Industrial Maintenance Technology I

8575 36 weeks / 140 hours

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Acknowledgments

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Course Description

Suggested Grade Level: 10 or 11

Industrial maintenance technicians repair and maintain commercial or industrial equipment in buildings. Students are taught safety and precision measurement skills and gain hands-on, practical experience in mechanical fundamentals, technical drawing, and welding.

As noted in Superintendent's Memo #058-17 (2-28-2017), this Career and Technical Education (CTE) course must maintain a maximum pupil-to-teacher ratio of 20 students to one teacher, due to safety regulations. The 2016-2018 biennial budget waiver of the teacher-to-pupil ratio staffing requirement does not apply.

Task Essentials Table

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.

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Performing Welding Operations

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Working with Technical Drawings

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Exploring Careers

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Legend: ☑Essential ☒Non-essential ☐Omitted

Curriculum Framework

Applying Basic Construction Safety Standards (Core Safety)

Task Number 39

Comply with federal, state, and local safety legal requirements, including the Occupational Safety and Health Administration (OSHA), Virginia Occupational Safety and Health (VOSH) Program, and Environmental Protection Agency (EPA).
Definition

Compliance should include the identification of the Hazard Communication Standard (HazCom), the information included on safety data sheets (SDS), and the responsibilities of employers and employees under HazCom.

Process/Skill Questions

- Where should hazardous materials be stored?
- What information can be found on an SDS?

Task Number 40

Maintain a safe working environment.

Definition

Maintenance should be ongoing and result in identifying potential hazards on a job site or in the lab, such as unstable or improperly erected scaffolding, electrical hazards, job site debris, improperly stored materials, and air quality hazards and when present, must be remedied by appropriate measures and comply with the school's and instructor's guidelines.

Process/Skill Questions

- What are some examples of job-site hazards?
- Why is it important to use good housekeeping standards on a job site?
- Why is it important to store materials and tools in their proper place?

Task Number 41

Explain safe working practices around electrical hazards.

Definition

Explanation includes

- identifying equipment used to test electrical circuits
- describing safe working conditions
- demonstrating safe work habits

according to industry standards and instructor guidelines.
Process/Skill Questions

- What are some examples of electrical hazards?
- What are some methods of testing electrical circuits?
- How are electrical hazards discovered and remedied?

Task Number 42

Identify emergency first-aid procedures.

Definition

Identification includes first-aid procedures for accidents involving

- body fluids
- electrical injuries
- eye injuries
- falls
- sprains and strain of limbs
- burns

according to standard first-aid and school policies.

Process/Skill Questions

- How do citizens obtain emergency medical assistance in their own locality?
- What are the contents of a standard first-aid kit?
- What are the symptoms of shock?
- What universal precautions should be taken by first-aid providers?

Task Number 43

Identify the types of fires and the methods used to extinguish them.

Definition

Identification should include

- classifications of fires (A, B, C, D, and K)
- causes and prevention of fires
• types of extinguishers
• extinguishers associated with types of fires.

Process/Skill Questions

• Why do fires have different classifications, and what are they?
• What is the fire triangle?
• What are the three things needed to start a fire?
• Why is it important to know the classification of a fire when trying to extinguish it?
• Why should extinguishers be inspected, and how often should they be inspected?
• What are the classifications of extinguishers?

Task Number 44

Demonstrate the use of a fire extinguisher.

Definition

Demonstration should include the use of the pull, aim, squeeze, sweep (PASS) method.

Process/Skill Questions

• Why is important to know how to use a fire extinguisher?
• When might you have to use a fire extinguisher while welding?

Task Number 45

Identify personal protective equipment (PPE) requirements.

Definition

Identification should include procedures for donning, wearing, and removing PPE (e.g., eye protection, respirator, hard hat, gloves, safety harness, hearing protection, safety shoes steel-toed/leather boots).

