Building Trades II

8516 36 weeks / 280 hours

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Acknowledgments

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Virginia Department of Education Staff
Course Description

Suggested Grade Level: 11 or 12
Prerequisites: 8515

Building Trades II teaches students advanced skills in masonry, carpentry, electricity, and plumbing. The class prepares students to synthesize these valuable skills to build or repair residential structures, using a variety of materials and tools. Students will also learn current residential building codes associated with the trades.

Note: The Virginia Board for Contractors’ Individual License and Certification Regulations addresses the requirements and standards of conduct for licenses issued to individuals, which includes tradesmen (i.e., electrical, plumbing, heating, ventilation, air-conditioning [HVAC], and gas fitting.) According to 18VAC 50-30-190 of the Virginia Board for Contractors’ Individual License and Certification Regulations, a contractor (i.e., the licensed business) or tradesman (i.e., the licensed individual) cannot perform work outside the scope of their license.

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 List

- 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.
<table>
<thead>
<tr>
<th>Task Number</th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CORE CONSTRUCTION SKILLS</strong></td>
<td></td>
</tr>
<tr>
<td>Applying Basic Construction Safety Standards (Core Safety)</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>✦ Comply with federal, state, and local safety legal requirements.</td>
</tr>
<tr>
<td>40</td>
<td>✦ Identify personal protective equipment (PPE) requirements.</td>
</tr>
<tr>
<td>41</td>
<td>✦ Maintain a safe working environment.</td>
</tr>
<tr>
<td>42</td>
<td>✦ Explain safe working practices around electrical hazards.</td>
</tr>
<tr>
<td>43</td>
<td>✦ Identify emergency first-aid procedures.</td>
</tr>
<tr>
<td>44</td>
<td>✦ Identify the types of fires and the methods used to extinguish them.</td>
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<tr>
<td>45</td>
<td>✦ Inspect course-specific hand and power tools to identify defects.</td>
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<tr>
<td>46</td>
<td>✦ Demonstrate lifting and carrying techniques.</td>
</tr>
<tr>
<td>47</td>
<td>✦ Demonstrate safe laddering techniques.</td>
</tr>
<tr>
<td>48</td>
<td>✦ Demonstrate safe scaffolding techniques.</td>
</tr>
<tr>
<td>49</td>
<td>✦ Report personal injury, violations of environmental regulations, and equipment safety violations to the appropriate authority.</td>
</tr>
<tr>
<td>50</td>
<td>✦ Pass the safety exam.</td>
</tr>
<tr>
<td>Understanding Local, State, and Federal Regulations</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>✦ Identify local, state, and federal regulations for a tradesman license.</td>
</tr>
<tr>
<td>52</td>
<td>✦ Identify local, state, and federal regulations for operating a business.</td>
</tr>
<tr>
<td>Applying Fundamental Construction Skills</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>✦ Interpret scale.</td>
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<tr>
<td>Task Number</td>
<td>Tasks/Competencies</td>
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<td>54</td>
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<tr>
<td>56</td>
<td>Identify reference materials that govern professional procedures (e.g., code books).</td>
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**Performing Masonry Skills**

<table>
<thead>
<tr>
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<td>65</td>
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</tr>
<tr>
<td>66</td>
<td>Compare types of masonry cements.</td>
</tr>
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</table>

**Framing a Floor**

<table>
<thead>
<tr>
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<th>Tasks/Competencies</th>
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</thead>
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<td>67</td>
<td></td>
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<tr>
<td>68</td>
<td>Identify properties of subfloor sheathing.</td>
</tr>
<tr>
<td>Task Number</td>
<td>Tasks/Competencies</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------</td>
</tr>
<tr>
<td><strong>Framing Walls</strong></td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Lay out walls on the floor deck.</td>
</tr>
<tr>
<td>70</td>
<td>Lay out wall framing detail on wall plates.</td>
</tr>
<tr>
<td>71</td>
<td>Raise a wall.</td>
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<tr>
<td><strong>Framing a Ceiling</strong></td>
<td></td>
</tr>
<tr>
<td>✔</td>
<td>Lay out the ceiling framing detail on the top wall plate.</td>
</tr>
<tr>
<td>✔</td>
<td>Cut ceiling joists.</td>
</tr>
<tr>
<td>✔</td>
<td>Install ceiling joists.</td>
</tr>
<tr>
<td>75</td>
<td>Install strongback (i.e., stiffener or catwalk).</td>
</tr>
<tr>
<td><strong>Framing a Roof</strong></td>
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<tr>
<td>76</td>
<td>Lay out the roof framing detail on a cap plate.</td>
</tr>
<tr>
<td>77</td>
<td>Reproduce common rafters from a pattern.</td>
</tr>
<tr>
<td>78</td>
<td>Install the ridge board.</td>
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<td>79</td>
<td>Install common rafters.</td>
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<td>80</td>
<td>Frame a gable end.</td>
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<tr>
<td>81</td>
<td>Install collar beams (i.e., rafter ties).</td>
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<tr>
<td>82</td>
<td>Install roof sheathing.</td>
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<td>83</td>
<td>Install trusses.</td>
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<td><strong>Installing Roofing</strong></td>
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<td>84</td>
<td>Install roof underlayment.</td>
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<tr>
<td>Task Number</td>
<td>8516</td>
</tr>
<tr>
<td>-------------</td>
<td>------</td>
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<tr>
<td>85</td>
<td>Install roof coverings and shingles.</td>
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<tr>
<td>86</td>
<td>Fasten stock with metal fasteners.</td>
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<td>87</td>
<td>Install a ridge cap.</td>
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<td>88</td>
<td>Install roof coverings in a valley.</td>
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<td>Calculate the rise and run for stairs.</td>
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<td>90</td>
<td>Lay out straight-run stair stringer.</td>
</tr>
<tr>
<td>91</td>
<td>Cut a stair component.</td>
</tr>
<tr>
<td>92</td>
<td>Construct an unfinished stair unit.</td>
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</tbody>
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**ELECTRICITY**

**Applying Basic Electrical Wiring**

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<th>Task Number</th>
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<td>Describe series and parallel circuits.</td>
</tr>
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<td>94</td>
<td>Identify commonly used materials.</td>
</tr>
<tr>
<td>95</td>
<td>Identify the functions, operation, and characteristics of grounding systems.</td>
</tr>
<tr>
<td>96</td>
<td>Wire a series circuit.</td>
</tr>
<tr>
<td>97</td>
<td>Troubleshoot circuits.</td>
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</table>

**Navigating the NEC Book**

<table>
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<th>Task Number</th>
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<tbody>
<tr>
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<td>Explain the intent of the NEC (Article 90).</td>
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<td>99</td>
<td>Interpret the NEC requirements for electrical installation.</td>
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</tbody>
</table>

**Identifying and Installing Panelboards and Switchboards**
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<th>Tasks/Competencies</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Describe the purpose and location of overcurrent devices (OCDs).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Select OCDs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Install OCDs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify the wire size and breaker size used for 220-volt appliance circuits.</td>
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</table>

Installing Waste and Soil Pipes

| 104 |      |
| 105 |      |
| 106 |      |
| 107 |      |
| 104 | Calculate and set waste and soil pipes to level and gradient. |
| 105 | Install a water closet flange. |
| 106 | Test the drainage system by performing a standing water test. |

