

# Machinist Level 4

## Machinist

**Unit:** A14 Reconditioning

**Level:** Four

**Duration:** 12 hours

Theory: 12 hours

Practical: 0 hours

### Overview:

This unit of instruction is designed to introduce knowledge of the procedures used for reconditioning.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Identify types of fits, clearances, tolerances and serviceable limits.</b>	<b>10%</b>
<b>2. Identify types of mechanical components, and describe their disassembly procedures.</b> a. Bearings. b. Seals. c. Threaded inserts. d. Adapters/bushings.	<b>15%</b>
<b>3. Describe the procedures used to repair or replace mechanical components.</b> a. Materials.	<b>15%</b>
<b>4. Identify types of equipment used in reconditioning and describe their procedures for use.</b> a. Pullers. b. Presses.	<b>15%</b>
<b>5. Identify types of materials used to fit and reassemble components and describe their applications and procedures for use.</b> a. Adhesives. b. Sealants. c. Lubricants and lubrication systems.	<b>15%</b>
<b>5. Describe the procedures used to fit and reassemble components.</b>	<b>15%</b>
<b>6. Identify the considerations and requirements for selecting machines and tooling to complete specified jobs.</b>	<b>15%</b>

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## Machinist

**Unit:** A16 Job Planning

**Level:** Four

**Duration:** 14 hours

Theory: 14 hours

Practical: 0 hours

### Overview:

This unit of instruction is designed to introduce knowledge of the procedures used to plan and organize jobs.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Identify sources of information relevant to job planning.</b> a. Documentation. <ul style="list-style-type: none"> <li>• Work orders/shop orders.</li> <li>• Technical data.</li> <li>• Resource materials.</li> </ul> b. Drawings. c. Related professionals. d. Clients. e. Quality standards. <ul style="list-style-type: none"> <li>• International Standards Organization (ISO).</li> </ul>	<b>10%</b>
<b>2. Interpret and complete relevant trade documentation.</b>	<b>5%</b>
<b>3. Interpret advanced drawing specifications.</b> a. Tolerance. b. Finish requirements. c. Geometric dimensioning and tolerancing.	<b>20%</b>
<b>4. Identify the consideration and requirements when planning jobs and job tasks.</b> a. Materials. b. Machines and tooling. c. Sequence of work. d. Clean-up.	<b>20%</b>
<b>5. Calculate cutting time requirements.</b>	<b>10%</b>
<b>6. Identify the considerations and requirements for selecting machines and tooling to complete specified jobs.</b>	<b>20%</b>
<b>7. Calculate materials required to complete specified jobs.</b>	<b>15%</b>

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## Machinist

**Unit: A17 Pre-Certification Review**

**Level:** Four

**Duration:** 35 hours

Theory: Instructor's hours  
discretion

Practical: Instructor's hours  
discretion

### Overview:

This unit offers apprentices a systematic review of skills and knowledge required to pass the Certification Examination. It provides the connections between on-the-job learning and the content of in-school technical training. The unit includes pertinent information about the significance of certification and the main features of the exam. **No testing is prescribed for this instructional unit; a Pass grade will be awarded for participation in this unit.**

### Objectives and Content:

1. **Describe the significance, format, and general content of Certification Examination.**
  - a. Scope and aims of Provincial Certification Examination system; value of certification.
  - b. Obligations and entitlements of candidates for Provincial certification.
    - Relevance of Provincial Certification Examination to current, accepted trade practices; industry-based national validation of test items.
    - Supplementals Policy (retesting) by the Apprenticeship Branch.
    - Confidentiality of examination content; the certified journey person's own stake in examination security (value of credential).
    - Limitations on use of calculators (cannot be programmable).
  - c. Multiple-choice (four-option) item format; Apprenticeship Branch standards for acceptable test items (e.g. no "trick"-type questions; specifications for use of metric/imperial units).
  - d. Important government materials relevant to the Provincial Examination for apprentice Machinists.
    - Provincial Occupational Analysis (POA); prescribed scope of the skills and knowledge which comprise the trade.
    - POA "Pie-chart" and its relationship to content distribution of Provincial Examination items.
    - Manitoba Apprentice POA-based Practical Record Book