Process/Skill Questions

• What are some dangerous effects of exposure, and how can one significantly prevent these effects?
• Why is wearing jewelry prohibited while in the lab or on the job site?
Task Number 46

Describe ventilation requirements and regulations pertaining to welding procedures and materials.

Definition

Description should include determining

- the ventilation system and heating/cooling system in the work area
- the need for a personal breathing apparatus when welding in confined spaces or using fume extractors.

Process/Skill Questions

- What is your welding shop's ventilation system? What are its components?
- Why should there always be a clean supply of fresh air available?
- How do you decide when you should use a personal breathing apparatus when completing welding tasks?

Task Number 47

Inspect hand and power tools to ensure safety and usability.

Definition

Inspection should include

- verifying that components of machinery (e.g., guards, blades, moving parts, start/stop switches) are in good working condition
- identifying any defects in tools, parts, or functions
- adhering to standard safety procedures (i.e., shop practices and manufacturer's recommendations)
- demonstrating the safe operation and use of all welding equipment, tools, and machines.

Process/Skill Questions

- What are some of the basic power tools used in construction?
- What are the proper actions to take before using a power circular saw?
- Why should a power tool always be grounded?
Task Number 48

Demonstrate lifting and carrying techniques.

Definition

Demonstration involves lifting and carrying materials and equipment based on the principles of

- lifting with legs
- keeping back straight
- holding load close to the body
- getting help if necessary

completed in accordance with government regulations and instructor guidelines.

Process/Skill Questions

- What are some common injuries associated with lifting and carrying?
- What are some devices that assist lifting and carrying?

Task Number 49

Identify types of ladders.

Definition

Identification should include

- wall (straight) ladder
- extension ladder
- roof ladder
- attic ladder
- special-purpose ladders (e.g., "A" ladder, folding ladder, pompier ladder)
- solid beam ladder
- truss beam wood ladder
- aluminum ladder
- wood and aluminum truss ladder
- fiberglass ladder.

Process/Skill Questions

- When would you use a wall ladder? Extension ladder?
Task Number 50

Demonstrate safe laddering techniques for various types of ladders.

Definition

Demonstration should involve using appropriate conduct and safety procedures while using aluminum ladders (e.g., three-point contact), while carrying ladders (e.g., two people at all times) and erecting and setting ladders.

Process/Skill Questions

- Why are ladders rated for certain weights?
- Why is the apex (highest point) of a step ladder not considered a step?

Task Number 51

Describe safe scaffolding techniques.

Definition

Description should include inspecting settings and identifying and adhering to duty ratings and safety tags.

Process/Skill Questions

- How can one determine the safe weight limit of any particular scaffolding?
- In what situations is scaffolding preferred or required?

Task Number 52

Report injuries.

Definition
Report should consist of an immediate oral statement of the job-related or non-job-related injury to the instructor or supervisor, which may be followed by a written confirmation reporting the date, extent of the injury, and circumstances of the incident.

**Process/Skill Questions**

- Why is it important to report injuries?
- What are common reporting procedures?
- Why is it important to report an injury promptly, before leaving the job site?
- What is workers’ compensation?
- What are the key components of a report?

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**Task Number 53**

**Report personal, environmental, and equipment safety violations to the appropriate authority.**

**Definition**

Report should include

- providing an oral or written statement identifying the violation and the date it was observed
- submitting it to the instructor, supervisor, or local OSHA inspectors.

**Process/Skill Questions**

- What ethical considerations might be involved when reporting coworkers?
- Why is it important to follow reporting procedures?
- What is liability?

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**Task Number 54**

**Earn the OSHA 10 card.**

**Definition**

Earning an OSHA 10 card requires completing the formal training program.
Process/Skill Questions

- What are the benefits of earning the OSHA 10 card?
- What is OSHA, and how are its standards validated?
- Why was OSHA established, and how has it evolved?

Task Number 55

Pass the safety exam.