Roughing-in Water Distribution Components

<p>| 108 |      |
| 109 |      |
| 110 |      |
| 111 |      |
| 112 |      |
| 113 |      |
| 114 |      |
| 115 |      |
| 108 | Install a water distribution system of hard-drawn copper, chlorinated polyvinyl chloride (CPVC), and PEX. |
| 109 | Rough-in water supply for a variety of fixtures. |
| 110 | Identify procedures for installing a building’s water service. |
| 111 | Identify the types of main shut-off valves. |
| 112 | Install a main shut-off valve. |
| 113 | Perform an air- or water-pressure test. |
| 114 | Identify the need for backflow prevention devices. |
| 115 | Install nail plates for the protection of piping. |</p>
<table>
<thead>
<tr>
<th>Task Number</th>
<th>8516</th>
<th>Tasks/Competencies</th>
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</thead>
<tbody>
<tr>
<td>Installing Fixtures and Trim</td>
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<tr>
<td>116</td>
<td>Install a lavatory (wall-hung and cabinet installation).</td>
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</tr>
<tr>
<td>117</td>
<td>Install a tank-type water closet.</td>
<td></td>
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<tr>
<td>118</td>
<td>Install a kitchen sink.</td>
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</tr>
<tr>
<td>119</td>
<td>Install a garbage disposal.</td>
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</tr>
<tr>
<td>120</td>
<td>Install a dishwasher.</td>
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</tr>
<tr>
<td>121</td>
<td>Install a water heater.</td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>Install various fixture shut-off valves.</td>
<td></td>
</tr>
</tbody>
</table>

**Curriculum Framework**

**CORE CONSTRUCTION SKILLS**

**Applying Basic Construction Safety Standards (Core Safety)**

**Task Number 39**

Comply with federal, state, and local safety legal requirements.

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.

Compliance should also include requirements from Occupational Health and Safety Administration (OSHA), Virginia Occupational Safety and Health (VOSH), and Environmental Protection Agency (EPA).

**Process/Skill Questions**

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

**NCCER Standards**

*Core Curriculum: Introductory Craft Skills*

- 00101-04 Basic Safety

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**Task Number 40**

**Identify personal protective equipment (PPE) requirements.**

**Definition**

Identification should include procedures for putting on, wearing, and removing PPE and inspecting PPE to determine whether it is safe to use. (Appropriate PPE may include eye protection, respirator, hard hat, gloves, safety harness, hearing protection, and safety shoes.)

**Process/Skill Questions**

- What are some dangerous effects of sun exposure, and how can these risks be significantly diminished?
- Why is wearing jewelry prohibited while in the lab or on the job site?

**NCCER Standards**

*Core Curriculum: Introductory Craft Skills*
Task Number 41

Maintain a safe working environment.

Definition

Maintenance should include regular inspection of the working environment. Maintenance should 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. When present, these must be remedied by appropriate measures, and the working environment must comply with the school's and the instructor's guidelines.

Process/Skill Questions

- What are 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 places?

NCCER Standards

Core Curriculum: Introductory Craft Skills

Task Number 42

Explain safe working practices around electrical hazards.

Definition

Explanation should include

- identifying equipment used to test electrical circuits
- describing safe working conditions
- demonstrating safe work habits
• knowing how to administer cardiopulmonary resuscitation (CPR), if needed.

Process/Skill Questions

• What is the definition of proximity work?
• What are safe working clearances, according to National Electrical Code (NEC)?
• What are considered safe working conditions and safe working habits?
• What is the unseen hazard with electrical work?

NCCER Standards

Core Curriculum: Introductory Craft Skills

○ 00101-04 Basic Safety

Task Number 43

Identify emergency first-aid procedures.

Definition

Identification should include standard first-aid procedures and school policies with regard to accidents involving

• bodily fluids
• electrical injuries
• eye injuries
• falls
• burns.

Process/Skill Questions

• What are the steps that should be followed in an accident?
• Why is knowing CPR an important skill in the construction trades?
• Why is it important to be certified to administer first aid?
• What are the different classifications (i.e., degrees) of electrical burns?

NCCER Standards

Core Curriculum: Introductory Craft Skills
Task Number 44

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

Definition

Identification should include the classifications of fires (e.g., classes A, B, C, and D), causes and prevention of fires, types of extinguishers, and, when possible, the demonstrated use of a fire extinguisher, in accordance with government regulations and instructor guidelines.

Process/Skill Questions

- Why do fires have different classifications, and what are they?
- What are the fire triangle and fire tetrahedron?
- What are the three things necessary to start a fire?
- Why is it important to know the classification of 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 45

Inspect course-specific hand and power tools to identify defects.

Definition

Inspection of power tools should include

- identifying the components of the machinery (e.g., guards, blades, moving parts, start/stop switches)
- identifying standard safety procedures (e.g., lab practices and manufacturer's recommendations)
- observing a demonstration of the safe operation and use of each piece of machinery in the lab
- identifying tool defects.
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?

NCCER Standards

Core Curriculum: Introductory Craft Skills

- 00101-04 Basic Safety
- 00103-04 Introduction to Hand Tools
- 00104-04 Introduction to Power Tools

Task Number 46

Demonstrate lifting and carrying techniques.

Definition

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

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

Process/Skill Questions

- What are common injuries associated with improper lifting techniques?
- What can one do to prevent injury?
- How does proper positioning affect proper technique?

NCCER Standards

Core Curriculum: Introductory Craft Skills
**Task Number 47**

**Demonstrate safe laddering techniques.**

**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 when erecting and setting ladders. Identification of additional ladder types may 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

and the parts and safety features of each.

**Process/Skill Questions**

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

**NCCER Standards**

*Core Curriculum: Introductory Craft Skills*

- 00101-04 Basic Safety
Task Number 48

Demonstrate safe scaffolding techniques.

Definition

Demonstration should include inspecting settings, 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?

NCCER Standards

Core Curriculum: Introductory Craft Skills

- 00101-04 Basic Safety
- 00106-04 Basic Rigging

Task Number 49

Report personal injury, violations of environmental regulations, and equipment safety violations to the appropriate authority.

Definition

Report should include an oral or written statement identifying the violation and the date it was observed and should be given to the instructor, supervisor, or local OSHA inspector(s).

Process/Skill Questions

- What ethical considerations are involved when reporting coworkers?
- Why is it important to follow reporting procedures?
- What is liability?
NCCER Standards

Core Curriculum: Introductory Craft Skills

- 00101-04 Basic Safety
- 00107-04 Basic Communication Skills

Task Number 50

Pass the safety exam.

Definition

Passing the exam must result from participation in safety training programs, including attending safety meetings and completing periodic demonstration of knowledge and skills gained from program topics (e.g., interpretation of SDS).

Process/Skill Questions

- How often should one participate in safety training programs? Why?
- What is the relationship between insurance and establishing or validating a continual retraining program for safety?
- What is workers’ compensation?

NCCER Standards

Core Curriculum: Introductory Craft Skills

- 00101-04 Basic Safety
- 00103-04 Introduction to Hand Tools
- 00104-04 Introduction to Power Tools

Understanding Local, State, and Federal Regulations
Task Number 51

Identify local, state, and federal regulations for a tradesman license.

Definition

Identification should include the varying regulations within the local, state, and federal regulations for a tradesman license.

Process/Skill Questions

- Who regulates tradesmen in Virginia?
- What are the specialty areas for a tradesman license?

Task Number 52

Identify local, state, and federal regulations for operating a business.

Definition

Identification should include the varying regulations within the local, state, and federal regulations for operating a business.

Process/Skill Questions

- What are the license classifications for a contractor’s license?
- What jurisdiction does the locality have over the regulation for operating a business?
- What jurisdiction does the state have over the regulation for operating a business?
- What jurisdiction does the federal government have over the regulation for operating a business?

Applying Fundamental Construction Skills

Task Number 53

Interpret scale.
Definition

Interpretation of scale should include

- reading a variety of scales (1/4 inch, 1-1/2 inch, 3 inch, and 3/4 inch)
- performing measurement-to-scale and scale-to-measurement procedures.

