

Tool and Die Maker Level 4

Tool and Die Maker

Unit: D1 Geometric Dimensioning and Tolerancing (GD and T)

Level: Four

Duration: 21 hours

Theory: 21 hours

Practical: 0 hours

Overview:

This unit of instruction is designed to provide the Tool and Die Maker apprentice with the knowledge and understanding of geometric dimensioning and tolerancing.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Identify symbols and terms:	5%
a. Geometric tolerancing.	
b. American National and International Standards: <ul style="list-style-type: none">• American National Standards.• ISO Standards.	
c. Common symbols: <ul style="list-style-type: none">• Common symbol application.• Dimension origin symbol.• Statistical tolerancing symbol.• Radius, controlled radius.	
d. Feature definition – with size and without size.	
e. Geometric characteristic symbols.	
f. Features and characteristics.	
g. Geometric tolerance zones.	
h. Feature control frame: <ul style="list-style-type: none">• Common symbols in a feature control frame.	
i. Material condition modifiers.	
2. Describe how the geometric system works:	5%
a. Limit of plus/minus tolerancing applied to angle block.	
b. Geometric tolerancing applied to angle block.	
c. Comparison- geometric and limit tolerancing.	
d. Material Condition Modifiers: <ul style="list-style-type: none">• Effect of MMC.• Effect of LMC.• Effect of RFS.• Effect of modifiers with zero tolerance.	
e. Applicability of material condition modifiers.	

- f. Modifier rules:
 - Current practice.
 - Former practice.
 - g. Rules for screw threads, gears and splines.
 - h. When to use the modifiers, MMC, LMC and RFS:
 - MMC application.
 - RFS application.
 - LMC application.
3. **Verify position tolerance:** **5%**
 - a. Position tolerancing verification:
 - Hole verification at MMC.
 - Hole verification at LMC.
 4. **Identify the fundamental concepts:** **5%**
 - a. Taylor Principle (Rule 1 or Envelope Principle).
 - B. Go-no go gauges for size.
 - c. Terms and definitions for individual features of size.
 - d. Actual size definitions.
 5. **Describe datum reference frame theory.** **20%**
 6. **Describe form tolerances:** **5%**
 - a. Plan for manufacture.
 - b. Plan for verification.
 7. **Describe orientation tolerances.** **5%**
 8. **Describe profile tolerances:** **20%**
 - a. Plan for manufacture.
 - b. Plan for verification.
 9. **Describe position tolerances:** **20%**
 - a. Plan for manufacture.
 - b. Plan for verification.
 - 10 **Identify the controls of runout, concentricity, and symmetry:** **5%**
 - a. Plan for manufacture.
 - b. Plan for verification.
 11. **Determine the tolerances for fixed and floating fasteners.** **5%**

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Unit: D2 Trade Mathematics II

Level: Four

Duration: 21 hours

Theory: 21 hours

Practical: 0 hours

Overview:

This unit consists of mathematical concepts and continues with computed measure of plane objects, drawing calculations and applied 3D trigonometry.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Identify computed measure (advanced): a. Perimeter. b. Area. c. Volume. d. Bend allowances.	20%
2. Identify chord lengths, arc lengths and chord heights.	20%
3. Identify draw die calculations (advanced).	20%
4. Identify Cartesian coordinate system.	20%
5. Identify applied trigonometry (advanced): a. Right triangles. b. Oblique triangles. c. 3-D applications.	20%

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Unit: D3 Trade Science II

Level: Four

Duration: 21 hours

Theory: 21 hours

Practical: 0 hours

Overview:

This unit of instruction consists of concepts of forces, heat treating principles and blanking pressures and cryogenics.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Identify strength of materials (advanced): a. Stress calculations. b. Strain calculations. c. Elasticity.	25%
2. Identify blanking pressures.	25%
3. Identify heat treatment of tool steels.	25%
4. Identify cryogenics.	25%

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Unit: D4 The Coordinate Measuring System

Level: Four

Duration: 7 hours

Theory: 4 hours

Practical: 3 hours

Overview:

This unit of instruction is designed to provide the Tool and Die Maker apprentice with information about the coordinate measuring system.

Objectives and Content:

Percent of Unit Mark (%)

1. Describe Coordinate Measuring System:

50%

- a. Principles and procedures for using coordinate measuring machines.
- b. Purpose and applications of the system and its advantages in use.
- c. Components and operation of the measuring unit.
 - Three basic components:
 - Machined spar with a calibrated grating.
 - Reading head.
 - Counter with a digital readout display.