Definition

Passing the safety exam, when complemented with the OSHA 10 card, should allow the instructor to approve the student for working with course materials and equipment.

Process/Skill Questions

- How often should one participate in safety training programs? Why?
- How does insurance impact the requirement of continuous retraining for safety?
- What is workers’ compensation?

Performing Mathematical Calculations Related to Measurement

Task Number 56

Perform calculations using fractions.

Definition

Calculations include addition, subtraction, multiplication, and division of fractions, particularly when performing measurements and reading blueprints.

Process/Skill Questions

- What are some examples of situations in which calculations with fractions are necessary?
• Why might it be useful to calculate fractions when reading blueprints?
• How can technology be an aid when calculating fractions?

Task Number 57

Convert between fractions and decimals.

Definition

Conversions are made when performing measurements and reading blueprints. Using a calculator, the student will convert fractions to decimals and convert decimals to the nearest fraction of an inch as read from a machinist’s scale.

Process/Skill Questions

• What are some examples of situations in which conversions between fractions and decimals are necessary?
• What are some possible consequences of improper conversions?

Task Number 58

Use geometric functions.

Definition

Geometric functions are used when performing lay out or setup to calculate measurements such as

• angles
• linear distances
• volume
• perimeter
• diameter
• circumference.

Process/Skill Questions

• In what situations might it be necessary to calculate diameter?
• What methods are used to measure linear distances?
• What tools assist the measurement of angles?
Task Number 59

Make metric measurements and conversions.

Definition

Performance includes reading a print with metric dimensions and

- converting to inch-based measurements
- making linear measurements with metric measuring tools
- converting between metric and U.S. systems.

Process/Skill Questions

- In what types of situations is it necessary to convert U.S. system measurements to metric?
- Why is it necessary to know how to read a print with metric dimensions?
- What are some examples of metric measuring tools?

Task Number 60

Make linear measurements accurately to 1/16".

Definition

Performance includes

- measuring a machined part using a six-inch steel rule with 1/16” gradations
- recording the dimensions appropriately
- as if performing an inspection.

Process/Skill Questions

- What are some consequences of failure to record dimensions appropriately?
- What are some common mistakes made when measuring machined parts?
- How are measurements used when performing inspections?

Task Number 61
Use a micrometer to measure accurately to .001".

**Definition**

Performance includes

- measuring parts or gauge blocks accurately using a micrometer equipped with a Vernier
- recording the dimensions

as if performing an inspection.

**Process/Skill Questions**

- How are adjustments made to a micrometer?
- What are some necessary considerations when using a micrometer?
- What are some unique characteristics of the micrometer?

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**Task Number 62**

Use a dial caliper to measure accurately to .001".

**Definition**

Performance includes

- measuring length, depth, and inside and outside dimensions of a part accurately using a dial caliper
- recording the dimensions

as if performing an inspection.

**Process/Skill Questions**

- In what situations is a dial caliper preferred to a micrometer for measuring machined parts?
- Why might it be important to measure inside dimensions? Outside dimensions?

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**Task Number 63**
Use combination squares and protractors.

Definition

Usage involves measuring and laying out angles and dimensions using squares and protractors.

Process/Skill Questions

• How might one apply the angle measurements obtained with a protractor?
• What are the consequences of incorrectly measuring an angle?
• What types of angles are drawn using a square?

Task Number 64

Calculate speeds and feeds for machine tools.

Definition

Performance includes using a chart of cutting speeds for various materials to

• calculate rpm and feed rates for machine tools
• determine machining time based on removing a given amount of stock to form a part according to a print.

Process/Skill Questions

• How is the cutting speed chart used to calculate speeds?
• What are consequences of miscalculating a feed rate?
• How does calculating speed and feed help to determine machining time?

Demonstrating Mechanical Skill with Hand and Power Tools

Task Number 65
Select appropriate hand tools.