*International Residential Code (IRC)*: Chapter 1, sections R101 thru R114, identifies the requirements and specifications for permit applications, required construction documents, and responsibilities of parties involved in residential construction.

Process/Skill Questions

- What factors determine the scale used on a drawing?
- How many scales are on the scale rule?

NCCER Standards

*Core Curriculum: Introductory Craft Skills*

- 00102-04 Introduction to Construction Math

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**Task Number 54**

**Determine materials based on a blueprint.**

Definition

Determination should include

- generating a cutting list from plans
- indicating the number of pieces, thickness, width, and length to within +/- 1/16 inch
- selecting type of materials.

*IRC*: Chapters 3, 4, 5, 6, 7, 8, 9, and 10 provide the information to determine the code-approved material and size of materials for spans and spacing. These chapters cover approved materials and span charts for the code-compliant selection.

Process/Skill Questions

- How are blueprints used to estimate materials needed for a job?
• Where is information about doors and windows located on a blueprint?

NCCER Standards

Core Curriculum: Introductory Craft Skills

- 00102-04 Introduction to Construction Math
- 00105-04 Introduction to Blueprints

Task Number 55

Estimate labor and material cost.

Definition

Estimation should include

- preparing the materials list, using plans or blueprints
- contacting a local supplier for pricing
- calculating the flat labor cost
- increasing material and labor costs by 25 percent (or a specified percentage) to include profit.

IRC: Chapters 3, 4, 5, 6, 7, 8, 9, and 10 provide information to determine the code-approved material and size of materials for spans and spacing based on the design. This ensures an accurate estimate for materials.

Process/Skill Questions

- Where could one find information about labor costs?
- If material costs rise during a job, how might this affect the estimated price of the job?

NCCER Standards

Core Curriculum: Introductory Craft Skills

- 00102-04 Introduction to Construction Math
Task Number 56

Identify reference materials that govern professional procedures (e.g., code books).

Definition

Identification should include all regional code books for

- masonry
- electricity
- carpentry
- plumbing.

IRC: *International Residence Code* is an all-inclusive codebook used nationwide for residential construction and contains carpentry, electric, masonry, and plumbing standards as they pertain to residential construction. It ensures all disciplines comply with one code standard.

Process/Skill Questions

- Why are code books important to construction?
- How often are codes revised?
- What happens when a building does not conform to code?

NCCER Standards

Core Curriculum: Introductory Craft Skills

- 00108-04 Basic Employability Skills

MASONRY

Performing Masonry Skills

Task Number 57

Estimate amounts of materials needed for a job.
Definition

Estimation should include amounts of

- block/brick
- mortar
- sand
- wall anchors
- other materials, as determined by wall dimensions and specifications.

Calculations should be accurate and complete.

*IRC*: Chapters 4, 5, 6, 7, and 10 provide the standards for masonry construction, from wall design to reinforcement, wall ties, anchoring, including mortar components and mix, and anchor bolt placement.

Process/Skill Questions

- How does providing an estimate affect cost and making a competitive bid for a job?
- How can providing an accurate estimate be beneficial to customer satisfaction?
- What are some problems with estimation?
- What is included in providing a total job estimate for a customer?

NCCER Standards

Masonry: Level One (L1NCCT28)

- 28103-04 Measurements, Drawings, and Specifications

Task Number 58

Establish elevation reference points from a benchmark.

Definition

Establishing a reference point should include transferring an elevation from a predetermined benchmark to the wall, checking accuracy with leveling devices.

Process/Skill Questions

- What is a benchmark?
Task Number 59

Establish footing grades.

Definition

Establishment should include using leveling devices to determine the top of a continuous footing that will provide a level surface throughout. Grades must meet local building codes.

**IRC:** Chapter 4, section R403, covers footing placement and tolerances for a variety of masonry walls.

Process/Skill Questions

- What are grade stakes?
- Why is it important to consult building codes before grading?

NCCER Standards

**Masonry: Level One (L1NCCT28)**

- 28103-04 Measurements, Drawings, and Specifications

**Masonry Level Two**
Task Number 60

Locate corners.

Definition

Locating corners include laying out and squaring the foundation, using a transit level or the 6-8-10 method, according to plans.

IRC: Chapter 4, section R403, covers footing placement and tolerances for a variety of masonry walls.

Process/Skill Questions

- What are two methods used to square a foundation?
- What is meant by pinning the corners?

NCCER Standards

Masonry: Level One (L1NCCT28)

- 28105-04 Masonry Units and Installation Techniques

Masonry Level Two

- 28202-05 Residential Masonry

Task Number 61

Level walls.

Definition

Leveling walls should include
• using a builder’s level, set and adjusted with 100 percent accuracy
• taking readings from the wall height to ensure level coursing.

IRC: Chapters 4, 6, and 7 cover the importance and tolerances in masonry construction.

Process/Skill Questions

• What is the difference between a builder's level and a transit level?
• Why is it important to make a wall as level as possible?
• What could happen to a wall that is not level at construction?
• What natural elements can cause a wall to become uneven over time?

NCCER Standards

Masonry: Level One (L1NCCT28)

 o 28102-04 Masonry Tools and Equipment
 o 28105-04 Masonry Units and Installation Techniques

Task Number 62

Gauge a masonry wall with mason’s scales.

Definition

Gauging a wall should include

• selecting the scale according to the type of unit and wall construction
• making the walls level with the tops of openings
• providing proper spacing for seals or wire reinforcements.

IRC: Chapters 4 and 7 cover modular masonry components, reinforcement, and installation.

Process/Skill Questions

• What is the advantage of using scales over using inches and fractions?
• Which scale is used most often in commercial/residential construction?

NCCER Standards
Task Number 63

Build a straight lead.

Definition

Building a straight lead should include

- laying brick on a stretcher bond
- forming a plumb jamb on one end
- racking back a half brick on the opposite end
- maintaining uniform joint width.

*IRC:* Chapters 4 and 7 cover coursing of brick and block along with head- and bed-joint-required sizing.

Process/Skill Questions

- What is meant by *checking the range*?
- Where is the tail located on the lead?

NCCER Standards

Masonry: Level One (L1NCCT28)

- 28105-04 Masonry Units and Installation Techniques

Task Number 64

Build corners.

Definition
Building corners should include

- laying out corners in a 90-degree orientation, plumb and level
- racking back a half brick on both tails
- maintaining uniform joint width.

*IRC*: Chapter 7 covers brick veneer installation to include reinforcement, flashing, weep holes, lintels, spans, and installation.

**Process/Skill Questions**

- What is the angle, in degrees, of most corners?
- When laying standard brick in stretcher position, to what extent should each course lap the other?

**NCCER Standards**

*Masonry: Level One (L1NCCT28)*

- 28105-04 Masonry Units and Installation Techniques

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**Task Number 65**

**Build a block corner.**

**Definition**

Building a block corner should include

- laying out corners in 90-degree orientation, plumb and level
- stepping block back 8 inches on each tail
- maintaining 3/8-inch thickness in the joint.

*IRC*: Chapter 4 covers code-approved masonry foundation types, installation, and reinforcement based on wall height, widths, and placement on footing. Chapter 4 also covers cement types and allowed joint widths for head and bed joints.

**Process/Skill Questions**

- When examining from the exterior, is there a noticeable difference among 8-inch, 10-inch, and 12-inch corners? Why or why not? What are the implications of this?
• Why should a corner be ranged?

NCCER Standards

Masonry: Level One (L1NCCT28)

  o 28105-04 Masonry Units and Installation Techniques

Task Number 66

Compare types of masonry cements.

