

# Course Outline

Manufacturing and Product Development

REVISED: August/2017

**Job Title**  
Machinist

**77-85-50**

**Career Pathway:**  
Machining and Forming  
Technologies

**Machinist/1**

**Industry Sector:**  
Manufacturing and Product  
Development

**Credits:** 15

**Hours:** 180

**O\*NET-SOC CODE:**  
51-4041.00

**Course Description:**

This competency-based course is the first in a sequence of two designed for machine and forming technology. It provides students with project-based experiences in basic machining. Technical instruction includes an orientation, workplace safety policies and procedures, resource management, trade mathematics, and employability skills. Emphasis is placed on machine tools and materials, blueprint reading – part I, bench work, drilling machine operation, metal cutting operation, lathe operation, milling operation, grinding machine operation, heat treatment operation, and tool and die work operation, calculations, and layout. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

**CBEDS Title:**  
Machining and Forming  
Technologies

**Prerequisites:**

Enrollment requires reading level of 6.0 as measured by the CASAS GOALS test.

**CBEDS No.:**  
5635

**NOTE:** For Perkins purposes this course has been designated as an **introductory** course.

This course **cannot** be repeated once a student receives a Certificate of Completion.



## **COURSE OUTLINE COMPETENCY-BASED COMPONENTS**

A course outline reflects the essential intent and content of the course described. Acceptable course outlines have six components. (Education Code Section 52506). Course outlines for all apportionment classes, including those in jails, state hospitals, and convalescent hospitals, contain the six required elements:

(EC 52504; 5CCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

### **COURSE OUTLINE COMPONENTS**

### **LOCATION**

#### **GOALS AND PURPOSES**

Cover

The educational goals or purposes of every course are clearly stated and the class periods are devoted to instruction. The course should be broad enough in scope and should have sufficient educational worth to justify the expenditure of public funds.

The goals and purpose of a course are stated in the COURSE DESCRIPTION. Course descriptions state the major emphasis and content of a course, and are written to be understandable by a prospective student.

#### **PERFORMANCE OBJECTIVES OR COMPETENCIES**

pp. 8-17

Objectives should be delineated and described in terms of measurable results for the student and include the possible ways in which the objectives contribute to the student's acquisition of skills and competencies.

Performance Objectives are sequentially listed in the COMPETENCY-BASED COMPONENTS section of the course outline. Competency Areas are units of instruction based on related competencies. Competency Statements are competency area goals that together define the framework and purpose of a course. Competencies fall on a continuum between goals and performance objectives and denote the outcome of instruction.

Competency-based instruction tells a student before instruction what skills or knowledge they will demonstrate after instruction. Competency-based education provides instruction which enables each student to attain individual goals as measured against pre-stated standards.

Competency-based instruction provides immediate and continual repetition and In competency-based education the curriculum, instruction, and assessment share common characteristics based on clearly stated competencies. Curriculum, instruction and assessment in competency-based education are: explicit, known, agreed upon, integrated, performance oriented, and adaptive.

**COURSE OUTLINE COMPETENCY-BASED COMPONENTS**  
**(continued)**

<b>COURSE OUTLINE COMPONENTS</b>	<b>LOCATION</b>
<p><b>INSTRUCTIONAL STRATEGIES</b></p> <p>Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.</p> <p>Instructional strategies for this course are listed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructional strategies and activities for a course should be selected so that the overall teaching approach takes into account the instructional standards of a particular program, i.e., English as a Second Language, Programs for Adults with Disabilities.</p>	p. 19
<p><b>UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT</b></p> <p>The approximate time devoted to each instructional unit within the course, as well as the total hours for the course, is indicated. The time in class is consistent with the needs of the student, and the length of the class should be that it ensures the student will learn at an optimum level.</p> <p>Units of study, with approximate hours allotted for each unit are listed in the COMPETENCY AREA STATEMENT(S) of the course outline. The total hours of the course, including work-based learning hours (community classroom and cooperative vocational education) is listed on the cover of every CBE course outline. Each Competency Area listed within a CBE outline is assigned hours of instruction per unit.</p>	Cover pp. 8-17
<p><b>EVALUATION PROCEDURES</b></p> <p>The evaluation describes measurable evaluation criteria clearly within the reach of the student. The evaluation indicates anticipated improvement in performances as well as anticipated skills and competencies to be achieved.</p> <p>Evaluation procedures are detailed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructors monitor students' progress on a continuing basis, assessing students on attainment of objectives identified in the course outline through a variety of formal and informal tests (applied performance procedures, observations, and simulations), paper and pencil exams, and standardized tests.</p>	pp. 19-20
<p><b>REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT</b></p> <p>After a student has completed all the objectives of the course, he or she should not be allowed to reenroll in the course. There is, therefore, a need for a statement about the conditions for possible repetition of a course to prevent perpetuation of students in a particular program for an indefinite period of time.</p>	Cover