**2. Identify resources, strategies, and other key considerations for maximizing successful completion of written exams used in certifying tradespeople.**

- a. Personal preparedness.
- b. Proper rest and nutrition, eye-testing.
- c. Making room for a personal study regimen.
- d. Focused reflection on prior test taking.
- e. Self-assessment and a Personal Study Plan:
  - Preliminary self-assessment of individual strengths and weaknesses in trade-related skills and knowledge; usefulness of old tests; reflection on the in-school and on-the-job components of the Apprenticeship Program.
  - Use(s) of approved textbooks, chapter tests, study guides, and notetaking in preparing for an examination.
  - Study groups; perils and possibilities.
  - Formulation of a personal study plan, including an approximate timetable, which describes and schedules a course of action for reviewing all relevant material(s) and for strengthening areas of deficient skills and knowledge.

**3. Review program content.**

- a. Trade Safety Awareness (A & C Board Standard).
  - Identify safety and health requirements.
  - Identify personal protection equipment (PPE) and PPE procedures.
  - Identify electrical safety.
  - Identify ergonomics.
  - Identify hazard recognition and control.
  - Describe the hazards of confined-space entry.
  - Identify First Aid/Cardiopulmonary Resuscitation (CPR).
  - Identify safety requirements as they apply to the WHMIS.
  - Describe the identification and control of specified hazards.
- b. Safety.
  - Identify types of personal protective equipment (PPE) and describe their applications and procedures for use.
  - Describe the procedures used to care for and maintain PPE.
  - Identify types of fire extinguishing equipment and describe their applications and procedures for use.
  - Identify workplace hazards and describe safe work practices and equipment.
  - Identify and interpret workplace safety and health regulations.
- c. Orientation I: The Structure & Scope of Machinist Trade Learning. (A & C Board Standard).
  - Describe the structure and scope of the trade.
  - Describe the Manitoba Machinist Apprenticeship Program.
  - Describe special opportunities and challenges re: Machinist training.
- d. Hand Treading.
  - Define terminology associated with threads.
  - Identify hazards and describe safe work practices pertaining to threading.
  - Identify types of threads and describe their purpose and applications.
  - Explain thread fit, classifications and series.
  - Identify types of thread inserts and describe their applications and installation procedures.
  - Describe the importance of thread fit and the use of thread gauges.
  - Identify types of thread failures and describe their causes and remedies.
  - Calculate and select tap drill sizes in metric and imperial.
  - Identify methods used to measure and gauge threads and describe their associated procedures.

- Describe the procedures used to produce threads using taps and dies.
  - Perform the procedures used to cut or tap a thread.
- e. Hoisting, Lifting and Rigging.
- Define terminology associated with hoisting, lifting and rigging.
  - Identify hazards and describe safe work practices pertaining to hoisting, lifting and rigging.
  - Identify codes and regulations pertaining to rigging, hoisting and lifting.
  - Identify types of rigging equipment and accessories and describe their applications, limitations and procedures for use.
  - Identify and interpret hand signals used for hoisting and lifting.
  - Identify types of hoisting and lifting equipment and accessories and describe their applications, limitations and procedures for use.
  - Describe the considerations when rigging material/equipment for lifting.
  - Describe the procedures used to inspect, maintain and store hoisting, lifting and rigging equipment.
  - Perform the procedures used to inspect, maintain and store hoisting, lifting and rigging equipment.
- f. Basic drawings.
- Define terminology associated with drawings.
  - Identify types of basic drawings and sketches and describe their purpose.
  - Interpret and extract information from drawings.
  - Explain the principles of orthographic projection.
  - Describe basic sketching techniques.
- g. Precision Measurement.
- Define terminology associated with basic precision measurement.
  - Describe the imperial and metric measuring systems and the procedures used to perform conversions for machining operations.
  - Describe the procedures used to read basic precision measuring instrument scales.
  - Identify types of precision measuring instruments and describe their applications and procedures for use.
  - Describe the procedures used to perform basic calibration of measuring instruments.
  - Demonstrate precision measuring instrument applications and procedures.
- h. Hand and Power Tools.
- Identify hazards and describe safe work practices pertaining to hand and power tools.
  - Identify types of hand tools and describe their applications and procedures for use.
  - Describe the procedures used to inspect, maintain and store hand tools.
  - Identify types of power tools and equipment and describe their applications and procedures for use.
  - Describe the procedures used to inspect, maintain and store power tools and equipment.
  - Perform hand tool procedures.
  - Perform power tool procedures.
- i. Basic Layout.
- Define terminology associated with basic layout.
  - Identify types of basic layout tools, equipment and accessories and describe their applications and procedures for use.
  - Identify types of layout media/solutions and describe their applications.
  - Calculate layout dimensions and reference points.