Definition

Comparison should include

• identifying the applications, strengths, and use of the three most commonly used cements: M, S, and N
• describing additives used in masonry cements, (e.g., accelerators, retardants, water-repellent agents, colors, air-entraining agents)
• describing the type of cement-and-additive combination that would be best for different jobs.

IRC: Chapters 4 and 7 cover types of cement approved for block and brick installation. Additives are also discussed in these chapters.

Process/Skill Questions

• What are the types of masonry cements?
• What accounts for the differences in masonry cements?
• What affects the selection of masonry cements and additives?

NCCER Standards

Masonry: Level One (L1NCCT28)

  o 28104-04 Mortar
CARPENTRY

Framing a Floor

Task Number 67

Identify bridging and blocking.

Definition

Identification should include the

- components of bridging and blocking
- function of bridging and blocking
- location of bridging and blocking, once they are installed
- building code reference for the use or installation requirements for bridging and blocking.

IRC: Chapter 5 covers all aspects of wood floor framing, the difference between blocking and bridging, and when and where it is required.

Process/Skill Questions

- What are the types of metal bridging?
- What are the different uses of bridging and blocking?

Task Number 68

Identify properties of subfloor sheathing.

Definition

Identification should include the

- physical description
- function
- location, once it is installed
- building code reference or installation requirements.

IRC: Chapter 5, section R503, covers floor sheathing and allowable spans and uses, along with installation requirements.
Process/Skill Questions

- What factors should be considered when determining the type of sheathing to use?
- What methods should be used to reduce the number of structural problems?
- What are the consequences of improper installation of sheathing?

Framing Walls

Task Number 69

Lay out walls on the floor deck.

Definition

Layout should include

- marking the walls
- following the blueprint.

IRC: Chapter 6 covers wall construction from material species, wall heights, stud sizing based on house size and floor loads, shear and braced walls, fasteners of the wall types, sheathing requirements, and nail placement. It also provides information needed to lay out walls for assembly.

Process/Skill Questions

- Which set of plans is used to find wall locations?
- How does one determine the location of a wall if no dimensions are given?
- Who is responsible if dimensions are incorrect?

NCCER Standards

Carpentry Fundamentals: Level 1

- 27106-06 Wall and Ceiling Framing

Task Number 70

Lay out wall framing detail on wall plates.
Definition

Layout should include

- locating rough openings, corners, and wall tees
- ensuring that the stud layout is 16 inches or 24 inches on center, as required by plan
- ensuring that door and window openings are of the proper width +/- 1/16 inch
- identifying wall plate layout marks
- stocking proper components.

**IRC:** Chapter 6 identifies stud placement based on building height, floor and roof loads, and design. It identifies the size and height of the stud along with stud spacing based on building design. Header size, jack placement, and the number of jacks and studs required at openings (based on opening width and load above header) are also covered.

Process/Skill Questions

- Are all way layouts 16 inches on center?
- What are some of the special wall framing details?

NCCER Standards

**Carpentry Fundamentals: Level 1**

- 27106-06 Wall and Ceiling Framing

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Task Number 71

Raise a wall.

Definition

Raising a wall should include

- following blueprints
- raising
- aligning with appropriate leveling instruments
- anchoring
- ensuring the wall is plumb
- bracing at the best angle and at correct intervals with appropriate fasteners.
**IRC:** Chapter 6, section R602, ensures the proper placement of walls for proper attachment, braced wall requirements, and shear wall placement.

**Process/Skill Questions**

- What are different strategies for raising walls?
- How do building codes relate to the way wall sections are anchored? What is the appropriate nailing schedule for anchoring wall sections?
- What is the difference between plumb and level?
- What is the relationship between the level of the floor and the plumb of the wall?
- What method should be used to align the wall?

**NCCER Standards**

- Carpentry Fundamentals: Level 1
  - 27106-06 Wall and Ceiling Framing

**Framing a Ceiling**

**Task Number 72**

**Lay out the ceiling framing detail on the top wall plate.**

**Definition**

Layout should include

- determining the number of ceiling joists needed for a given job
- laying out ceiling joists on the top plate
- marking openings according to blueprint.

**IRC:** Chapter 8 defines ceiling joist material, allowed spans, and spacing live and dead loads, along with attachment to wall plates.

**Process/Skill Questions**

- Where are the details for ceiling framing on plans?
- What are the typical layout dimensions for ceiling members?
Task Number 73

Cut ceiling joists.

Definition

Cutting joists should include measuring and cutting joists to fit rafters to an accuracy within +/- 1/16 inch.

IRC: Chapter 8 covers bearing requirements and depth of bearing points.

Process/Skill Questions

- What considerations for roof sheathing are made when cutting a joist?
- What allowance should be made for bearing on a wall plate?

NCCER Standards

Task Number 74

Install ceiling joists.

Definition

Installation should include crowning and installing joists according to a layout, using appropriate fasteners.
**IRC:** Chapter 8, section R802, covers the code-approved method of framing and attachment requirements, ceiling joist lap, blocking, species, and spans.

**Process/Skill Questions**

- To what measurement on center should joists be installed?
- What determines the size of ceiling joists?

**NCCER Standards**

*Carpentry Fundamentals: Level 1*

- 27106-06 Wall and Ceiling Framing

**Task Number 75**

**Install strongback (i.e., stiffener or catwalk).**

**Definition**

Installation should include locating and fastening strongback, according to specifications.

*IRC:* Chapter 8 covers code-approved and required strongbacks in stick- and truss-roof framing along with gable-end supports.

**Process/Skill Questions**

- What is a strongback?
- When is a strongback required? When is a catwalk required?
- What may be the consequences of not having a strongback?
- Where is the strongback located on an engineered building product?

**NCCER Standards**

*Carpentry Fundamentals: Level 1*

- 27106-06 Wall and Ceiling Framing
Framing a Roof

Task Number 76

Lay out the roof framing detail on a cap plate.

Definition

Laying out should include

- following blueprints
- laying out on the double top plate
- determining the types of rafters, pitch, overhang, and spacing.

**IRC**: Chapter 8 covers all aspects of rafter and truss framing, from species and spans for lumber, depths of birdsmouth, bearing requirements, material labeling, and attachments to openings.

Process/Skill Questions

- What set of plans should be referred to when reading and laying out roof-framing detail on a cap plate?
- What are some relevant roof-framing details?
- How might region and type of climate affect spacing and sizing?
- What types of fasteners can be used?

NCCER Standards

- **Carpentry Fundamentals: Level 1**
  - 27107-06 Roof Framing

Task Number 77

Reproduce common rafters from a pattern.

Definition

Reproduction should include replicating pattern dimensions to within +/- 1/8 inch.
Process/Skill Questions

- Why is it important to designate a pattern?
- What might be the consequence of failing to designate a pattern?

NCCER Standards

Carpentry Fundamentals: Level 1

- 27107-06 Roof Framing

Task Number 78

Install the ridge board.

Definition

Installation should include

- measuring the ridge board (sometimes called a ridge pole)
- cutting with 90-degree ends
- crowning
- laying out to match the top plate
- installing and bracing the ridge board.

IRC: Chapter 8, section R802.3, specifically covers ridge board installation, rafter spacing, connections, attachments, proper placement, and bearing.

Process/Skill Questions

- How should one determine the height of ridge boards?
- What codes apply to ridge boards?
- Why does the heel of the rafter need to bear on the ridge board?

NCCER Standards

Carpentry Fundamentals: Level 1

- 27107-06 Roof Framing
Task Number 79

Install common rafters.

Definition

Installation should include

- interpreting the rafter layout according to plans
- computing the rafter length
- laying out for a specified pitch and birdsmouth as required for cutting
- using fasteners according to specifications.