## ***ACKNOWLEDGMENTS***

Thanks to JOHN ALVAREZ for developing and editing this course outline. Acknowledgment is also given to ERICA ROSARIO for designing the original artwork for the course covers.

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**CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS**  
**Manufacturing and Product Development Industry Sector**  
**Knowledge and Performance Anchor Standards**

**1.0 Academics**

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Manufacturing and Product Development academic alignment matrix for identification of standards.

**2.0 Communications**

Acquire and accurately use Manufacturing and Product Design sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

**3.0 Career Planning and Management**

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

**4.0 Technology**

Use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the Manufacturing and Product Design sector workplace environment.

**5.0 Problem Solving and Critical Thinking**

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Manufacturing and Product Design sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

**6.0 Health and Safety**

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Manufacturing and Product Design sector workplace environment.

**7.0 Responsibility and Flexibility**

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Manufacturing and Product Design sector workplace environment and community settings.

**8.0 Ethics and Legal Responsibilities**

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

**9.0 Leadership and Teamwork**

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organizations.

**10.0 Technical Knowledge and Skills**

Apply essential technical knowledge and skills common to all pathways in the Manufacturing and Product Design sector, following procedures when carrying out experiments or performing technical tasks.

**11.0 Demonstration and Application**

Demonstrate and apply the knowledge and skills contained in the Manufacturing and Product Design anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organizations.

## ***Manufacturing and Product Development Pathway Standards***

### **B. Machining and Forming Technologies Pathway**

The Machine and Forming Technologies pathway provides students with an understanding of manufacturing processes and systems common to careers in machine tool and materials forming industries. Representative topics include: trade vocabulary; shop math; basic material identification; proper use of hand and machine tools; reading precision measuring tools within .001" and the interpretation of machined and formed-part prints; the cutting, shaping, fastening, and finishing of machined parts; fixtures: forging, molding (casting), cold forming, and shearing processes.

Sample occupations associated with this pathway:

- ◆ CAD/CAM Specialist
- ◆ CNC Machinist
- ◆ Manufacturing Engineer
- ◆ Materials/Supply Management Specialist
- ◆ Quality Assurance Technician

- B1.0 Validate that a provided part meets specifications from its engineering drawing by comparing specifications (geometric dimensioning and tolerancing) and by demonstrating proper technique using appropriate precision measuring tools.
- B2.0 Describe and layout a project according to specifications or engineering drawings. Demonstrate proper technique with layout tools and work-holding devices such as: three- and four-jaw chucks, collet chucks, angle plates, sine bars, parallels, and v-blocks to machine a real part.
- B3.0 Research and compare the properties of two metals using two different material specifications and a process specification.
- B4.0 Demonstrate a cutoff saw operation(s) to produce a length of bar stock to specification.
- B5.0 Demonstrate bending, shaping, other metal forming, and fabrication techniques, including processes such as basic hand filing, knurling on a lathe, forging metal shapes or objects, green sand casting, sheet metal machines, spot welding equipment or rivets, cold form bending with cold forming machinery or homemade devices, and shapes (tooling) to achieve a specific design specification.
- B6.0 Identify and select the right grinding wheel; perform wheel dressing; and grind the provided part/material to the size and surface finish specifications provided.
- B7.0 Perform a series of routine boring operations from a set of specifications or a drawing and explain the selection of proper tools (drill, reamer, countersink, spot facer, counter bore, tap, and center drill) for each step of the process.
- B8.0 Describe and demonstrate the machining of an external and internal taper, knurled part, and threaded and bored part on an engine lathe to plan specification or drawing to produce a part and measure each end diameter within tolerance.
- B9.0 Produce parts to specification using a boring head or angular cutting with a sine bar, a keyway, and pockets with a typical vertical mill.