- Describe the procedures used to read and transfer sizes from a drawing.
  - Describe the procedures used to perform basic layout.
  - Identify methods used to mark workpieces for identifications and describe their associated procedures.
  - Describe the procedures used to inspect, maintain and store layout tools and equipment.
  - Perform procedures used to perform basic layout.
- j. Fluids and Coolants.
- Define terminology associated with fluids and coolants.
  - Identify hazards and describe safe work practices pertaining to fluids and coolants.
  - Interpret regulations pertaining to the use of fluids and coolants.
  - Identify types of fluids and coolants and describe their purpose, characteristics and applications.
  - Describe the procedures used to apply and maintain lubricants.
  - Perform the procedures used for mixing, maintaining and adjusting coolants.
  - Describe the procedures used to apply cutting fluids and coolants.
  - Describe the procedures used to handle, store, and dispose of fluids and coolants.
  - Perform procedures used to handles, store and dispose of fluids and coolants.
- k. Drills and Drill Presses.
- Define terminology associated with drills and drill presses.
  - Identify hazards and describe their safe work practices pertaining to drills and drill presses.
  - Identify types of drills and describe their application.
  - Identify drill press accessories and describe their applications and procedures for use.
  - Describe the procedures used to set and perform drill press operations.
  - Describe the procedures used to inspect, maintain and store drilling equipment and accessories.
  - Perform the procedures used to sharpen drill bits.
  - Describe the considerations to determine speed, feed and depth of cut for drill press operations.
  - Perform set up and drill press operations.
- l. Introduction to Grinding Machines.
- Define terminology associated with grinding machines.
  - Identify hazards and describe safe work practices pertaining to grinding machines.
  - Identify types of work holding devices and describe their applications.
  - Identify types of grinding machines and accessories and describe their applications.
  - Describe the procedures used to perform offhand (bench) grinding operations.
  - Describe the procedures used to perform special (form) grinding operations.
  - Perform the procedures used to perform offhand (bench) grinding operations.
  - Perform the procedures to changing and dressing a grinding wheel.
- m. Introduction to Conventional Lathe.
- Define terminology associated with conventional lathes.
  - Identify types of conventional lathes and describe their operating principles and applications.
  - Identify the components and controls of conventional lathes and describe their purpose and operations.
  - Identify conventional late accessories and attachments and describe their applications.
  - Identify types of tool holding devices and describe their applications.

- Identify types of work holding devices and describe their applications.
  - Identify types of conventional lathe tools and describe their characteristics and applications.
  - Describe the procedures used to sharpen conventional lathe cutting tools.
  - Describe the procedures used to grind cutting tool angles.
- n. Basic Conventional Lathe Operation
- Identify hazards and describe safe work practices pertaining to conventional lathe.
  - Describe the considerations to determine speed, feed and depth of cut for conventional lathe operations.
  - Calculate speed, feed and depth of cut.
  - Identify potential set up problems and describe their causes and remedies.
  - Describe the procedures used to set up lathes.
  - Describe the procedures used to mount and adjust rests.
  - Identify cutting fluids and coolants used during lathe operations.
  - Identify the considerations and requirements for selecting tools and accessories for specific operations.
  - Describe the procedures used to adjust and maintain conventional lathes.
  - Describe the procedures used to align lathe centres.
  - Describe the procedures used to perform basic conventional lathe operations.
  - Describe the procedures used to set up eccentrics on conventional lathes.
  - Identify techniques used to troubleshoot conventional lathe operations and describe their associated procedures.
  - Describe the procedures used to inspect and maintain conventional lathes.
- Perform the procedures used to perform basic conventional lathe operations.
- o. Conventional Lathe Drilling, Boring Reaming, Tapping and Die Threading.
- Describe the procedures used for spotting and drilling work on a conventional lathe.
  - Identify types of boring tools and describe their applications and procedures for use.
  - Describe the procedures used for boring work on a conventional lathe.
  - Identify types of machine reamers and describe their applications and procedures for use.
  - Describe the procedures used for reaming work on a conventional lathe.
  - Identify types of machine taps and dies and describe their applications and procedures for use.
  - Describe the procedures used for tapping on a conventional lathe.
  - Describe the procedures used for counterboring and countersinking work on a conventional lathe.
  - Describe speed, feed and depth of cut for conventional lathe operations.
- p. Introduction to Milling Machines.
- Define terminology associated with milling machines.
  - Identify hazards and describe safe work practices pertaining to conventional milling machines.
  - Identify types of milling machines and describe their applications.
  - Identify the components and controls of milling machines and describe their purpose and operations.
  - Identify types of milling machine accessories and attachments and describe their applications and maintenance.
  - Identify types of tool holding devices and describe their applications.
  - Identify types of work holding devices and describe their applications and maintenance.
  - Identify types of materials used in milling cutter construction and describe their characteristics.
  - Identify types of cutting tools and describe their applications.