IRC: Chapter 8 furnishes span tables for a variety of rafters and live and dead load combinations. Also included are details on rafter cut tolerances and attachment methods approved by code.

Process/Skill Questions

- What determines the spacing and size of rafters?
- How can rafters be installed? What are the advantages and disadvantages of each method?
- What are the differences among common, header, and cripple rafters? In what situations should each be used?
- What plans should be referenced when reading and laying out rafters?

NCCER Standards

Carpentry Fundamentals: Level 1

- 27107-06 Roof Framing

Task Number 80

Frame a gable end.

Definition

Framing requires
• constructing a gable end to specifications
• establishing a straight line to within +/- 1/8 inch.

IRC: Chapters 6 and 8 outline the framing of gable ends and the required support based on the height and width of materials and the materials being used.

Process/Skill Questions

• What are the advantages and disadvantages of the various methods for attaching gable end studs to the rafters?
• Why should gable ends have a vent framed into them?
• What situations would warrant ventilation?
• What determines the size of a vent?
• What precautions should be taken when standing a wall with a gable attached?

NCCER Standards

Carpentry Fundamentals: Level 1

○ 27107-06 Roof Framing

Task Number 81

Install collar beams (i.e., rafter ties).

Definition

Installation requires

• cutting the collar tie to length within +/- 1/16 inch
• cutting the collar tie to angle within +/- 1 degree
• positioning
• installing according to specifications.

IRC: Chapter 8 specifically defines the differences among a ceiling joist, rafter, collar tie, and a rafter tie, along with details about the specific use and limits on the components. The attachment of each of these materials is based on the location of a specific nailing. More details are found in table R602.3 (1).

Process/Skill Questions
• What purpose do collar beams serve?
• What could happen if collar beams were not installed?

NCCER Standards

Carpentry Fundamentals: Level 1

- 27107-06 Roof Framing

Task Number 82

Install roof sheathing.

Definition

Installation requires

- centering the roof sheathing on the rafter
- facing the grain perpendicular to the rafter
- nailing the sheathing according to code.

IRC: Chapter 6, table R503.2.1.1 (1), identifies sheathing span for floor and roof sheathing. Section R803 specifies roof sheathing based on species, thickness, span rating, and framing spacing. Table R603.3 (1) identifies nailing requirements.

Process/Skill Questions

- What safety concerns are associated with roof sheathing installation?
- What are the possible consequences of improperly nailed sheathing?

NCCER Standards

Carpentry Fundamentals: Level 1

- 27107-06 Roof Framing
Task Number 83

Install trusses.

Definition

Installation should include

- determining and laying out centers from details, accurate to within +/- 1/16 inch (for example, 12-inch, 16-inch, 18.5-inch, and 24-inch centers)
- selecting the appropriate truss
- using safe lifting techniques
- sliding the truss into place according to the layout, on the double top plate
- anchoring the truss with fasteners
- maintaining centers
- bracing temporarily to prepare for sheathing.
- cutting and installing the brace according to manufacturer's specifications, using fasteners and materials (e.g., 2x4, 2x6).

IRC: Chapter 8, section R802.10, covers wood truss installation, design, installation, tie-downs, uplift resistance, bracing, and limits to a truss design. Section R806 covers required venting for all roof structures.

Process/Skill Questions

- What is the most common spacing of trusses?
- What factors influence the spacing of trusses?
- What safety concerns are associated with setting trusses?
- What things can a worker do to protect himself/herself in setting trusses?
- What is the purpose of bracing?
- What are possible consequences of improper bracing?

NCCER Standards

Carpentry Fundamentals: Level 1

- 27107-06 Roof Framing

Installing Roofing

Task Number 84
Install roof underlayment.

Definition

Installation should include

- tightening the underlayment with 2-inch horizontal overlaps
- fastening according to code.

IRC: Chapter 9 covers all types of roof underlayment approved for use under the building code. Table R905.1.1 (1) identifies underlayments, while Table R905 explains the use of different roof coverings.

Process/Skill Questions

- What purpose does roof felt serve?
- What are the problems associated with improperly installed felt?

NCCER Standards

Carpentry: Level 3

- 27302-02 Roofing Applications

Task Number 85

Install roof coverings and shingles.

Definition

Installation should include

- keeping roof coverings flush to the surface
- maintaining fastener pattern to manufacturer specifications
- providing adequate shingle exposure
- following plans per manufacturer specifications.

IRC: Chapter 9 identifies roof coverings permitted by code, along with underlayment required for each material. Installation is per manufacturer’s specification and must comply with the minimum requirements of the code.
Process/Skill Questions

- How does the slope of a roof affect the installation of shingles and the use of materials?
- What effect does the weight of a shingle have?

NCCER Standards

Carpentry: Level 3

- 27302-02 Roofing Applications

Task Number 86

Fasten stock with metal fasteners.

Definition

Fastening could include

- selecting and using nails, screws, staples, floor-framing fasteners, and other mechanical fasteners
- affixing fasteners with hand or pneumatic tools
- installing metal hold-downs.

IRC: Chapter 9 covers attachment requirements for roof coverings, from asphalt shingles, wood shakes, standing seam, and other roof coverings. Each roof material section will include the materials-fastening requirements.

Process/Skill Questions

- What determines the size of nails?
- What does the gauge of screws mean?

Task Number 87

Install a ridge cap.

Definition
Installation should include

- laying out and cutting the ridge cap
- overlapping the ridge equally on both sides
- covering all exposed nails with proper sealant.

*IRC*: Chapter 9 covers the installation of types of roof caps based on the specific materials installed. The process for installation of caps will be found in each material's description.

**Process/Skill Questions**

- What is the proper method of cutting shingles for a ridge cap?
- How does one place nails for a ridge cap?

**NCCER Standards**

**Carpentry: Level 3**

- 27302-02 Roofing Applications

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**Task Number 88**

**Install roof coverings in a valley.**

**Definition**

Installation should require

- following manufacturer specifications
- ensuring that the roof covering line is straight, even, and parallel to the valley
- following specifications, without harming the flashing.

*IRC*: Chapter 9 covers flashing details and material requirements for each roof covering in each material section.

**Process/Skill Questions**

- What are two common methods of installing composite shingles in a valley?
- What is the purpose of underlayment in a valley?

**NCCER Standards**
Constructing and Installing Stairs

Task Number 89

Calculate the rise and run for stairs.

Definition

Calculation should include

- the total rise and run
- individual rise heights and run lengths, limited by building code maximums
- the total rise divided by individual step rise for the total step number.

IRC: Chapter 3 covers egress and life-safety requirements and covers stairs rise, tread, railings, and guard rails that run the length of stairs, and other details.

Process/Skill Questions

- Why is there a minimum rise or run for stairs?
- What problems could arise from an inequality in rise dimension?

NCCER Standards

Carpentry: Level 3

- 27304-02 Stairs

Task Number 90

Lay out straight-run stair stringer.

Definition
Laying out should include using a framing square and square gauges to determine the proper dimensions within code requirement.

**Process/Skill Questions**

- What type of lumber is suited for stringers? Why?
- How can defects in lumber affect its use?

**NCCER Standards**

**Carpentry: Level 3**

- 27304-02 Stairs

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**Task Number 91**

**Cut a stair component.**

**Definition**

Procedure should include cutting the following components to within the code requirement of given dimensions:

- Stringers
- Risers
- Tread

**IRC:** Chapter 3, section R311, covers details of code requirements for a set of stairs.

**Process/Skill Questions**

- What is the critical tolerance in cutting the stringer?
- How would this tolerance affect the product?

**NCCER Standards**

**Carpentry: Level 3**

- 27304-02 Stairs
Task Number 92

Construct an unfinished stair unit.

Definition

Construction should include

- selecting the proper materials and fasteners
- assembling the stair components for an unfinished stair unit, according to specifications.