- B10.0 Produce parts to specifications or drawings provided on a computer numerical controlled (CNC) mill or lathe. Demonstrate common functions or controls through manual input and through programmed (stored) input. Introduce basic G and M Code Programming focusing on the use of the Cartesian coordinate system and machine axis.
- B11.0 Understand and defend the purposes and processes of inspection and quality control in machining and forming processes.

**CBE**  
**Competency-Based Education**

**COMPETENCY-BASED COMPONENTS**  
**for the Machinist/1 Course**

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. ORIENTATION AND SAFETY</p> <p>Understand, apply, and evaluate classroom and workplace policies and procedures used in accordance with federal, state, and local safety and environmental regulations.</p> <p>(4 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe the scope and purpose of the course.</li> <li>2. Describe the overall course content as a part of the Linked Learning Initiative.</li> <li>3. Describe classroom policies and techniques.</li> <li>4. Describe the different occupations in the Manufacturing and Product Development Industry Sector which have an impact on the role of machinists.</li> <li>5. Describe the opportunities available for women in the machine and forming technology field.</li> <li>6. Describe the purpose of the California Occupational Safety and Health Administration (Cal-OSHA) and its laws governing machinists.</li> <li>7. Describe the impact of Environmental Protection Agency (EPA) legislation on the Manufacturing and Product Development Industry Sector techniques.</li> <li>8. Describe and demonstrate the techniques for contacting proper authorities for the removal of hazardous materials based on the EPA standards.</li> <li>9. Describe and demonstrate the use of the Material Safety Data Sheet (MSDS) as it applies to the machine and forming technology industry.</li> <li>10. Describe classroom and workplace first aid and emergency procedures according to American Red Cross (ARC) standards.</li> <li>11. Describe how each of the following insures a safe workplace:               <ol style="list-style-type: none"> <li>a. employees' rights as they apply to job safety</li> <li>b. employers' obligations as they apply to job safety</li> <li>c. role of the Division of Workers' Compensation (DWC)</li> <li>d. safe use and storage of flammable liquids, materials, and safety supplies</li> <li>e. wearing of eye protection</li> <li>f. removal of jewelry</li> <li>g. avoidance of loose clothing</li> <li>h. never leaving an operating machine unattended</li> <li>i. not stopping and starting a machine for someone else</li> <li>j. never leaving a chuck wrench in the chuck of a machine</li> </ol> </li> <li>12. Pass the safety test with 100% accuracy.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 3, 4, 5, 7, 9, 10, 12</p> <p><b>CTE Anchor:</b> Career Planning and Management: 3.2, 3.4, 3.5, 3.7, 3.9 Health and Safety: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8 Ethics and Legal Responsibilities: 8.1, 8.2, 8.3, 8.4 Leadership and Teamwork: 9.2, 9.3, 9.4 Technical Knowledge and Skills: 10.1, 10.2, 10.3 Demonstration and Application: 11.2</p> <p><b>CTE Pathway:</b> B1.1, B2.5, B3.1, B3.2, B4.1, B5.1, B5.6, B5.8, B6.1, B7.1, B7.4, B8.1, B8.2, B9.1, B10.1, B10.3</p>