2. Use Coordinate Measuring System.

50%

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Unit: D5 Computer Numerical Control (CNC) III - Operation

Level: Four

Duration: 21 hours

Theory: 21 hours

Practical: 0 hours

Overview:

This unit of instruction introduces the Tool and Die Maker Apprentice to the principles and practices related to the set up and operation of numerically controlled machine tools. Material covered includes history and advantages, principles of operation and applications.

Objectives and Content:

- 1. Describe the development of the computer as applied to the control of machine tools. 10%**
- 2. Describe the principles and applications of the Cartesian coordinates and guidelines for their use. 10%**
- 3. Describe the characteristics and advantages of CNC: 20%**
 - a. Machine tool movement.
 - b. Accuracy.
 - c. Reliability.
 - d. Repeatability.
 - e. Productivity.
 - f. Advantages.
- 4. Describe the main and secondary axis and the relationship between them 10%**
- 5. Describe the types of CNC machines, their characteristics and applications: 10%**
 - a. Size.
 - b. Turning centre.
 - c. Combination.
 - d. Vertical.
 - e. Horizontal.
- 6. Describe the types of accessories and tool changers associated with CNC machines: 10%**
 - a. Manual system.
 - b. Belts.
 - c. Track with tool pockets.
 - d. Rotary tables.

- e. Indexing heads.
7. **Describe the various types of tool holders and work holding devices used with CNC machines, their applications and procedures for use:** **10%**
- a. Conventional tool holders with set screws.
 - b. Tool holder heated electrically and shrinks around tool.
8. **Describe the procedures used for setting up the CNC centre:** **10%**
- a. Simple programming and program notes.
 - b. Setting part zero.
 - c. Setting tool offset.
 - d. Standard size machining centres.
9. **Identify Electrical Discharge Machining(EDM):** **10%**
- a. Use of EDM.
 - b. Principle of EDM.
 - c. Types of EDM circuits.
 - d. Electrode.
 - e. EDM process:
 - Servo mechanism.
 - Cutting current (amperage):
Characteristics of pulse-type circuits.
 - Discharge process.
 - Dielectric fluid:
Types of dielectrics.
Methods of circulating dielectrics.
 - Down through the electrode.
 - Up through the workpiece.
 - Vacuum flow.
 - Vibration.
 - Metal-removal rates.
 - Electrode (tool) wear.
 - Overcut.
 - Surface finish.
 - Advantages of EDM.
 - Limitations of EDM.
 - f. The Wire-Cut EDM machine:
 - EDM process.
 - Operating systems:
Servo mechanism.
Dielectric fluid.
Electrode.
Machine control unit.

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Unit: D6 Grinding Operations II

Level: Four

Duration: 21 hours

Theory: 0 hours

Practical: 21 hours

Overview:

This unit of instruction is designed to develop practical skills in the operating procedures associated with surface grinding operations.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Perform procedures used to plan the sequence for grinding operations.	10%
2. Perform procedures used to align grinder heads, tables and fixtures .	10%
3. Perform procedures used to select speeds, feeds and depth of cuts.	10%
4. Troubleshoot potential problems during grinding operations, their causes and remedies.	10%
5. Perform the procedures used to parallel grind an internal diameter.	10%
6. Perform procedures used for a toolpost grinder.	10%
7. Perform the procedures required to set up a tool and cutter grinder.	10%
8. Perform methods required for calculating, grinding and checking clearance angles:	10%
a. Tool and cutter grinding:	
• Types of machines.	
• Controls.	
• Operations.	
• Attachments.	
- Surface grinding.	
- Cylindrical grinding.	
- Internal grinding.	
- Gear cutter sharpening.	
- Small end mill.	
• Radius grinding.	
• Optical form grinding.	

- Jig grinding.
- Form grinding.

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| 9. Perform the procedures required to set up and sharpen a cutter using a tool and cutter grinder. | 5% |
| 10. Perform the procedures required to grind clearance angles: | 5% |
| a. Clearance grinding. | |
| b. Hollow grinding. | |
| c. Circle grinding. | |
| 11. Troubleshoot potential problems that might be encountered during operations, their causes and remedies. | 5% |
| 12. Perform preventative maintenance procedures for tool and cutter grinders. | 5% |

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Unit: D7 Advanced Die Making (Theory)

Level: Four

Duration: 42 hours

Theory: 42 hours

Practical: 0 hours

Overview:

This unit of instruction is designed to provide the Tool and Die apprentice with the knowledge and understanding of advanced tool and die making practices. The unit of instruction will consist of various topics as follows: progressive dies, forming, drawing, die design, secondary options, inverted compound style, forging dies, and more calculations as related to advanced die making.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Die design: a. Essential die-to-press relationships. b. Automatic feeds.	10%
2. Drawing operations: a. Draw dies. b. Redraw dies, combination dies. c. Computation procedures.	15%
3. Progressive dies: a. Blank-through principle. b. Chopoff principle. c. Parting principle.	15%
4. Forming.	15%
5. Secondary options: a. Dies to pierce, semipierce, shearform, form. b. Dies to notch, trim, shave, side-action dies.	15%
6. Perform the procedures required to set up and sharpen a cutter using a tool and cutter grinder.	15%
7. More calculations as related to advanced die making .	15%

Tool and Die Maker

Unit: D8 Advanced Die Making (Practical)

Level: Four

Duration: 85 hours

Theory: 0 hours

Practical: 85 hours

Overview:

This unit of instruction is designed to provide the Tool and Die apprentice with the practical application of advanced tool and die making practices.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Essential die-to-press relationships.	15%
2. Automatic feeds: a. Draw dies. b. Redraw dies, combination dies. c. Computation procedures.	10%
3. Inverted dies.	15%
4. Compound dies.	15%
5. Progressive dies: a. Blank-through principle. b. Chop-off principle. c. Parting principle.	15%
6. Secondary operations: a. Dies to pierce, semipierce, shearform, form. b. Dies to notch, trim, shave, side-action dies.	15%
7. Drawing operations: a. Draw dies. b. Redraw dies, combination dies. c. Drawing operations: computation procedures.	15%

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Unit: D9 Jigs and Fixtures (Theory)

Level: Four

Duration: 21 hours

Theory: 21 hours

Practical: 0 hours

Overview:

This unit of instruction is designed to provide the Tool and Die apprentice with the knowledge and understanding of jigs and fixtures, their characteristics, applications and associated procedures for use.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe specialty holding devices.	10%
a. The purpose of tool design as it relates to: <ul style="list-style-type: none">• Design economy.• Objectives.• Manufacturing.• Planning.	
b. Types, purpose and applications of jigs and fixtures.	
c. Principles of supporting and locating datums in relation to jigs and fixtures.	
d. Rules and procedures for locating multiple jigs and fixtures.	
e. Special clamping accessories, their purpose and procedures for use.	
2. Describe the purpose of tool design:	10%
a. Tool design.	
b. Tool design objectives.	
c. Tool design in manufacturing.	
d. Planning the design.	
3. Describe the types and functions of jigs and fixtures:	20%
a. Jigs and fixtures.	
b. Types of jigs.	
c. Types of fixtures.	
4. Identify supporting and locating principles:	20%
a. Referencing.	
b. Basic rules of locating.	
c. Planes of movement.	
d. Locating the work.	
5. Identify clamping and workholding principles:	10%
a. Workholders.	

- b. Basic rules of clamping.
 - c. Types of clamps.
 - d. Special clamping operations.
 - e. Clamping accessories.
- 6. Describe basic construction principles: 10%**
- a. Tool bodies.
 - b. Prefomed materials.
 - c. Drill bushings.
 - d. Set blocks.
 - e. Fastening devices.
- 7. Describe developing the initial design: 10%**
- a. Predesign analysis.
 - b. Designing around the human element:
 - Ergonomics.
 - Operator safety.
 - c. Previous machining operations.
 - d. Developing tooling alternatives.
 - e. Notetaking.
- 8. Interpret tool drawings: 10%**
- a. Tool drawings versus production drawings.
 - b. Simplified drawings.
 - c. Making the initial drawing.
 - d. Dimensioning tool drawings.
 - e. Metric versus English dimensioning.
 - f. Geometric dimensioning.

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Unit: D10 Jigs and Fixtures (Practical)

Level: Four

Duration: 41 hours

Theory: 0 hours

Practical: 41 hours

Overview:

This unit of instruction is designed to develop practical skills in the procedures associated with jigs and fixtures.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Design a project.	25%
2. Use clamping.	25%
3. Use locating.	25%
4. Analyzes and corrects jigs, fixtures and tooling faults.	25%

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Unit: D11 Journeyperson Trainer

Level: Four

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

Level 1 in-school technical training offers an entry-level orientation to the challenges of apprenticeship training as it relates to the development of core tasks and skill requirements, as well as social competencies. This unit introduces senior apprentices to the responsibilities of workplace training that they will assume as supervising journeypersons. Most trades have a rich tradition of refreshing and sharing their trade skills from one generation of trade practitioner 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 become certified journeypersons and, ultimately, journeyperson trainers.