Process/Skill Questions

- How might one describe the various fasteners used to construct the stair unit?
- What other measures may be taken to ensure solid construction?

NCCER Standards

  Carpentry: Level 3

  o 27304-02 Stairs

ELECTRICITY

Applying Basic Electrical Wiring

Task Number 93

Describe series and parallel circuits.

Definition

Description should include

- diagramming simple series and parallel circuits
- identifying the expected values for voltage, current, resistance, and wattage.
IRC: Chapter 34 is the National Electrical Code (NEC) related to residential construction. Throughout Chapters 34 to 43, all aspects of voltage, Ohm’s law, and Watt’s law are discussed as they relate to all aspects of residential electrical installation.

Process/Skill Questions

- When using Ohm's law equation, does E, R, or I stay the same?
- What is Kirchoff's law?
- What function does series circuitry typically perform in a residential setting?

NCCER Standards

Electrical

- 26101-02 Electrical Safety
- 26104-02 Electrical Theory One
- 26105-02 Electrical Theory Two

Task Number 94

Identify commonly used materials.

Definition

Identification should consist of naming electrical materials and supplies associated with different wiring systems, including nonmetallic (NM) sheathed cabling, conduit, raceways, and others as specified by the instructor. Identification should take into account regional variance of terminology.

IRC: Chapters 34 through 43 identify all electrical components related to residential construction along with their use and installation.

Process/Skill Questions

- What is a Madison strap or standoff strap?
- What is a one-hole strap? What is a two-hole strap?
- What is electrical metallic tubing (EMT), rigid metal conduit (RMC), and intermediate metal conduit (IMC)?
- What is a 1900, or a four-by-four-by-one-and-a-half box?
Task Number 95

Identify the functions, operation, and characteristics of grounding systems.

Definition

Based on the latest NEC, identification should include

- explaining the purpose of grounding
- distinguishing between a short circuit and a ground fault
- defining a ground circuit
- explaining the requirements for physical protection for the grounding electrode conductor
- defining made electrodes
- defining the use of a grounding electrode system
- explaining the use of a main bonding jumper
- explaining the purpose of the grounded conductor
- explaining the requirements for grounding more than one building
- explaining the requirements for grounding subpanels.

IRC: Chapters 34 through 43 identify all electrical components related to residential construction along with their use and installation. These chapters include general requirements, electrical services, branch circuits and feeders, wiring methods, power and lighting distribution, devices and luminaries, appliance installation, swimming pools and Class 2 remote controls, and power-limited controls.

Process/Skill Questions

- In which article in the NEC would one find grounding systems?
- What is a man-made grounding system?
- Why is grounding important?

NCCER Standards

Electrical

- 26101-02 Electrical Safety
Task Number 96

Wire a series circuit.

Definition

Wiring includes the fabrication of a series circuit, using lab materials. The circuit must conform to common trade practices, NEC requirements, and instructor's guidelines.

*IRC:* Chapter 37 explains branch circuits and feeder requirements.

Process/Skill Questions

- What is an example of a series circuit?
- What happens when a series circuit is opened?
- Why are three light bulbs dimmed in a series circuit?

NCCER Standards

**Electrical**

- 26101-02 Electrical Safety
- 26104-02 Electrical Theory One
- 26112-02 Wiring: Residential

Task Number 97

Troubleshoot circuits.
Definition

Troubleshooting should include checking continuity using a multimeter and

- setting the multimeter and adjusting for a specified test or measurement (e.g., voltage, amperage, resistance, and continuity)
- interpreting the scale.

Process/Skill Questions

- What are the common types of meters used in the electricity trade? What do they measure?
- Why is it important to have the meter set to the proper function before taking a reading?
- Why should the meter leads be inspected before taking a reading?
- How is a meter verified?

NCCER Standards

Electrical

- 26101-02 Electrical Safety
- 26104-02 Electrical Theory One
- 26105-02 Electrical Theory Two
- 26106-02 Electrical Test Equipment

Navigating the NEC Book

Task Number 98

Explain the intent of the NEC (Article 90).

Definition

Explanation should include the

- purpose
- scope
- intent
- enforcement
• code arrangement
• history of the NEC.

IRC: Chapter 35 identifies the NEC’s relationship with the IRC.

Process/Skill Questions

• What is the NEC?
• Who uses the NEC?
• What is the purpose of the NEC?

NCCER Standards

Electrical

- 26107-02 Introduction to National Electrical Code
- 26111-02 Wiring: Commercial and Industrial
- 26112-02 Wiring: Residential

Task Number 99

Interpret the NEC requirements for electrical installation.

Definition

Interpretation involves the use of the NEC Book to locate definitions, to identify code markings, and to calculate general job requirements, including residential, commercial, and industrial wiring methods.

Process/Skill Questions

• What is the focus of NEC Article 250?
• Who enforces the NEC?
• Who designs and writes the code?
• What is a fine print note (FPN)?

NCCER Standards
Electrical

- 26107-02 Introduction to National Electrical Code

**Identifying and Installing Panelboards and Switchboards**

**Task Number 100**

**Describe the purpose and location of overcurrent devices (OCDs).**

**Definition**

Description should include

- listing the areas where OCDs may be located in residential, commercial, and industrial facilities
- identifying OCDs from structural plans, appliance wiring diagrams, and various available equipment
- differentiating between a short and an overload
- describing a blown fuse after a short and overload.

**IRC:** Chapter 37, section E3705, covers overcurrent protection.

**Process/Skill Questions**

- What is an OCD and what is its purpose?
- Where are the OCDs found?
- What code article references the standard sizes for OCDs?
- What breaker size should be used on a No. 14 wire?

**NCCER Standards**

**Electrical**

- 26108-02 Raceways, Boxes, and Fittings
Task Number 101

Select OCDs.

Definition

Selection should include

- identifying the types of OCD fuses used in system wiring (e.g., plug, cartridge, blade, type S)
- identifying the types of circuit breakers in single- and three-phase systems (e.g., single-pole 120V, double-pole 208V/240V, triple-pole 480V)
- using the NEC to determine the correct type of OCD for use in existing and new installations.

**IRC:** Chapter 37, section E3705, covers overcurrent protection.

Process/Skill Questions

- What is a data protection overcurrent protection device (DPOCPD)?
- How are overcurrent protection devices (OCPDs) selected in reference to wire size?
- Are breakers from different manufacturers interchangeable in the service entrance panel (SEP)? Why or why not?

NCCER Standards

**Electrical**

- 26108-02 Raceways, Boxes, and Fittings
- 26109-02 Conductors

Task Number 102

Install OCDs.
Definition

Installation should include replacing and/or installing

- a plug fuse in a panel or safety cutoff
- a cartridge fuse in an assigned piece of equipment (e.g., disconnect box, pullout block)
- single-, double-, and triple-pole breakers in single-phase and three-phase panels.

Process/Skill Questions

- How is a breaker reset?
- Should power be disconnected before installing an OCD? Why or why not?
- Can a 20-amp breaker be replaced with a 30-amp breaker? Why or why not?
- What gauge wire should be used for 20- and 30-amp circuits?

NCCER Standards

Electrical

- 26108-02 Raceways, Boxes, and Fittings
- 26109-02 Conductors

Task Number 103

Identify the wire size and breaker size used for 220-volt appliance circuits.

Definition

Identification should include

- using Watt’s law
- determining voltage
- using the wire size chart.

IRC: Chapter 36, 37, and 38 cover wiring size, ratings, and loads.

Process/Skill Questions
- What is the wire size for a 30-amp 220-volt appliance circuit?
- What is the wire size for a 60-amp 220-volt appliance circuit?