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>B. RESOURCE MANAGEMENT</p> <p>Understand, apply, and evaluate the basic principles of resource management in the machine and forming technology business.</p> <p>(1 hour)</p>	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. resources</li> <li>b. management</li> <li>c. sustainability</li> <li>d. Critical Path Method (CPM)</li> </ol> </li> <li>2. Describe the management of the following resources in the machine and forming technology business:               <ol style="list-style-type: none"> <li>a. time</li> <li>b. materials</li> <li>c. personnel</li> </ol> </li> <li>3. Describe the following components of CPM and how they impact project management:               <ol style="list-style-type: none"> <li>a. work breakdown structure</li> <li>b. duration</li> <li>c. dependencies</li> </ol> </li> <li>4. List specific examples of effective management of the following in the machine and forming technology business:               <ol style="list-style-type: none"> <li>a. time</li> <li>b. materials</li> <li>c. personnel</li> </ol> </li> <li>5. Describe the benefits of effective resource management in the machine and forming technology business:               <ol style="list-style-type: none"> <li>a. profitability</li> <li>b. sustainability</li> <li>c. company growth</li> </ol> </li> <li>6. Describe the economic benefits and liabilities of managing resources in an environmentally responsible way.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 9, 10, 12</p> <p><b>CTE Anchor:</b> Problem Solving and Critical Thinking: 5.4 Responsibility and Flexibility: 7.1, 7.4, 7.6 Leadership and Teamwork: 9.1, 9.3 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B11.3, B11.4, B11.5, B11.6</p>
<p>C. TRADE MATHEMATICS</p> <p>Understand, apply, and evaluate the basic mathematical principles and procedures required for machine trades.</p>	<ol style="list-style-type: none"> <li>1. Describe the practical applications of math in the machining industry.</li> <li>2. Describe and demonstrate problem-solving techniques involving whole number problems, using arithmetic operations (addition, subtraction, multiplication, and division).</li> <li>3. Describe and demonstrate problem-solving techniques involving various fraction problems using arithmetic operations.</li> <li>4. Describe and demonstrate problem-solving techniques involving various decimal problems using addition, subtraction, multiplication, and division.</li> <li>5. Describe and demonstrate techniques for changing fractions to decimals.</li> <li>6. Describe and demonstrate techniques for changing decimals to fractions.</li> <li>7. Describe the English and metric systems of measuring length.</li> <li>8. Describe the English and metric systems of measuring weight.</li> <li>9. Describe the English and metric systems of measuring volume or capacity.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 4, 5</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B1.1, B1.2, B2.3, B2.4, B3.3</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(10 hours)	<ol style="list-style-type: none"> <li>10. Describe and demonstrate English and metric problem-solving techniques for various measuring problems using arithmetic operations.</li> <li>11. Describe and demonstrate English and metric measuring techniques of objects by using tools common to the trade.</li> <li>12. Express metric units in ascending and descending powers of ten.</li> <li>13. Convert the English numbering system to metric system.</li> <li>14. Convert metric system to English numbering system.</li> <li>15. Calculate square roots of English numbers.</li> <li>16. Describe and demonstrate problem-solving techniques for geometric problems.</li> <li>17. Describe and demonstrate problem-solving techniques for algebraic problems.</li> <li>18. Describe and demonstrate problem-solving techniques using percentages.</li> <li>19. Describe and demonstrate techniques for reading and interpreting graphs.</li> <li>20. Describe and demonstrate techniques for using a calculator.</li> </ol>	
<p>D. TOOLS</p> <p>Understand, apply, and evaluate the safe use, maintenance, and storage techniques for hand, measuring, and precision tools.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe and demonstrate the safe use, maintenance, and/or storage of the following hand tools: <ol style="list-style-type: none"> <li>a. open, box end and adjustable wrenches</li> <li>b. screwdrivers</li> <li>c. tap handles</li> <li>d. Allen wrenches</li> <li>e. files</li> <li>f. hammers and mallets</li> <li>g. vice grips</li> <li>h. pliers</li> <li>i. channel locks</li> <li>j. C clamps</li> <li>k. punches</li> <li>l. chisels: <ol style="list-style-type: none"> <li>i. flat</li> <li>ii. cape</li> <li>iii. round nose</li> <li>iv. diamond point</li> </ol> </li> </ol> </li> <li>2. Identify and demonstrate the proper use, maintenance, and storage of the following precision measuring tools: <ol style="list-style-type: none"> <li>a. steel rules</li> <li>b. calipers: <ol style="list-style-type: none"> <li>i. dial</li> <li>ii. digital/electronic</li> </ol> </li> <li>c. micrometers</li> <li>d. protractors</li> <li>e. depth gauges</li> <li>f. combination squares</li> <li>g. surface gauges</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Health and Safety: 6.3 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B1.1, B1.2, B1.3, B2.1, B2.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>E. MATERIALS</p> <p>Understand, apply, and evaluate ferrous and non-ferrous materials use in machine and forming technology.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. ferrous</li> <li>b. nonferrous</li> </ol> </li> <li>2. Differentiate between the two main classes of materials:               <ol style="list-style-type: none"> <li>a. ferrous alloys</li> <li>b. nonferrous alloys</li> </ol> </li> <li>3. List the following forms of material identification:               <ol style="list-style-type: none"> <li>a. the numbering system</li> <li>b. color codes</li> </ol> </li> <li>4. Describe how the two types of materials are used.</li> </ol>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B3.1, B3.2</p>
