

# Tool and Die Maker Level 4

## Tool and Die Maker

**Unit: B4 Geometric Dimensioning and Tolerancing**

**Level:** Four

**Duration:** 24 hours

Theory: 24 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:**

**Percent of  
Unit Mark (%)**

**1. Identify symbols and terms**

**5%**

- a. Geometric tolerancing
- b. American National and International Standards
  - American National Standards
  - ISO Standards
- c. Common symbols
  - 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
  - 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
  - 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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## Tool and Die Maker

**Unit:** C4 Trade Mathematics IV

**Level:** Four

**Duration:** 24 hours

Theory: 24 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.

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

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## Tool and Die Maker

**Unit:** D4 Trade Science IV

**Level:** Four

**Duration:** 24 hours

Theory: 24 hours

Practical: 0 hours

**Overview:**

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

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

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## Tool and Die Maker

**Unit: E4 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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## Tool and Die Maker

**Unit:** K5 Grinding Operations II

**Level:** Four

**Duration:** 20 hours

Theory: 0 hours

Practical: 20 hours

**Overview:**

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

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
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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|---|-----------|
| <b>9. Perform the procedures required to set up and sharpen a cutter using a tool and cutter grinder</b>          | <b>5%</b> |
| <b>10. Perform the procedures required to grind clearance angles:</b>   | <b>5%</b> |
| a. Clearance grinding   |           |
| b. Hollow grinding  |           |
| c. Circle grinding  |           |
| <b>11. Troubleshoot potential problems that might be encountered during operations, their causes and remedies</b> | <b>5%</b> |
| <b>12. Perform preventative maintenance procedures for tool and cutter grinders</b>                               | <b>5%</b> |

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## Tool and Die Maker

**Unit:** L3 Advanced Die Making (Theory)

**Level:** Four

**Duration:** 40 hours

Theory: 40 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
- more calculations as related to advanced die making

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Die design:</b> <ul style="list-style-type: none"><li>a. essential die-to-press relationships</li><li>b. automatic feeds</li></ul>	<b>10%</b>
<b>2. Drawing operations:</b> <ul style="list-style-type: none"><li>a. draw dies</li><li>b. redraw dies, combination dies</li><li>c. computation procedures</li></ul>	<b>15%</b>
<b>3. Progressive dies:</b> <ul style="list-style-type: none"><li>a. blank-through principle</li><li>b. chopoff principle</li><li>c. parting principle</li></ul>	<b>15%</b>
<b>4. Forming</b>	<b>15%</b>
<b>5. Secondary options:</b>	<b>15%</b>

- a. dies to pierce, semipierce, shearform, form
  - b. dies to notch, trim, shave, side-action dies
- 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%**

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## Tool and Die Maker

**Unit:** L4 Advanced Die Making (Practical)

**Level:** Four

**Duration:** 88 hours

Theory: 0 hours

Practical: 88 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.

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

- a. draw dies.
- b. redraw dies, combination dies.
- c. drawing operations: computation procedures

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## Tool and Die Maker

**Unit:** L5 Jigs and Fixtures (Theory)

**Level:** Four

**Duration:** 24 hours

Theory: 24 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:

### Percent of Unit Mark (%)

**1. Describe specialty holding devices.**

**10%**

- a. The purpose of tool design as it relates to:
  - 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:**

**25%**

- a. Jigs and fixtures
- b. Types of jigs
- c. Types of fixtures

- 4. Identify supporting and locating principles: 25%**
- 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. Preformed materials
  - c. Drill bushings
  - d. Set blocks
  - e. Fastening devices
- 7. Describe developing the initial design: 5%**
- 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: 5%**
- 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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## Tool and Die Maker

**Unit:** L6 Jigs and Fixtures (Practical)

**Level:** Four

**Duration:** 48 hours

Theory: 0 hours

Practical: 48 hours

**Overview:**

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

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
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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