NCCER Standards

Electrical

- 26106-02 Electrical Test Equipment
- 26108-02 Raceways, Boxes, and Fittings

PLUMBING

Installing Waste and Soil Pipes

Task Number 104

Rough-in a drainage, waste, and vent (DWV) assembly of polyvinyl chloride (PVC)/acrylonitrile butadiene styrene (ABS) for a variety of fixtures.

Definition

Roughing-in should include

- selecting from water closet, lavatory, bathtub, shower, kitchen or bar sink, washing machine
- following code, manufacturer's specifications, and industry standards.

IRC: Chapters 26 and 30 cover sanitary drainage, Chapter 31 covers venting of waste pipes, and Chapter 32 covers traps. This includes installation, pipe connections, securing pipe, and falling pipe.

Process/Skill Questions

- What is meant by rough-in?
- What is another name for a water closet?
- Where does all drainage water flow?

NCCER Standards
Task Number 105

Calculate and set waste and soil pipes to level and gradient.

Definition

Calculation should include

- using measurements and leveling instruments
- determining that gradient = fall/distance.

IRC: Chapters 26 and 30 cover sanitary drainage, Chapter 31 covers venting of waste pipes, and Chapter 32 covers traps. This includes installation, pipe connections, securing pipe, and falling pipe.

Process/Skill Questions

- How much head pressure is required for an accurate water test?
- How are open lines sealed?
- Who oversees and checks the water test?

NCCER Standards

Plumbing: Level 1

- 02104-05 Introduction to Plumbing Math
- 02106-05 Plastic Pipe and Fittings
- 02108-05 Cast-Iron Pipe and Fittings
Task Number 106

Install a water closet flange.

Definition

Installation should include aligning and measuring according to code, manufacturer specifications, blueprints, and the Americans with Disabilities Act (ADA).

IRC: See Chapter 27, section P2712.

Process/Skill Questions

- What materials are used in closet flanges?
- What holds the water closet to the flange?
- What types of materials are used in closet bolts?

NCCER Standards

Plumbing: Level 1

- 02106-05 Plastic Pipe and Fittings
- 02108-05 Cast-Iron Pipe and Fittings
- 02112-05 Introduction to Drain, Waste, and Vent (DWV) Systems

Task Number 107
Test the drainage system by performing a standing water test.

Definition

Testing should be performed according to code.

IRC: See chapter 25, section P2503.

Process/Skill Questions

- How much head pressure is required for an accurate water test?
- How are open lines sealed?
- Who oversees and checks the water test?

NCCER Standards

Plumbing: Level 1

- 02106-05 Plastic Pipe and Fittings
- 02108-05 Cast-Iron Pipe and Fittings
- 02112-05 Introduction to Drain, Waste, and Vent (DWV) Systems

Roughing-in Water Distribution Components

Task Number 108

Install a water distribution system of hard-drawn copper, chlorinated polyvinyl chloride (CPVC), and PEX.

Definition

Installation should be performed according to blueprints, code, and manufacturer specifications.

IRC: Chapter 27 covers plumbing fixtures installation; Chapter 29 covers water supply and distribution for various materials and fixtures approved by code.

Process/Skill Questions
• How are water systems sized?
• How are the three types of pipes joined?
• Which type of system is least expensive to install?

NCCER Standards

Plumbing: Level 1

  o 02106-05 Plastic Pipe and Fittings
  o 02107-05 Copper Pipe and Fittings
  o 02113-05 Introduction to Water Distribution Systems

Task Number 109

Rough-in water supply for a variety of fixtures.

Definition

Roughing-in should include

  • selecting from a variety of fixtures, including a washing machine, lavatory, kitchen sink, tank-type water closet, bathtub and/or shower, ice maker, hose bib
  • following blueprints, manufacturer specifications, and code.

IRC: Chapter 27 covers a wide variety of plumbing fixtures and installation.

Process/Skill Questions

• How is the proper size piping for each fixture determined?
• What is the location of the stub-out for each fixture?
• What are the consequences of not correctly locating the stub-out?

NCCER Standards

Plumbing: Level 1

  o 02105-05 Introduction to Plumbing Drawings
Task Number 110

Identify procedures for installing a building’s water service.

Definition

Identification should include ensuring materials are correctly listed, according to instructor’s guidelines.

Process/Skill Questions

- What is the depth at which water services are put into the ground?
- What are three types of pipe used for water service?
- Where are values placed on water services?

NCCER Standards

Plumbing: Level 1

- 02113-05 Introduction to Water Distribution Systems

Task Number 111

Identify the types of main shut-off valves.

Definition

Identification should include
• gate
• ball
• butterfly.

**IRC:** Chapters 26, 27, 28, and 29, cover plumbing code for types of shut-off valves, depending on the type of service, shut-off requirements, and placement, including access.

**Process/Skill Questions**

- Where are main shut-off valves typically located in a house?
- What size is the main shut-off valve in a house?
- What types of materials are the main shut-off valve constructed?

**NCCER Standards**

**Plumbing: Level 1**

- 02113-05 Introduction to Water Distribution Systems

**Task Number 112**

**Install a main shut-off valve.**

**Definition**

Installation should be made to code and follow manufacturer specifications. The valve must operate properly without leaks.

**IRC:** See Chapter 29, section P2903.9.1.

**Process/Skill Questions**

- What are the materials used to install shut-off valves?
- Where is the main shut-off valve typically located?

**NCCER Standards**

**Plumbing: Level 1**
Task Number 113

Perform an air- or water-pressure test.

Definition

Performance should include a water-pressure test by

- selecting from among various water pressure gauges
- tightening the gauge on an open spigot
- ensuring the pressure is within normal range, according to code (pressure may fluctuate over time)
- turning on another supply that will pull demand
- checking the original gauge to determine whether the pressure drop is within normal range

Performance should include an air pressure test by

- following manufacturer directions for using an air pressure pump and gauge at no more than 5 pounds per square inch (psi)
- determining whether plumbing maintains pressure.

IRC: Chapter 29 covers water pressure testing.

Process/Skill Questions

- At what pressure should an air test be conducted?
- What materials are needed to perform the test?
- Who checks the tests on the piping?

NCCER Standards

Plumbing: Level 1

- 02113-05 Introduction to Water Distribution Systems
Task Number 114

Identify the need for backflow prevention devices.

Definition

Identification should include situations when hydraulic conditions deviate from normal. This requirement is typically found in local/regional code or by city ordinance and inspected and determined by water suppliers.

IRC: Chapter 29 covers protection of potable water supply in section P2902.

Process/Skill Questions

- Where are backflow devices used?
- What is required to install backflow devices?
- Who can install backflow devices?

NCCER Standards

Plumbing: Level 1

02113-05 Introduction to Water Distribution Systems

Task Number 115

Install nail plates for the protection of piping.

Definition

Installation should include

- determining when nail plates are necessary
- identifying the hazards associated with installation
- paying special attention to using the correct nail plates size
- determining the proper location and placement.

IRC: Chapter 26, section P2603, highlights and references drilling, notching, and protection.

Process/Skill Questions
What are the types of materials from which are nail guards typically constructed?
Where are nail guards typically installed?
How are nail guards attached?

NCCER Standards

**Plumbing: Level 1**

- 02111-05 Fixtures and Faucets
- 02113-05 Introduction to Water Distribution Systems

**Installing Fixtures and Trim**

**Task Number 116**

**Install a lavatory (wall-hung and cabinet installation).**

**Definition**

Installation should include

- following blueprints and manufacturer specifications
- trimming out
- leveling
- caulking.

**IRC:** Chapter 27 covers the installation of residential fixtures in sections P2701 through P2725.

**Process/Skill Questions**

- What is a typical height at which bathroom lavatories are installed?
- How are wall-hung lavatory brackets installed?
- What types of connections are used on lavatory supplies?