Definition

The identification, selection, and use of hand tools must be appropriate for a given application. Consideration must be given to the selection of tools available, safety, and quality of work being performed. Tools should include

- hammers of various types
- screwdrivers for various applications, including torx, square, and hex drive tools
- ratchets & sockets (metric and standard, shallow & deep, various drive sizes)
- drive tools
- impact tools
- pliers of all sizes and descriptions
- vise grip tools
- plumbing wrenches
- specialty tools.

Process/Skill Questions

- What are consequences of selecting an inappropriate tool for a job?
- When is it necessary to use metric tools? Standard tools?
- What safety issues should be considered when selecting tools?

Task Number 66

Cut stock accurately with a hand hacksaw.

Definition

Selection and appropriate use of a hacksaw includes

- metal identification
- blade selection
- safety
- accuracy.

Process/Skill Questions

- What methods are used for identifying metal?
- What characteristics are considered when selecting a hacksaw blade?
- What safety precautions should be taken when using a hacksaw?
Task Number 67

Thread pipe with hand tools.

Definition

Performance includes

- identifying and using various types of fixed and adjustable tapered pipe thread dies to properly thread pipe
- selecting and using appropriate lubricants.

Process/Skill Questions

- When is it necessary to use a hand tool to thread pipe?
- What considerations influence the choice of tools to use?
- How do some lubricants differ from others?

Task Number 68

Use a file to de-burr, radius, and chamfer parts.

Definition

Performance includes

- identifying files and making appropriate selections for a given filing task
- safe and accurate de-burring of parts
- safe and accurate cutting of radii and chamfers on mechanical components.

Process/Skill Questions

- What characteristics of a part determine the appropriate file to select?
- How does one ensure safety when de-burring parts with a file?
- What preparation steps are necessary before cutting radii and chamfers?

Task Number 69
Use punches and chisels properly.

Definition

Performance includes identifying punches and chisels and using them safely and appropriately. Types of punches include

- center
- prick
- pin
- transfer
- alignment.

Chisel use includes cold chisel size selection, use, and proper sharpening technique.

Process/Skill Questions

- What are consequences of failure to sharpen chisels on a regular basis?
- What machining tasks require the use of a punch?

Task Number 70

Select appropriate power tools.

Definition

The identification, selection, and use of power tools must be appropriate for a given application. Consideration must be given to the selection of tools available, and to the safety, quality, and accuracy of work being performed.

Process/Skill Questions

- How does power supply influence the selection of power tools?
- What safety precautions should be taken when using power tools?
- Do power tools allow for greater accuracy than hand tools? Why, or why not?

Task Number 71

Use light-duty and heavy-duty drills.
**Definition**

Usage includes drilling a variety of materials such as light- and heavy-gauge ferrous and non-ferrous metals, plastics, and wood. Drill types include

- cordless
- masonry
- variable-speed
- heavy-duty.

**Process/Skill Questions**

- Why is it important to analyze the material before choosing the appropriate drill bit?
- What are the benefits and drawbacks of cordless drills?
- What qualifies a drill as “heavy-duty”?

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**Task Number 72**

**Use hand grinders.**

**Definition**

Usage includes

- selecting appropriate grinding wheels for various applications
- inspecting wheels routinely
- servicing equipment.

**Process/Skill Questions**

- What types of jobs require use of hand grinders?
- What should one look for when inspecting a grinder wheel?
- What are consequences of failure to service equipment regularly?

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**Task Number 73**

**Use power-driven pipe threaders.**

**Definition**
Usage includes

- selecting the proper cutting fluid
- threading pipe with a power threader
- servicing equipment routinely.

**Process/Skill Questions**

- What types of jobs require the use of power-driven pipe threaders, as opposed to hand-driven threaders?
- How is the proper cutting fluid selected?

---

**Task Number 74**

**Use fixed and adjustable reamers.**

**Definition**

Usage includes

- identifying various types of fixed and adjustable reamers
- reaming holes to a specified size and finish.