<p>F. BLUEPRINT READING</p> <p>Understand, apply, and evaluate the techniques used in deciphering blueprint or working drawings and assembly drawings, including information sections.</p> <p>(15 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify the following information blocks:               <ol style="list-style-type: none"> <li>a. title block</li> <li>b. material block</li> <li>c. tolerance block</li> <li>d. change block</li> <li>e. gear and spine data</li> <li>f. notes</li> </ol> </li> <li>2. Pass written test in dimensions of notes with a score of 80% or higher.</li> <li>3. Explain view or projections.</li> <li>4. Identify the following types of lines used:               <ol style="list-style-type: none"> <li>a. outline or visible</li> <li>b. section</li> <li>c. hidden</li> <li>d. center</li> <li>e. dimension</li> <li>f. cutting plane</li> <li>g. break line</li> </ol> </li> <li>5. Explain dimension using the following terms:               <ol style="list-style-type: none"> <li>a. fractional</li> <li>b. decimal</li> <li>c. regular</li> </ol> </li> <li>6. Explain tolerance using the following terms:               <ol style="list-style-type: none"> <li>a. fractional</li> <li>b. decimal</li> <li>c. regular</li> </ol> </li> <li>7. Identify symbols and abbreviations used in blueprint reading.</li> <li>8. Pass a written exam in orthographic projection with a score of 80% or higher.</li> </ol>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B1.1, B1.3, B2.1, B2.2, B2.3, B2.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>G. BENCH WORK</p> <p>Understand and apply bench work techniques.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify and describe the features and functions of the following types of files:               <ol style="list-style-type: none"> <li>a. single cut</li> <li>b. double cut</li> <li>c. bastard cut</li> <li>d. second cut</li> <li>e. smooth cut</li> </ol> </li> <li>2. Describe and demonstrate the use of taps and dies.</li> <li>3. Describe the use of lubricants.</li> <li>4. Identify the following:               <ol style="list-style-type: none"> <li>a. drill sizes</li> <li>b. types and sizes of vises</li> </ol> </li> <li>5. Describe the function of the jaws on a vise.</li> <li>6. Identify and describe the features and functions of the following types of reamers:               <ol style="list-style-type: none"> <li>a. hand</li> <li>b. expanding</li> <li>c. taper</li> </ol> </li> <li>7. Describe and demonstrate the following:               <ol style="list-style-type: none"> <li>a. using different types of hammers</li> <li>b. using a center punch</li> <li>c. using a drift punch</li> <li>d. using a prick punch</li> <li>e. laying out work</li> <li>f. sharpening of cutting edge of chisel</li> <li>g. chipping</li> <li>h. filing</li> <li>i. template making</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B2.1, B2.4, B5.1, B5.2, B7.1, B7.3, B7.5</p>
<p>H. DRILLING MACHINE OPERATION</p> <p>Understand and apply the techniques used in drilling machine operations.</p>	<ol style="list-style-type: none"> <li>1. Identify and describe the features and functions of the following:               <ol style="list-style-type: none"> <li>a. sensitive drill press</li> <li>b. vertical drill press</li> <li>c. radial drill press</li> <li>d. multi-spindle drill press</li> </ol> </li> <li>2. Describe the following drilling machine operations:               <ol style="list-style-type: none"> <li>a. drilling</li> <li>b. reaming</li> <li>c. boring</li> <li>d. counter-sinking</li> <li>e. counter boring</li> <li>f. spot-facing</li> <li>g. tapping</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B7.1, B7.3, B7.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(15 hours)	3. Demonstrate the following drilling machine operations: <ol style="list-style-type: none"> <li>a. drilling</li> <li>b. reaming</li> <li>c. boring</li> <li>d. counter-sinking</li> <li>e. counter boring</li> <li>f. spot-facing</li> <li>g. tapping</li> </ol>	
I. METAL-CUTTING OPERATION  Understand and apply the techniques used in metal-cutting operations.	<ol style="list-style-type: none"> <li>1. Identify and describe the features and functions of the following types of metal-cutting saws:               <ol style="list-style-type: none"> <li>a. power hack saws</li> <li>b. band saws</li> <li>c. circular-cut-off saws</li> </ol> </li> <li>2. Identify and describe the features and functions of the following parts of metal-cutting saws:               <ol style="list-style-type: none"> <li>a. butt welder</li> <li>b. blade guides</li> <li>c. alignment control</li> <li>d. speed and feed controls</li> </ol> </li> <li>3. Identify and describe the features and functions of the different types of metal-cutting saw blades.</li> <li>4. Identify various sawing operations:               <ol style="list-style-type: none"> <li>a. welding a blade</li> <li>b. splitting a line</li> <li>c. filing metal</li> <li>d. sheet metal sawing</li> <li>e. contour sawing</li> </ol> </li> <li>5. Describe and demonstrate the different types of sawing operations using metal-cutting saws.</li> </ol>	<b>Career Ready Practice:</b> 1  <b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1  <b>CTE Pathway:</b> B4.1, B4.2
J. LATHE OPERATIONS  Understand and apply the techniques used in lathe operations.	<ol style="list-style-type: none"> <li>1. Describe the following types of lathes:               <ol style="list-style-type: none"> <li>a. engine lathe</li> <li>b. turret lathe</li> <li>c. automatic chucker</li> </ol> </li> <li>2. Describe the six principal parts of a lathe:               <ol style="list-style-type: none"> <li>a. headstock</li> <li>b. tailstock</li> <li>c. quick change gear box</li> <li>d. apron</li> <li>e. carriage</li> <li>f. compound rest</li> </ol> </li> <li>3. Use the following feeds and speeds:               <ol style="list-style-type: none"> <li>a. rough</li> <li>b. finish turning</li> <li>c. thread cutting</li> </ol> </li> <li>4. Identify the following machining operations:               <ol style="list-style-type: none"> <li>a. tool grinding</li> </ol> </li> </ol>	<b>Career Ready Practice:</b> 1  <b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1  <b>CTE Pathway:</b> B2.5, B5.3, B7.5, B8.1, B8.2, B8.3

