Machinist
Level 2

Apprenticeship Manitoba

Rev. December 12, 2012

Machinist

Unit: A7 Advanced Drawings

Level: Two
Duration: 32 hours
Theory: 32 hours
Practical: 0 hours

Overview:

This unit of instruction is designed to introduce knowledge of views of drawings and their applications. It is also designed to introduce knowledge of industry symbols and markings and their applications. It introduces knowledge of geometric dimensions and tolerances and their applications.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify drawing views and describe their purpose and applications. a. Isometric. b. Orthographic. c. Sectional. d. Auxiliary.	**20%**
2. Identify and interpret industry symbols and markings and describe their applications. a. Surface textures. b. Hidden (phantom) lines. c. Geometric dimensions and tolerances. d. Datums. e. Moldings, forgings and castings.	**30%**
3. Explain the principles of geometric dimensioning and tolerancing.	**30%**
4. Perform basic drafting skills.	**20%**

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Unit: A9 Mechanical Components

Level: Two

Duration: 7 hours

Theory: 4 hours

Practical: 3 hours

Overview:

This unit of instruction is designed to introduce knowledge of mechanical components, their applications and procedures for use.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with mechanical components.	**5%**
2. Identify hazards and describe safe work practices pertaining to mechanical components.	**5%**
3. Identify types of fasteners, retainers and locators and describe their characteristics and applications. a. Bonds. b. Nuts. c. Dowel pins. d. Washers. e. Studs. f. Snap rings.	**5%**
4. Identify head styles of threaded fasteners and describe their characteristics and applications.	**5%**
5. Identify techniques used to torque fasteners and describe their associated procedures.	**5%**
6. Identify nut and bolt designs and describe their characteristics and applications.	**10%**
7. Identify grades of nuts and bolts and describe their characteristics and applications.	**5%**
8. Identify types of keys, keyseats and keyways and describe their characteristics and applications. a. Square. b. Woodruff. c. Flat/rectangular. d. Gib.	**5%**

e. Taper.

9.	**Explain the principles of stepped keys.**	**5%**
10.	**Describe the procedures used to hand broach keyways.**	**5%**
11.	**Identify types of bearings and bushings and describe their characteristics and applications.**	**20%**
12.	**Perform procedures used to hand broach keyways.**	**25%**

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Unit: A11 Heat Treatment

Level: Two
Duration: 12 hours
Theory: 8 hours
Practical: 4 hours

Overview:

This unit of instruction is designed to introduce knowledge of basic heat treatment and its applications.

Objectives and Content:	Percent of Unit Mark (%)
1. Define terminology associated with heat treatment.	**10%**
2. Identify hazards and describe safe work practices pertaining to heat treatment.	**10%**
3. Identify methods used to determine the carbon content of steels.	**10%**
4. Describe the procedures used to determine properties of metals. a. Chemical. b. Physical. c. Mechanical.	**10%**
5. Identify the processes used in the heat treatment of metals and describe their appliances. a. Annealing. b. Hardening. c. Normalizing. d. Stress relieving. e. Tempering.	**10%**
6. Identify and interpret technical data used in the heat treatment of metals. a. Charts. b. Tables.	**10%**
7. Identify methods used for hardening steel and describe the properties of the steel produced by each. a. Water hardening. b. Oil hardening. c. Air hardening. d. Case hardening.	**10%**
8. Identify methods used to heat treat metals and describe their associated	**10%**

procedures and equipment.

a. Flame.
b. Furnace.
c. Induction.

9. Perform basic heat treatment and applications. 20%

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Apprenticeship Manitoba

Machinist

Unit: A13 Introduction to Welding

Level: Two
Duration: 7 hours
Theory: 7 hours
Practical: 0 hours

Overview:

This unit of instruction is designed to introduce knowledge of basic welding processes used in machining operations and their applications.