**Process/Skill Questions**

- In what situations are fixed reamers preferred to adjustable reamers? Adjustable to fixed?
- What are common characteristics of fixed and adjustable reamers?
- What does finish refer to when related to reaming?

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**Task Number 75**

**Use a hydraulic press.**

**Definition**

Usage includes

- pressing bearings and shafts
- servicing equipment.
Process/Skill Questions

- What safety precautions should be taken when working with hydraulic presses?
- What level of experience should be required of a press operator?
- How often should hydraulic presses be serviced?

Task Number 76

Use a drill press.

Definition

Usage includes

- performing various operations, such as drilling, reaming, countersinking, and counter boring holes
- demonstrating proper setup and clamping techniques
- drilling holes in metal, wood, and plastic accurately.

Process/Skill Questions

- For what types of jobs is a drill press best suited?
- What are consequences of failure to practice proper setup techniques?
- How do drilling techniques differ between drilling metal, wood, and plastic?

Task Number 77

Use a band saw.

Definition

Usage includes

- selecting blades for various applications
- cutting metal or wood stock
- changing coolant and blades as needed
- servicing equipment routinely.

Process/Skill Questions
• What factors influence the selection of blades?
• How many variations of band saw blades are there?

Task Number 78

Identify types of metals.

Definition

Identification includes methods, such as visual inspections and spark testing, that yield information (i.e., properties of given materials such as weight, strength, corrosion resistance) to consider when selecting materials for various maintenance applications such as repairing or fabricating mechanisms.

Process/Skill Questions

• What are procedures for identifying types of metals?
• Why is it necessary to determine metal types?
• What resources exist to assist in identifying metals?

Performing Welding Operations

Task Number 79

Demonstrate knowledge of welding processes.

Definition

Demonstration includes

• interpretation of symbols and drawings
• identification of various welding equipment
• performance of various welding processes
• demonstrated knowledge of electrical terms and theory related to welding
• identification of various applications of welding.
Process/Skill Questions

- What are two methods of checking equipment for leaks?
- What is the duty cycle?
- How does Ohm’s Law apply to welding?
- In what situations would a V-groove weld be used instead of a square-groove weld?
- What is the significance of a weld symbol straddling a reference line?
- What information can be located in the tail of a weld symbol?
- What is the purpose of fluxes?
- How are electrode holders rated?

Task Number 80

Perform visual inspection of welds.

Definition

Demonstrations should include

- visual examination of surfaces of material for serious notches, grooves, or gouges
- visual inspection of tacks, intermediate layers, and completed welds for defects and discontinuities (e.g., undercut, slag inclusion, and overlap)

in accordance with the instructor’s guidelines.

Process/Skill Questions

- What are considerations when selecting a bevel angle?
- What are considerations when selecting a root gap?
- What are possible causes of undercut?
- Define overlap.
- What are possible causes of porosity?
- What is the difference between a discontinuity and a defect?

Task Number 81

Perform oxyfuel cutting operations.

Definition
Performance includes the ability to

- place equipment in operation
- perform minor repairs
- select proper operating pressures, tips, and filler rods
- set up and use a manual oxyfuel cutting torch to cut carbon steel.

Process/Skill Questions

- What are the dangers of working with oxygen, and what precautions should be taken?
- What equipment must be changed when the fuel gas type is changed? Why?
- How is the proper cutting tip selected?
- What is the process for selecting a brazing rod?
- What is the difference between welding and brazing?

Task Number 82

Perform SMAW welding operations.

Definition

Performance includes the ability to place equipment in operation, perform minor repairs, select machine settings, select electrodes, and perform the following procedures:

- perform fillet and groove welds in flat, horizontal, and vertical positions
- perform single- and multiple-pass welds with organic and low hydrogen electrodes in flat, horizontal, and vertical positions.