- Describe climb and conventional milling.
- q. Orientation II: The Job of Journeywork: Workplace Skill-Coaching & Mentoring (A & C Board Standard).
- Describe the scope, substance, and significance of journey-level status.
  - Compare/contrast role-options and responsibilities of the supervising journeyperson.
  - Describe/demonstrate common requirements re: providing journey-level supervision.
  - Describe workplace coaching skills.
- r. Conventional Milling Machine Operation
- Identify hazards and describe safe work practices pertaining to vertical milling machines.
  - Describe the considerations used to determine speed, feed and depth of cut for vertical milling machines.
  - Calculate speed, feed and depth of cut.
  - Identify potential set up problems and describe their causes and remedies.
  - Describe the procedures used to align vertical milling machine heads.
  - Describe the procedures used to align workpieces.
  - Describe the procedures used to set up vertical milling machines to perform basic milling operations.
  - Identify the considerations and requirements used for selecting tools and accessories for milling operations.
  - Describe the procedures used to perform milling operations on vertical milling machines.
  - Describe the procedures used to mill profiles using milling machines.
  - Describe the procedures used to perform gear cutting operations on milling machines.
  - Describe the procedures used to inspect and maintain milling machines.
  - Identify types of rotary tables and describe their construction, applications and procedures for use.
  - Identify types of dividing heads and describe their characteristics and applications.
  - Explain the principles and perform calculations involved in indexing.
  - Identify milling cutter failures and describe their causes and remedies.
  - Identify techniques used to troubleshoot vertical milling operations and describe their associated procedures.
  - Perform the procedures used to perform milling operations on vertical milling machines.
- s. Advanced Drawings.
- Identify drawing views and describe their purpose and applications.
  - Identify and interpret industry symbols and markings and describe their applications.
  - Explain the principles of geometric dimensioning and tolerancing.
  - Perform basic drafting skills.
- t. Precision Measurement II
- Identify types and grades of gauge blocks and describe their applications and procedures for use.
  - Calculate and perform gauge block build-ups.
  - Identify types of wear blocks and describe their purpose and applications.
  - Explain the principles of angular measurement.
  - Identify universal bevel protractors and describe their applications and procedures for use.
  - Identify sine bars and describe their applications and procedures for use.
  - Identify compound sine plates and describe their applications and procedures for use.
  - Describe procedures used to maintain and store gauge blocks.

- u. Cutting Machine Tools.
  - Define terminology associated with cutting machine tools.
  - Identify hazards and describe safe work practices pertaining to cutting machine tools.
  - Explain the principles of chip formation.
  - Identify types of cutting machine tools and describe their characteristics and applications.
  - Identify types of cutting tool materials and describe their applications and procedures of use.
  - Explain tool geometry and its purpose.
  - Describe the procedures used to sharpen cutting tools.
  - Interpret the systems for the identification of carbide inserts/coatings and tool holders.
  - Describe the effect of carbide cutting tools on speed, feed and depth of cut.
  - Identify types of carbide tool holding devices and describe their applications.
  - Demonstrate cutting tool geometry and its use.
  