Objectives and Content:	Percent of Unit Mark (%)
1. Define terminology associated with basic welding.	**10%**
2. Identify hazards and describe safe work practices pertaining to basic welding processes.	**30%**
3. Interpret codes and regulations pertaining to welding. a. Training and certification requirements.	**10%**
4. Identify welding processes and describe their characteristics and applications.	**20%**
5. Identify types of welding equipment and describe their applications.	**10%**
6. Describe the procedures used to perform basic welding and heating applications. a. Bending. b. Tacking.	**10%**
7. Describe the procedures used to perform basic oxy-fuel cutting.	**10%**
8. Describe the procedures used to inspect and store welding equipment.	**10%**

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Apprenticeship Manitoba

Machinist

Unit: A15 Orientation II: Journeywork

Level: Two

Duration: 21 hours

Theory: 14 hours

Practical: 7 hours

Overview:

Machinist technical training offers an entry-level orientation to the challenges of apprenticeship learning. The present unit introduces senior apprentices to the responsibilities of workplace *teaching* that they will assume as supervising journeypersons. Tradeworkers have a particularly rich tradition of refreshing and sharing their skills from one generation of practitioners to the next. This unit orients senior apprentices to some of the practical and conceptual tools that can enable them to contribute to this trade heritage when they themselves become certified journeypersons. The journeyperson's obligation to assist trade learners to develop skills and knowledge is complex and challenging. It involves safety considerations, employer expectations, provincial regulations, as well as the tradition of skills stewardship that links modern practice with the long history of workplace teaching and learning that defines the apprenticeable trades. The ability to offer timely, appropriate support to apprentices is itself an important area of trade learning. This unit presents material intended to help refine this ability through reflection and discussion by senior apprentices, and dialogue with their instructor. The detailed descriptors under each unit objective reflect Manitoba and Canadian standards prescribed for journey-level supervisory capabilities, as well as key topics in current research on the importance of workplace teaching and learning in trades-apprenticeship systems. Thus, descriptors represent suggested focal points or guidelines for potentially-worthwhile exploration. Delivery of this content will vary with the discretion of individual instructors, and with the experiences senior apprentices bring forward for group/individual reflection on the skills-stewardship dimension of their own future practice as journeypersons.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Describe the scope, substance, and significance of journey-level status.	**10%**

a. Historical background, including trainee experiences

- Origin, definition, and examples of journey-level status
- Obligations to employers, trade clients, and apprentices
- Concept of skills stewardship, and its rationale
- Customary responsibilities of journeyperson as workplace trainer/supervisor
- Overview development of formal systems for regulating/recognizing journey-level competence in designated apprenticeable trades
- Contributions of 'unticketed journeymen' and other informally-qualified Machinists to workplace trade-learning
- Achievements/limitations of informal systems for workplace training
- Trends (e.g., succession planning in the trades; recognition of credentials and prior learning; defined standards for on-the-job trades education and training)

b. Regulatory/legal dimensions of journey-level status in designated trades
   - Manitoba provincial requirements [e.g., *Apprenticeship and Certification Act; General Regulation*; the *Machinist Trade Regulation*; relevant policies of the Apprenticeship and Certification Board]
   - Trade-specific requirements re: practical training supervision and documentation; importance of quality assurance and broad-scope coverage of prescribed task-content; ratios, etc.

c. Other (as may be specified by instructor)

2. Compare/contrast role-options and responsibilities of the supervising journeyperson. **20%**

a. Recognizing the variability of supervision assignments, situations, and roles
b. Source and specification of the supervision assignment
c. Formal vs. informal roles (e.g., mandated by an employer's succession plan)
d. Implicit vs. explicit standards and content: training goals are/are not codified; assessment measures are/are not used,
e. Accountability for results: subject/not subject to third-party notification; completion of supervision assignment itself is/is not assessed by third party; journeyperson is/is not required to prepare performance evaluation that could affect apprentice's employability or wage-rate, etc.
f. General vs. task- or job-specific supervision assignments: e.g., scope of expectations re: content of supervisory task(s)
g. Long-term vs. short-run supervision assignments – e.g., considerable latitude/little latitude for apprentice to learn from mistakes
h. Formally vs. informally structured – e.g., supervision assignment is part of a prescribed cycle of assignments involving coordination among multiple journeypersons; apprentice is trained according to an individual training plan negotiated with employer
i. Typology of common supervisory role-options and what is implied by each:
   - Coach role: is often initiated by someone other than apprentice, and limited to a particular skill set, task, or production requirement
   - Mentor role : often initiated by apprentice, and relatively open-ended regarding content, duration, etc.
   - Peer role: typically involves individual upgrading or cross-training of one journeyperson by another; can include senior apprentice assisting less-experienced trade learner
   - Managerial role(s): can shade over into hire/fire issues as lead-hand or site-boss
   - Coordinator role: often a senior-level journeyperson appointed by an organization to assume responsibilities for monitoring progression of groups of apprentices
   - Other roles: may be improvised by journeyperson
j. Possibilities, perils, and likelihood of role-overlap in 'real-life' trade practice
k. Importance of clarifying all roles, expectations, and implications involved in accepting a supervision assignment
l. Role of Apprenticeship Training Coordinator (ATC), Apprenticeship Manitoba
m Resources for developing skills and knowledge re: providing journey-level supervision
   - Books and journals (not always trade-specific)
   - Websites
   - Conversation with trade instructors, journeypersons, and peers
   - Workshops
n. Other (as may be specified by instructor