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(20 hours)	<ul style="list-style-type: none"> <li>b. center alignment-test bar</li> <li>c. filing and deburring</li> <li>d. drilling and reaming</li> <li>e. straight turning and shouldering</li> <li>f. use of cut-off tool</li> <li>g. knurling</li> <li>h. turning taper and angles using compound rest</li> </ul> <p>5. Demonstrate various machining operations.</p>	
<p>K. MILLING OPERATION</p> <p>Understand and apply the techniques used in milling operations.</p>	<ul style="list-style-type: none"> <li>1. Identify two types of milling machines: <ul style="list-style-type: none"> <li>a. vertical</li> <li>b. horizontal</li> </ul> </li> <li>2. Identify and describe the features and functions of the following parts of a milling machine: <ul style="list-style-type: none"> <li>a. column</li> <li>b. knee table</li> <li>c. over arm</li> <li>d. speed and feed dials</li> <li>e. spindle and arbors</li> <li>f. directional feed levers</li> </ul> </li> <li>3. Identify and describe the features of the following holding devices: <ul style="list-style-type: none"> <li>a. T-slots</li> <li>b. straps</li> <li>c. clamps</li> <li>d. blocks and jacks</li> <li>e. stops</li> <li>f. V-blocks</li> <li>g. single plates</li> <li>h. parallels</li> <li>i. plain vise</li> <li>j. swivel vise</li> <li>k. indexing head</li> <li>l. dividing head</li> <li>m. rotary table</li> </ul> </li> <li>4. Identify and describe the features and functions of the following cutting tools: <ul style="list-style-type: none"> <li>a. plain cutters</li> <li>b. slab cutters</li> <li>c. side-milling cutters</li> <li>d. face mills</li> <li>e. form cutters</li> <li>f. end mills</li> <li>g. fly cutters</li> <li>h. metal-slitting saws</li> <li>i. keyway cutters</li> </ul> </li> </ul>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B2.1, B2.2, B4.1, B4.2, B9.1, B9.2, B9.3, B9.4</p>