- v. Advanced Conventional Lathe Operation
  - Explain the principles of form turning.
  - Identify types of form turning tools and describe their characteristics and applications.
  - Describe the procedures used to turn forms.
  - Describe the procedures used to set up, position work and turn eccentrics.
  - Identify types of threads, and describe their purpose, characteristics and applications.
  - Identify methods used to cut multiple start threads and describe their associated procedures.
  - Identify methods used to cut specialty threads and describe their associated procedures.
  - Describe the procedures used to check and measure threads.
  - Perform treading operations.
  
- w. Taper Turning.
  - Define terminology associated with taper turning.
  - Identify hazards and describe safe work practices pertaining to taper turning.
  - Identify types of tapers and describe their applications.
  - Identify types of taper attachments and describe their applications and procedures for use.
  - Calculate dimensions of tapers in metric and imperial.
  - Identify methods used to turn tapers and describe their associated procedures.
  - Identify methods used to check tapers and describe their associated procedures.
  - Demonstrate methods used to turn tapers and associated procedures.
  
- x. Power Saws.
  - Define terminology associated with power saws.
  - Identify hazards and describe safe work practices pertaining to power saws.
  - Identify types of saws and attachments and describe their applications.
  - Identify types of sawing operations and describe their associated procedures.
  - Identify types of blades and describe their parameters, applications and installation procedures.
  - Identify potential problems during sawing operations and describe their causes and remedies.
  - Calculate speed and feed requirements.
  - Describe the procedures used to inspect and maintain power saws.
  - Perform sawing operations.

- y. Contour Bandsaws.
  - Define terminology associated with contour bandsaws.
  - Identify hazards and describe safe work practices pertaining to contour bandsaws.
  - Identify the components and accessories of contour bandsaws and describe their characteristics and applications.
  - Describe the procedures used to set up and operate contour bandsaws.
  - Calculate speed and feed requirements.
  - Describe the procedures used to butt weld bandsaw blades.
  - Describe the procedures used to inspect and maintain contour bandsaws.
  - Calculate the length of blade.
  - Perform contour bandsaw operations.
  
- z. Mechanical Components.
  - Define terminology associated with mechanical components.
  - Identify hazards and describe safe work practices pertaining to mechanical components.
  - Identify types of fasteners, retainers and locators and describe their characteristics and applications.
  - Identify head styles of threaded fasteners and describe their characteristics and applications.
  - Identify techniques used to torque fasteners and describe their associated procedures.
  - Identify nut and bolt designs and describe their characteristics and applications.
  - Identify grades of nuts and bolts and describe their characteristic and applications.
  - Identify types of keys, keyseats and keyways and describe their characteristics and applications.
  - Explain the principles of stepped keys.
  - Describe the procedures used to hand broach keyways.
  - Identify types of bearings and bushings and describe their characteristics and applications.
  - Perform procedures used to hand broach keyways.
  
- aa Heat Treatment.
  - Define terminology associated with heat treatment.
  - Identify hazards and describe safe work practices pertaining to heat treatment.
  - Identify methods used to determine the carbon content of steels.
  - Identify the processes used in the heat treatment of metals and describe their appliances.
  - Identify and interpret technical data used in the heat treatment of metals.
  - Identify methods used for hardening steel and describe the properties of the steel produced by each.
  - Identify methods used to heat treat metals and describe their associated procedures and equipment.
  
- bb Introduction to Welding.
  - Define terminology associated with welding.
  - Identify hazards and describe safe work practices pertaining to basic welding processes.
  - Interpret codes and regulations pertaining to welding.
  - Identify welding processes and describe their characteristics and applications.
  - Identify types of welding equipment and describe their applications.
  - Describe the procedures used to perform basic welding and heating applications.
  - Describe the procedures used to perform basic ox-fuel cutting.

cc Pre-Certification Review.

- Describe the significance, format and general content of Inter-Provincial Examinations for the trade of Machinist.
- Identify resources, strategies and other considerations for maximizing successful completion of written examinations.
- Review program content regarding occupational skills
- Review program content regarding tools.
- Review program content regarding layout and measurement.
- Review program content regarding lathes.
- Review program content regarding grinders.
- Review program content regarding computer numerical control (CNC) machines.