3. Describe/demonstrate common requirements re: providing journey-level supervision. **20%**

a. Review Unit A1 content re: challenges/opportunities opportunities of Apprenticeship learning adapted to journey-level supervision assignments and a journey-level standpoint
   - Application of adult education concepts to trades teaching/learning (e.g., responsibilities and expectations of adult learners)
   - Practical significance of 'styles' of adult learning and teaching
   - Helping apprentices to integrate technical training (in school) and practical training (on-the-job) learning experiences
   - Providing help and guidance re: new tasks and skills
   - Providing help and guidance re: fixing mistakes
   - Learning/teaching "the ropes" – socialization of learner within a community of trade practice (e.g., how to borrow a tool, interrupt a journeyperson, 'recruit' an advisor)
   - Coverage/documentation of prescribed tasks and subtasks (Machinist POA), including responsibility re: logbook sign-off (where applicable)
   - Consultation with Apprenticeship Training Coordinator (ATC), Apprenticeship Manitoba
   - Communicating with apprentices and employers about supervision assignments and assignment specifications, including the limits of the trainers' own responsibilities and competence (e.g., substance-abuse intervention)
   - Benefits of maintaining a personal record of achievements, ideas, and needs as a workplace trainer

b. Individual reflection and guided group discussion re: personal experiences of workplace learning as an apprentice
   - Identification of best and worst practices of supervising journeypersons
   - Assessment of personal experiences (if any) to date in supervising, coaching, or guiding other people to learn or improve their skills (e.g., entry-level apprentices, members of athletic team, younger family members, etc.), and how this might compare/contrast with the journey-level support of apprenticeship learning
   - Identification of workplace and other factors that can contribute to good and bad trades teaching/learning experiences
   - Development of personal standards re: responsibility to share one's knowledge and skill with others in the workplace (e.g., use/misuse of humour, rigour, discretion, craft-pride, etc.)

c. Comparison/contrast of discussion results with current knowledge/resources re: workplace skills coaching methods as applicable to journey-level supervision assignments
   - Qualities of a good workplace coach
   - Components of workplace skills coaching
   - Processes and recommended practices re: workplace coaching
   - Troubleshooting problems re: supervision assignments

d. Other (as may be specified by instructor)

4. Complete Modules 1 to 3, *Workplace Coaching Skills* (or equivalent). **25%**

a. Identifying purpose of the lesson
   - Explaining the point of the lesson
   - Role of the coach in specific coaching situation
   - Other (specified by instructor)

b. Linking the lesson
   - Learner needs
   - Lesson sequence
   - Focus on learner
   - Selection/timing of coaching opportunities

c. Demonstration of skill/task to be learned
   - Starting the coaching session

- Demonstration
- Hands-on trial
- Recap for learner

5. Complete Modules 4 to 6, *Workplace Coaching Skills* (or equivalent). 25%

a. Practice of skill/task to be learned
   - Nature and importance of practice
   - Setting up for learner practice
   - Types of practice
   - Recycling and reinforcing skill/task learning

b. Providing feedback to the learner
   - Value of feedback
   - Kinds of feedback
   - Guidelines and tips

c. Assessment
   - Value of assessing learner progress
   - Assessing level of skill
   - Planning further steps toward skill/task mastery

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Apprenticeship Manitoba

Machinist

Unit: B2 Power Saws

Level: Two
Duration: 7 hours
Theory: 3 hours
Practical: 4 hours

Overview:

This unit of instruction is designed to introduce knowledge of saws, their applications, maintenance and procedures for use.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with power saws.	**10%**
2. Identify hazards and describe safe work practices pertaining to power saws.	**10%**
3. Identify types of saws and attachments and describe their applications. a. Vertical. b. Horizontal. c. Reciprocating/power hacksaws. d. Cold circular. e. Abrasive cutoff.	**10%**
4. Identify types of sawing operations and describe their associated procedures.	**10%**
5. Identify types of blades and describe their parameters, applications and installation procedures.	**10%**
6. Identify potential problems during sawing operations and describe their causes and remedies.	**10%**
7. Calculate speed and feed requirements.	**10%**
8. Describe the procedures used to inspect and maintain power saws.	**10%**
9. Perform sawing operations.	**20%**

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Apprenticeship Manitoba

Machinist

Unit: B3 Contour Bandsaws

Level: Two

Duration: 7 hours

Theory: 2 hours

Practical: 5 hours

Overview:

This unit of instruction is designed to introduce knowledge of power saws, their applications, maintenance and procedures for use.

Objectives and Content:		**Percent of Unit Mark (%)**
1.	**Define terminology associated with contour bandsaws.**	**5%**
2.	**Identify hazards and describe safe work practices pertaining to contour bandsaws.**	**10%**
3.	**Identify the components and accessories of contour bandsaws and describe their characteristics and applications.**	**5%**
4.	**Identify types of blades and describe their characteristics and applications.**	**10%**
5.	**Describe the procedures used to set up and operate contour bandsaws.** a. Irregular shapes. b. Internal/external counters.	**10%**
6.	**Calculate speed and feed requirements.**	**10%**
7.	**Describe the procedures used to butt weld bandsaw blades.**	**10%**
8.	**Describe the procedures used to inspect and maintain contour band saws.**	**5%**
9.	**Calculate the length of blade.**	**5%**
10.	**Perform contour bandsaw operations.**	**30%**

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Apprenticeship Manitoba

Machinist

Unit: B5 Cutting Machine Tools

Level: Two

Duration: 8 hours

Theory: 4 hours

Practical: 4 hours

Overview:

This unit of instruction is designed to introduce knowledge of cutting machine tools, their applications and procedures for use. It is also designed to introduce knowledge of cutting tool geometry and its use.

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Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with cutting machine tools.	**5%**
2. Identify hazards and describe safe work practices pertaining to cutting machine tools.	**5%**
3. Explain the principles of chip formation.	**15%**
4. Identify types of cutting machine tools and describe their characteristics and applications. a. Indexable insert. b. High speed steel (HSS). c. Braized Carbide.	**5%**
5. Identify types of cutting tool materials and describe their applications and procedures for use. a. Carbide. b. High speed steel (HSS). c. Ceramic.	**5%**
6. Explain tool geometry and its purpose.	**15%**
7. Describe the procedures used to sharpen cutting tools.	**8%**
8. Interpret the systems for the identification of carbide inserts/coatings and tool holders. a. American National Standards Institute (ANSI). b. International System of Units (SI).	**2%**
9. Describe the effect of carbide cutting tools on speed, feed and depth of cut.	**5%**

10.	**Identify types of carbide tool holding devices and describe their applications.**	**5%**
11.	**Demonstrate cutting tool geometry and its use.**	**30%**

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Apprenticeship Manitoba

Machinist

Unit: C2 Precision Measurement II

Level: Two

Duration: 7 hours

Theory: 3 hours

Practical: 4 hours

Overview:

This unit of instruction is designed to introduce knowledge of gauge blocks, their applications and procedures for use. It is also designed to introduce knowledge of angular measurement and its use.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Identify types and grades of gauge blocks and describe their applications and procedures for use. a. Metric. b. Imperial.	**10%**
2. Calculate and perform gauge block build-ups.	**30%**
3. Identify types of wear blocks and describe their purpose and applications.	**10%**
4. Explain the principles of angular measurement.	**10%**
5. Identify universal bevel protractors and describe their applications and procedures for use.	**10%**
6. Identify sine bars and describe their applications and procedures for use.	**10%**
7. Identify compound sine plates and describe their applications and procedures for use.	**10%**
8. Describe procedures used to maintain and store gauge blocks.	**10%**

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Apprenticeship Manitoba

Machinist

Unit: D4 Advanced Conventional Lathe Operation

Level: Two

Duration: 80 hours

Theory: 15 hours

Practical: 65 hours

Overview:

This unit of instruction is designed to introduce knowledge of turning contours and forms. It is also designed to introduce knowledge of advanced threading and multiple starts.