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>M. HEAT TREATMENT OPERATION</p> <p>Understand and apply the techniques used in heat treatment operations.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify the purpose of heat treating.</li> <li>2. Define the following:               <ol style="list-style-type: none"> <li>a. flame hardening</li> <li>b. induction hardening</li> <li>c. case hardening</li> </ol> </li> <li>3. Describe and demonstrate the following processes:               <ol style="list-style-type: none"> <li>a. flame hardening</li> <li>b. induction hardening</li> <li>c. case hardening</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> B5.4, B5.6</p>
<p>N. TOOL AND DIE WORK OPERATION</p> <p>Understand and apply the techniques used in tool and die work operations.</p> <p>(15 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify common processes used in tool and die work.</li> <li>2. Describe the importance of following engineering directions in tool and die work.</li> <li>3. Describe and demonstrate tool and die work processes.</li> </ol>	<p><b>Career Ready Practice:</b> 1</p> <p><b>CTE Anchor:</b> Technical Knowledge and Skills: 10.1, 10.2, 10.3</p> <p><b>CTE Pathway:</b> B2.5</p>
<p>O. EMPLOYABILITY SKILLS</p> <p>Understand, apply, and evaluate the employability skills required in the machining industry.</p>	<ol style="list-style-type: none"> <li>1. Describe employer requirements for the following:               <ol style="list-style-type: none"> <li>a. punctuality</li> <li>b. attendance</li> <li>c. attitude toward work</li> <li>d. quality of work</li> <li>e. teamwork</li> <li>f. responsibility</li> <li>g. timeliness</li> <li>h. communication skills</li> </ol> </li> <li>2. Identify potential employers through traditional and internet sources.</li> <li>3. Describe the role of social media in job search.</li> <li>4. Design sample résumés and cover letters.</li> <li>5. Describe the importance of filling out a job application legibly, with accurate and complete information.</li> <li>6. Complete sample job application forms correctly.</li> <li>7. Describe the importance of enthusiasm in the interview and on a job.</li> <li>8. Describe the importance of appropriate appearance in the interview and on a job.</li> <li>9. Describe the importance of the continuous upgrading of job skills.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 3, 7</p> <p><b>CTE Anchor:</b> Communications: 2.3, 2.4, 2.5 Career Planning and Management: 3.3, 3.4, 3.7, 3.9 Responsibility and Flexibility: 7.2, 7.7 Leadership and Teamwork: 9.2, 9.3 Technical Knowledge and Skills: 10.1</p>