The journeyperson's obligation to assist entry-level apprentices 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 and 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 discussion with their in-school instructor and journeyperson trainer.

This content reflects Manitoba and Canadian standards prescribed for journeyperson-level supervisory capabilities, as well as key topics in current research on the importance of workplace training in apprenticeship systems. These detailed descriptors represent suggested focal points or guidelines for potentially worthwhile exploration, and are neither mandatory nor exhaustive.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Compare/contrast role-options and responsibilities of the supervising journeyperson.	40%
a. Implicit vs. explicit standards and content: training goals are/are not codified; assessment measures are/are not used.	
b. Accountability for results: e.g. journeyperson is/is not required to prepare performance evaluation that could affect apprentice's employability or wage-rate, etc.	
c. Long-term vs. short-term supervision assignments – e.g., considerable latitude/little latitude for apprentice to learn from mistakes.	
d. 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.	
e. Types of supervisory role options and what is implied by each:	
• Journeyperson Trainer (JT) role: 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.
- 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, such as combination or multiple roles of the above.

2. Describe and demonstrate common requirements about providing journeyperson level supervision. 60%

- a. Apprenticeship learning adapted to journeyperson supervision assignments and a journeyperson perspective:
 - Application of adult education concepts to trades teaching and learning (e.g. responsibilities and expectations of senior-level apprentices).
 - Practical significance of 'styles' of adult learning and teaching.
 - Helping senior-level apprentices integrate in-school technical training and on-the-job practical training experiences.
 - Providing help and guidance about new tasks and skills.
 - Providing help and guidance about fixing mistakes.
 - Learning and teaching "the ropes" – socialization of apprentice within a community of trade practice (e.g. how to borrow a tool, interrupt a journeyperson, and seek advice of experienced co-workers).
 - Coverage and documentation of prescribed tasks and subtasks where applicable.
 - Discuss the limits of the journeyperson trainers' own responsibilities and competence (e.g. scope, willingness to train, etc.).
 - Benefits of maintaining a personal record of achievements, ideas, and needs as a journeyperson trainer (e.g. resume, portfolio, training credentials, logbook, etc.).
- b. Individual reflection and guided group discussion about personal experiences of workplace learning as an apprentice:
 - Identification of best and worst practices of journeyperson trainer.
 - Identification of workplace and other factors that can contribute to good and bad trades teaching/learning experiences.
 - Development of professional standards and work ethics about responsibility to share one's knowledge and skill with others in the workplace (e.g., use/misuse of humour, rigour, discretion, craft-pride, etc.).
 - Qualities of a good journeyperson trainer.
 - Components of workplace journeyperson training.
 - Processes and recommended practices re: journeyperson training.
 - Troubleshooting problems re: supervision assignments.
- c. Role of assessment in supervising, coaching, or guiding other people to learn or improve their skills (e.g. formative and summative evaluation), and how this might contribute to how the journeyperson-level supervision task is approached in future.
- d. Compare and contrast discussion results with current knowledge and resources about workplace training methods as they apply to journeyperson-level supervision assignments.
- e. Other (as may be specified by instructor).

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Unit: D12 Pre-Interprovincial Exam Review

Level: Four

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

This unit offers apprentices a systematic review of skills and knowledge required to pass the Interprovincial (IP) 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 the Interprovincial (IP) Examination.**
 - a. Scope and aims of Red Seal Occupational Standard (RSOS) Certification Examination system; value of certification.
 - b. Obligations and entitlements of candidates for RSOS certification:
 - Relevance of RSOS Certification Examination to current, accepted trade practices; industry-based national validation of test items.
 - Supplementals Policy (retesting) by the Apprenticeship Manitoba.
 - 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 Manitoba 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 RSOS Certification Examination for apprentice Tool and Die Makers:
 - Red Seal Occupational Standard (RSOS); prescribed scope of the skills and knowledge which comprise the trade.
 - RSOS "Pie-chart" and its relationship to content distribution of RSOS Examination items.
 - Manitoba Apprentice RSOS-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. Pre-Certification Review:
 - Describe the significance, format and general content of Inter-Provincial Red Seal Occupational Standard (RSOS) Examinations for the trade of Tool and Die Maker.
 - Identify resources, strategies and other considerations for maximizing successful completion of written examinations.