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Objectives and Content:	**Percent of Unit Mark (%)**
1. Explain the principles of form turning.	**5%**
2. Identify types of form turning tools and describe their characteristics and applications.	**5%**
3. Describe the procedures used to turn forms.	**5%**
4. Describe the procedures used to set up, position work and turn eccentrics.	**5%**
5. Identify types of threads, and describe their purpose, characteristics and applications. a. Specialty. • Acme. • Buttress. • Tapered pipe. • Straight pipe. • UN threads. b. Multiple start.	**15%**
6. Identify methods used to cut multiple start threads and describe their associated procedures. a. Slotted drive or faceplate. b. Indexing of the spindle gear. c. Use of thread chasing dial. d. Compound rest method.	**5%**

7.	**Identify methods used to cut specialty threads and describe their associated procedures.**	**5%**
8.	**Describe the procedures used to check and measure threads.**	**8%**
9.	**Perform threading operations.**	**50%**

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Apprenticeship Manitoba

Machinist

Unit: D5 Taper Turning

Level: Two

Duration: 17 hours

Theory: 7 hours

Practical: 10 hours

Overview:

This unit of instruction is designed to introduce knowledge of tapers, their attachments and applications. It is also designed to introduce knowledge of taper turning operations.

Objectives and Content:	**Percent of Unit Mark (%)**
1. Define terminology associated with taper turning.	**10%**
2. Identify hazards and describe safe work practices pertaining to taper turning.	**10%**
3. Identify types of tapers and describe their applications. a. Morse. b. Taper pin. c. Pipe thread taper. d. Machine taper.	**10%**
4. Identify types of taper attachments and describe their applications and procedures for use a. Plain. b. Telescopic.	**10%**
5. Calculate dimensions of tapers in metric and imperial.	**10%**
6. Identify methods used to turn tapers and describe their associated procedures. a. Taper attachment. b. Tailstock. c. Compound rest.	
7. Identify methods used to check tapers and describe their associated procedures. a. Plug gauge. b. Ring gauge. c. Sine bar. d. Layout lines. e. Dial indicator.	**10%**
8. Demonstrate methods used to turn tapers and associated procredures.	**30%**

Apprenticeship Manitoba

Machinist

Unit: E2 Conventional Milling Machine Operation

Level: Two

Duration: 75 hours

Theory: 15 hours

Practical: 60 hours

Overview:

This unit of instruction is designed to introduce knowledge of vertical milling machines, their set up, maintenance and procedures for use.

Objectives and Content:	Percent of Unit Mark (%)
1. Identify hazards and describe safe work practices pertaining to vertical milling machines.	**5%**
2. Describe the considerations used to determine speed, feed and depth of cut for vertical milling machine operations.	**2%**
3. Calculate speed, feed and depth of cut.	**3%**
4. Identify potential set up problems and describe their causes and remedies.	**3%**
5. Describe the procedures used to align vertical milling machine heads.	**2%**
6. Align vertical milling machine heads.	**2%**
7. Describe the procedures used to align workpieces.	**2%**
8. Align workpieces.	**3%**
9. Describe the procedures used to set up vertical milling machines to perform basic milling operations.	**3%**
10. Identify the considerations and requirements used for selecting tools and accessories for milling operations.	**3%**
11. Describe the procedures used to perform milling operations on vertical milling machines. a. Contouring. b. Pocketing. c. Boring. d. Reaming.	**10%**

e. Grooving.
f. Surfacing.
g. Drilling.
h. Tapping.
i. Countersinking.
j. Counterboring.
k. Chamfering.
l. Spotfacing.
m. Dovetailing.

12.	**Describe the procedures used to mill profiles using milling machines.**	**3%**
13.	**Describe the procedures used to perform gear cutting operations on milling machines.**	**2%**
14.	**Describe the procedures used to inspect and maintain milling machines.**	**2%**
15.	**Identify types of rotary tables and describe their construction, applications and procedures for use.**	**3%**
16.	**Identify types of dividing heads and describe their characteristics and applications.**	**2%**
17.	**Explain the principles and perform calculations involved in indexing.**	**3%**
18.	**Identify milling cutter failures and describe their causes and remedies.**	**2%**
19.	**Identify techniques used to troubleshoot vertical milling operations and describe their associated procedures.**	**5%**
20.	**Perform procedures used to set up vertical milling machines to perform basic milling operations.**	**40%**

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