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(5 hours)	<ul style="list-style-type: none"> <li>10. Describe customer service as a method of building permanent relationships between the organization and the customer.</li> <li>11. Describe and demonstrate appropriate interviewing techniques.</li> <li>12. Identify the informational materials and resources needed to be successful in an interview.</li> <li>13. Design sample follow-up letters.</li> <li>14. Describe and demonstrate appropriate follow-up procedures.</li> </ul>	<p><b>CTE Pathway</b> B11.5</p>

## ***SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES***

### **TEXTBOOKS**

Boothroyd, Geoffrey and Winston A. Knight. Fundamentals of Machining and Machine Tools, 3<sup>rd</sup> Edition. Taylor and Francis, Inc. November 2005.

Oberg, Erik, Franklin D. Jones, Holbrook L. Horton, et al. Machinery's Handbook, 27<sup>th</sup> Edition. Industrial Press, Inc. April 2004.

Taylor, David L. Elementary Blueprint Reading for Machinist, 5<sup>th</sup> Edition. Cengage Learning, June 2003.

Walker, John R. Machining Fundamentals. Goodheart-Wilcox Publisher, January 2004.

### **RESOURCES**

Employer Advisory Board members

CTE Model Curriculum Standards for Manufacturing and Product Development:

<http://www.cde.ca.gov/ci/ct/sf/documents/manproddev.pdf>

[National Tooling and Machining Association \(NTMA\)](#), 9300 Livingston Rd., Fort Washington, MD 20744. Phone: (800) 248-6862.

[Precision Machined Products Association \(PMPA\)](#), 6700 West Snowville Rd., Brecksville, OH 44141-3292. Phone: (440) 526-0300. Fax: (440) 526-5803.

[Precision Metalforming Association Educational Foundation \(PMAEF\)](#), 6363 Oak Tree Blvd., Independence, OH 44131-2500. Phone: (216) 901-8800. Fax: (216) 901-9190.

### **COMPETENCY CHECKLIST**

## ***TEACHING STRATEGIES and EVALUATION***

### **METHODS AND PROCEDURES**

- A. Lectures and discussions
- B. Demonstrations and participation
- C. Multimedia presentations
- D. Individualized instruction
- E. Role-playing
- F. Guest speakers
- G. Field trips and field study experiences
- H. Projects

### **EVALUATION**

SECTION A – Orientation and Safety – Pass the safety test with 100% accuracy.

SECTION B – Resource Management – Pass all assignments and exams on resource management with a minimum score of 80% or higher.

SECTION C – Trade Mathematics – Pass all assignments and exams on trade mathematics with a minimum score of 80% or higher.

SECTION D – Tools – Pass all assignments and exams on tools with a minimum score of 80% or higher.

SECTION E – Materials– Pass all assignments and exams on materials with a minimum score of 80% or higher.

SECTION F – Blueprint Reading– Pass all assignments and exams on blueprint reading with a minimum score of 80% or higher.

SECTION G – Bench Work – Pass all assignments and exams on bench work with a minimum score of 80% or higher.

SECTION H – Drilling Machine Operation– Pass all assignments and exams on drilling machine operation with a minimum score of 80% or higher.

SECTION I – Metal-Cutting Operation– Pass all assignments and exams on metal-cutting operation with a minimum score of 80% or higher.

SECTION J – Lathe Operation– Pass all assignments and exams on lathe operation with a minimum score of 80% or higher.

SECTION K – Milling Operation– Pass all assignments and exams on milling operation with a minimum score of 80% or higher.

SECTION L – Grinding Machine Operation– Pass all assignments and exams on grinding-machine operation with a minimum score of 80% or higher.

SECTION M – Heat Treatment Operation– Pass all assignments and exams on heat-treatment operation with a minimum score of 80% or higher.

SECTION N – Tool and Die Work Operation– Pass all assignments and exams on tool and die work operation with a minimum score of 80% or higher.

SECTION O –Employability Skills – Pass all assignments and exams on employability skills with a minimum score of 80% or higher.

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### Statement for Civil Rights

All educational and vocational opportunities are offered without regard to race, color, national origin, gender, or physical disability.

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