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## Machinist

**Unit:** C5 Quality Inspection

**Level:** Four

**Duration:** 15 hours

Theory: 10 hours

Practical: 5 hours

### Overview:

This unit of instruction is designed to introduce knowledge of quality inspection and its use. The unit introduces knowledge of the Cartesian Coordinate System and its use. In addition the unit introduces knowledge of coordinate measuring machines, their applications and procedures for use.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Define terminology associated with quality inspection.</b>	<b>10%</b>
a. Basic dimension.	
b. Limits.	
c. Tolerance.	
d. Allowance.	
<b>2. Identify types of precision gauges used in quality inspection and describe their applications and procedures for use.</b>	<b>10%</b>
a. Fixed.	
b. Cylindrical.	
c. Ring.	
d. Taper.	
e. Snap.	
f. Thread.	
<b>3. Identify types of precision measuring instruments used in quality inspection and describe their applications and procedures for use.</b>	<b>10%</b>
<b>4. Describe the procedures used to inspect workpieces.</b>	<b>10%</b>
<b>5. Perform procedures used to inspect workpieces.</b>	<b>15%</b>
<b>6. Identify types of comparators and describe their applications and procedures for use.</b>	<b>10%</b>
a. Mechanical.	
b. Electronic.	
c. Optical.	
d. Pneumatic.	

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|---|------------|
| <b>7. Perform procedures for use of comparators and their applications.</b>   | <b>10%</b> |
| <b>8. Describe the Cartesian Coordinate System, its purpose and applications.</b>   | <b>5%</b>  |
| <b>9. Identify types of coordinate measuring machines and describe their components, applications and procedures for use.</b> | <b>10%</b> |
| <b>10. Perform coordinate measurement, applications and procedures.</b>   | <b>10%</b> |

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## Machinist

**Unit:** G1 Computer Numerical Control (CNC) Machine - Tools

**Level:** Four

**Duration:** 27 hours

Theory: 27 hours

Practical: 0 hours

### Overview:

This unit of instruction is designed to introduce knowledge of CNC machines-tools, their accessories, attachments and applications.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
1. Define terminology associated with CNC machine-tools.	10%
2. Interpret the hazards and describe safe work practices pertaining to CNC machine-tools.	10%
3. Describe the advantages of using CNC machine-tools.	10%
4. Identify CNC axes and describe the relationship between them.	10%
5. Identify types of CNC machine-tools and describe their characteristics and applications.	10%
6. Identify types of accessories and tool changes used with CNC machine-tools and describe their applications.	20%
7. Identify types of tool holders and work holding devices used with CNC machine-tools and describe their applications.	20%

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## Machinist

**Unit: G2 Computer Numerical Control (CNC) Operation**

**Level:** Four

**Duration:** 37 hours

Theory: 10 hours

Practical: 27 hours

### Overview:

This unit of instruction is designed to introduce knowledge of basic CNC programming. In addition the unit introduces knowledge of CNC machine-tools, their set up, maintenance and procedures for use.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
1. Identify CNC control units and describe their purpose.	5%
2. Identify types of basic programming codes and languages and describe their applications.	15%
a. G-codes.	
b. M-codes.	
c. Conversational.	
3. Perform basic programming codes and languages.	15%
4. Identify CNC related reference points and their location.	10%
a. Review process documentation.	
b. Calculate coordinates for tool path.	
c. Create basic program.	
d. Input program data into control memory.	
e. Optimize program.	
5. Describe the procedures used to set up CNC machines.	10%
a. Send/receive program.	
b. Select and set up tooling and tool holder.	
c. Dial tools.	
d. Set up workpiece.	
e. Establish work datum	
f. Verify program.	
6. Perform procedures used to set up CNC machines.	10%
7. Describe the procedures used to operate CNC machines.	10%
a. Adjust offsets.	
b. Load/unload workpiece.	



- c. Monitor process.
- d. Interrupt program cycle.
- e. Restart program cycle.

- 8. Perform procedures used to operate CNC machines. 15%**
- 9. Describe the procedures used to perform basic preventative maintenance. 10%**

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