Process/Skill Questions

- How does a welder determine the proper shade filter lens?
- Does SMAW welding require a constant current or constant voltage machine, and why?
- What is open circuit voltage?
- What are the considerations when selecting an electrode?

Task Number 83

Perform GMAW welding operations.

Definition
Performance includes the ability to place equipment in operation; perform minor repairs; select machine setting, electrodes, and shielding gas; and perform the following procedures:

- perform fillet and groove welds in flat, horizontal, and vertical positions using GMAW-S
- perform fillet and groove welds in flat, horizontal, and vertical positions using GMAW spray transfer.

**Process/Skill Questions**

- What are the effects of the voltage setting being too low? Too high?
- What indicates that a liner needs replacing?
- What shielding gases may be used for the spray transfer method on carbon steel?

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**Task Number 84**

**Perform FCAW welding operations.**

**Definition**

Performance includes the ability to place equipment in operation; perform minor repairs; select machine setting, electrodes, and shielding gas; and perform fillet and groove welds in flat, horizontal, and vertical positions using FCAW-S.

**Process/Skill Questions**

- What are the benefits of various gun manipulation patterns used during welding?
- What are the benefits provided by flux in flux core arc welding?
- What are the differences between the two types of filler wire used with FCAW?
- What is a disadvantage of FCAW?

---

**Task Number 85**

**Perform GTAW welding operations.**

**Definition**

Performance includes the ability to place equipment in operation; perform minor repairs; select machine setting, electrodes, and shielding gas; and perform the following procedures:

- perform fusion welds of aluminum, stainless steel, and carbon steel
• perform flat groove welds and horizontal fillet welds on aluminum, stainless steel, and carbon steel.

Process/Skill Questions

• How is the end of the tungsten electrode prepared for welding non-ferrous metals?
• What is the major advantage of GTAW welding? What are the disadvantages?
• How is the risk of argon asphyxiation related to GTAW welding?
• Why is AC current used for welding aluminum?

Working with Technical Drawings

Task Number 86

Interpret assembly drawings.

Definition

Interpretation includes

• identification of parts and associated part numbers
• order of operation in assembly/disassembly
• dissemination of title block information.

Process/Skill Questions

• What information is found on assembly drawings?
• What other types of drawings and documentation are usually associated with assembly drawings?

Task Number 87

Interpret building diagrams (including site plans).

Definition
Interpretation demonstrates knowledge of symbols and schematics used in building drawings and site plans and includes

- identification of systems such as plumbing, HVAC, and electrical
- identification of basic building features such as doors, windows, rooms, hallways, stairs, loading docks
- identification of features such as contour, landscape, traffic issues, drainage, utilities.

Process/Skill Questions

- What are some types of building drawings?
- What kinds of information are found on building drawings?

Exploring Careers

Task Number 88

Investigate careers in the industrial maintenance field.

Definition

Investigation includes using the Internet, magazines, books, and other resources to research characteristics, skills, benefits, and occupations found in industrial maintenance.

Process/Skill Questions

- What personal characteristics are best suited for work in the industrial maintenance field?
- What are some local employers of industrial maintenance workers?
- What are some benefits of a job in the industrial maintenance field?

