Use mathematical concepts (e.g., volume, density, mass, slope, ratio, proportion, and angles) related to machining.
- SLO 12B.8.1.10 Calculate machining time based on RPM and feed rate.
- SLO 12B.8.1.11 Calculate angles for milling head setting.

- SLO 12B.8.1.12 Use charts and reference books to determine tap drill sizes.
- SLO 12B.8.1.13 Use charts and reference books to determine conversions among metric, fractional, and decimal units of measurement.
- SLO 12B.8.1.14 Use charts and reference books to obtain data for use in machining operation calculations.

Goal 9: Demonstrate an awareness of **education and career opportunities** in machining technology and associated occupations.

GLO 9.1: Describe **education and career opportunities** in machining technology

- SLO 12B.9.1.1 Discuss training and career opportunities in machining.
- SLO 12B.9.1.2 Research apprenticeship and post-secondary opportunities for machining.

Goal 10: Describe the **history, technological progression, and emerging trends** in machining technology.

GLO 10.1: Describe the **history, technological progression, and emerging trends** in machining technology.

- SLO 12B.10.1.1 Discuss the evolution of computer-aided machining.

Goal 11: Demonstrate **employability skills** related to machining technology.

GLO 11.1: Demonstrate **employability skills** related to machining technology.

- SLO 12B.11.1.1 Demonstrate regular attendance and punctuality.
- SLO 12B.11.1.2 Demonstrate accountability by taking responsibility for their actions.
- SLO 12B.11.1.3 Demonstrate adaptability and effort.
- SLO 12B.11.1.4 Demonstrate the ability to accept and follow directions and listen to feedback.
- SLO 12B.11.1.5 Demonstrate the ability to stay on task and make effective use of time in class and shop environments.
- SLO 12B.11.1.6 Demonstrate the ability to communicate respectfully and effectively.
- SLO 12B.11.1.7 Demonstrate being responsible to oneself and to the facility.

- SLO 12B.11.1.8 Demonstrate behaviour appropriate to the workplace.
 - SLO 12B.11.1.9 Demonstrate neat personal appearance and proper hygiene.
 - SLO 12B.11.1.10 Prepare/revise a personal resumé specific to an application to an employer of machinists.
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Goal 12: Demonstrate awareness of the **ethical and legal standards** as they pertain to machining technology.

GLO 12.1: Demonstrate awareness of the **ethical and legal standards** as they pertain to machining technology.

- SLO 12B.12.1.1 Discuss ethical and legal expectations of machinists.
 - SLO 12B.12.1.2 No applicable SLO.
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Goal 13: Demonstrate awareness of **sustainability** as it pertains to machining technology.

GLO 13.1: Demonstrate awareness of **human sustainability** on machinists.

- SLO 12B.13.1.1 Discuss the sustainability of the machinists' working conditions, including working hours and shift work.
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GLO 13.2: Describe machining technology's sustainability practices and impact on the environment.

- SLO 12B.13.2.1 Discuss and demonstrate appropriate recycling, reduction of waste, and reusing of materials as they pertain to the machining industry.
 - SLO 12B.13.2.2 Discuss and demonstrate the appropriate disposal of coolants, oils, and non-recyclable waste.
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GLO 13.3: Demonstrate awareness of the **business sustainability** of a machining technology facility.

- SLO 12B.13.3.1 Discuss why businesses put resources into research and development.