SOL Correlation by Task

<p>| Comply with federal, state, and local safety legal requirements, including the Occupational Safety and Health Administration (OSHA), Virginia Occupational Safety and Health (VOSH) Program, and Environmental Protection Agency (EPA). | History and Social Science: GOVT.1, GOVT.15 |
| Maintain a safe working environment. |  |
| Explain safe working practices around electrical hazards. | English: 10.5, 11.5 |
| Identify emergency first-aid procedures. |  |</p>
<table>
<thead>
<tr>
<th>Task</th>
<th>Language: 10.5, 11.5</th>
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</thead>
<tbody>
<tr>
<td>Identify the types of fires and the methods used to extinguish them.</td>
<td></td>
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<tr>
<td>Demonstrate the use of a fire extinguisher.</td>
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<tr>
<td>Identify personal protective equipment (PPE) requirements.</td>
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<tr>
<td>Describe ventilation requirements and regulations pertaining to welding procedures and materials.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Inspect hand and power tools to ensure safety and usability.</td>
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<tr>
<td>Demonstrate lifting and carrying techniques.</td>
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<tr>
<td>Identify types of ladders.</td>
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<tr>
<td>Demonstrate safe laddering techniques for various types of ladders.</td>
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</tr>
<tr>
<td>Describe safe scaffolding techniques.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Report injuries.</td>
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<tr>
<td>Report personal, environmental, and equipment safety violations to the appropriate authority.</td>
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<tr>
<td>Earn the OSHA 10 card.</td>
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<tr>
<td>Pass the safety exam.</td>
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<tr>
<td>Perform calculations using fractions.</td>
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<tr>
<td>Convert between fractions and decimals.</td>
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<tr>
<td>Use geometric functions.</td>
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<tr>
<td>Make metric measurements and conversions.</td>
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<tr>
<td>Make linear measurements accurately to 1/16&quot;.</td>
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<tr>
<td>Use a micrometer to measure accurately to .001&quot;.</td>
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<tr>
<td>Use a dial caliper to measure accurately to .001&quot;.</td>
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<tr>
<td>Use combination squares and protractors.</td>
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<tr>
<td>Calculate speeds and feeds for machine tools.</td>
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<tr>
<td>Select appropriate hand tools.</td>
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<td>Cut stock accurately with a hand hacksaw.</td>
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<tr>
<td>Thread pipe with hand tools.</td>
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<tr>
<td>Use a file to de-burr, radius, and chamfer parts.</td>
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<tr>
<td>Use punches and chisels properly.</td>
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<td>Select appropriate power tools.</td>
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<td>Use light-duty and heavy-duty drills.</td>
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<td>Use hand grinders.</td>
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<td>Use power-driven pipe threaders.</td>
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<td>Use fixed and adjustable reamers.</td>
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<td>Use a hydraulic press.</td>
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<td>Use a drill press.</td>
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<tr>
<td>Use a band saw.</td>
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<td>Identify types of metals.</td>
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<td>English: 10.5, 10.8, 11.5, 11.8</td>
</tr>
</tbody>
</table>

**Entrepreneurship Infusion Units**

Entrepreneurship Infusion Units may be used to help students achieve additional, focused competencies and enhance the validated tasks/competencies related to identifying and starting a new business venture. Because the unit is a complement to certain designated courses and is not mandatory, all tasks/competencies are marked “optional.”
Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- College and Work Readiness Assessment (CWRA+)
- Customer Service Examination
- Customer Service Specialist (CSS) Examination
- EPA Technician Examinations
- ICC Certificates of Completion Examinations
- Industrial Maintenance Mechanics Assessment
- Industrial Technology Maintenance - Level 1 Examinations
- Maintenance Operations Assessment
- Manufacturing Specialist Certification Examination
- Manufacturing Technician Level I Certification Examination
- National Career Readiness Certificate Assessment
- Pre-Manufacturing Technician I (PreMT1) Examination
- Professional Communications Certification Examination
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.

- Industrial Maintenance Technology II (8576/36 weeks, 280 hours)

Career Cluster: Manufacturing

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
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<tbody>
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<td>Health, Safety, and Environmental Assurance</td>
<td>Occupational Health and Safety Specialist</td>
</tr>
<tr>
<td>Maintenance, Installation, and Repair</td>
<td>Safety Engineer</td>
</tr>
<tr>
<td>Manufacturing Production Process Development</td>
<td>Millwright</td>
</tr>
<tr>
<td>Production</td>
<td>Automated Manufacturing Technician</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>Welder</td>
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<tr>
<td></td>
<td>Quality Control Technician</td>
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</tbody>
</table>