**NCCER Standards**

**Plumbing: Level 1**

- 02111-05 Fixtures and Faucets
Task Number 117

Install a tank-type water closet.

Definition

Installation should include

- following blueprints and manufacturer specifications
- trimming out
- securing
- leveling
- keeping plumb and sealing.

IRC: Chapter 27 covers the installation of residential fixtures in sections P2701 through P2725.

Process/Skill Questions

- What is the standard inch requirement for the rough-in of standard tank-type water closets?
- Where is the water closet shut-off valve installed?
- Why is the water closet sealed to the closet flange?

NCCER Standards

- Plumbing: Level 1
  - 02111-05 Fixtures and Faucets

Task Number 118

Install a kitchen sink.

Definition

Installation should include

- following blueprints and manufacturer specifications
• trimming out
• keeping the sink plumb and level.

IRC: Chapter 27 covers the installation of residential fixtures in sections P2701 through P2725.

Process/Skill Questions

• What trap size is installed on a kitchen sink?
• What appliance can be attached to a kitchen sink?
• How many handles does a kitchen sink have?

NCCER Standards

Plumbing: Level 1

o 02111-05 Fixtures and Faucets

Task Number 119

Install a garbage disposal.

Definition

Installation should follow manufacturer specifications and operation should produce no leaks.

IRC: Chapter 27 covers the installation of residential fixtures in sections P2701 through P2725.

Process/Skill Questions

• How are garbage disposals rated?
• What other appliance drains can be connected to the garbage disposal?
• What minimum trap size must serve a garbage disposal?

NCCER Standards

Plumbing: Level 1

o 02111-05 Fixtures and Faucets
Task Number 120

Install a dishwasher.

Definition

Installation should follow manufacturer’s specifications and operation should produce no leaks.

IRC: Chapter 27 covers the installation of residential fixtures in sections P2701 through P2725.

Process/Skill Questions

- How are garbage disposals rated?
- What other appliance drains can be connected to the garbage disposal?
- What minimum trap size must serve a garbage disposal?

NCCER Standards

 Plumbing: Level 1

  o 02111-05 Fixtures and Faucets

Task Number 121

Install a water heater.

Definition

Installation could include

- following manufacturer’s directions
- creating a platform
- centering the tank on the platform
- connecting the water supply
- connecting the temperature and pressure (T&P) relief valve
- connecting the electricity
- installing a tankless water heater.
IRC: Chapter 28 covers installation of water heaters and related equipment, along with code requirements.

Process/Skill Questions

- What is the key advantage of an electric water heater vs. a gas water heater?
- What is the watt-to-kilowatt ratio?
- What is a point-of-use electric water heater?
- How are water heater size and capacity determined?
- When is a drain pan necessary?
- How does one read the energy efficiency rating?
- Who sets the thermostat on the water heater?
- What temperature is required for a dishwasher?

NCCER Standards

**Plumbing: Level 1**

- 02111-05 Fixtures and Faucets

Task Number 122

Install various fixture shut-off valves.

**Definition**

Installation should include following manufacturer specifications and ensuring that there are no leaks.

IRC: Chapter 27 covers the installation of residential fixtures in sections P2701 through P2725.

Process/Skill Questions

- What is the function of the shut-off valve?
- When is it necessary to use a shut-off valve?
- How should one determine whether to use a straight or 90-degree configuration?

NCCER Standards

**Plumbing: Level 1**
- 02106-05 Plastic Pipe and Fittings
- 02107-05 Copper Pipe and Fittings
- 02111-05 Fixtures and Faucets

## SOL Correlation by Task

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<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Related Subjects</th>
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</table>
| 39   | Comply with federal, state, and local safety legal requirements. | English: 11.5, 12.5  
History and Social Science: GOVT.8, GOVT.9, GOVT.15, VUS.8, VUS.13, VUS.14, WHII.8  
Science: BIO.1, CH.1 |
| 40   | Identify personal protective equipment (PPE) requirements. | History and Social Science: VUS.8, WHII.8 |
| 41   | Maintain a safe working environment. | History and Social Science: VUS.8, WHII.8 |
| 42   | Explain safe working practices around electrical hazards. | History and Social Science: VUS.8, WHII.8 |
| 43   | Identify emergency first-aid procedures. |  |
| 44   | Identify the types of fires and the methods used to extinguish them. | Science: CH.1 |
| 45   | Inspect course-specific hand and power tools to identify defects. |  |
| 46   | Demonstrate lifting and carrying techniques. |  |
| 47   | Demonstrate safe laddering techniques. |  |
| 48   | Demonstrate safe scaffolding techniques. |  |
| 49   | Report personal injury, violations of environmental regulations, and equipment safety violations to the appropriate authority. | English: 11.5, 12.5  
History and Social Science: GOVT.16 |
<p>| 50   | Pass the safety exam. | History and Social Science: VUS.8, WHII.8 |
| 51   | Identify local, state, and federal regulations for a tradesman license. | History and Social Science: VUS.13, VUS.14 |
| 52 | Identify local, state, and federal regulations for operating a business. | History and Social Science: VUS.13, VUS.14 |
| 53 | Interpret scale. | English: 11.5, 12.5 |
| 54 | Determine materials based on a blueprint. | |
| 55 | Estimate labor and material cost. | History and Social Science: GOVT.15 |
| 56 | Identify reference materials that govern professional procedures (e.g., code books). | English: 11.5, 12.5 |
| 57 | Estimate amounts of materials needed for a job. | |
| 58 | Establish elevation reference points from a benchmark. | |
| 59 | Establish footing grades. | |
| 60 | Locate corners. | Mathematics: G.8 |
| 61 | Level walls. | |
| 62 | Gauge a masonry wall with mason’s scales. | |
| 63 | Build a straight lead. | |
| 64 | Build corners. | Mathematics: G.8 |
| 65 | Build a block corner. | Mathematics: G.8 |
| 66 | Compare types of masonry cements. | |
| 67 | Identify bridging and blocking. | |
| 68 | Identify properties of subfloor sheathing. | |
| 69 | Lay out walls on the floor deck. | |
| 70 | Lay out wall framing detail on wall plates. | |
| 71 | Raise a wall. | |
| 72 | Lay out the ceiling framing detail on the top wall plate. | |
| 73 | Cut ceiling joists. | |
| 74 | Install ceiling joists. | |
| 75 | Install strongback (i.e., stiffener or catwalk). | |
| 76 | Lay out the roof framing detail on a cap plate. | |
| 77 | Reproduce common rafters from a pattern. | |
| 78 | Install the ridge board. | |
| 79 | Install common rafters. | |
| 80 | Frame a gable end. | |
| 81 | Install collar beams (i.e., rafter ties). | |
| 82 | Install roof sheathing. | |
| 83 | Install trusses. | |</p>
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<th></th>
<th>Task</th>
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<tr>
<td>84</td>
<td>Install roof underlayment.</td>
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<td>85</td>
<td>Install roof coverings and shingles.</td>
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<td>86</td>
<td>Fasten stock with metal fasteners.</td>
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<td>87</td>
<td>Install a ridge cap.</td>
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<td>88</td>
<td>Install roof coverings in a valley.</td>
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<td>Calculate the rise and run for stairs.</td>
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<td>Lay out straight-run stair stringer.</td>
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<td>Cut a stair component.</td>
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<td>92</td>
<td>Construct an unfinished stair unit.</td>
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<td>93</td>
<td>Describe series and parallel circuits.</td>
<td>Science: PH.11</td>
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<td>94</td>
<td>Identify commonly used materials.</td>
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<td>95</td>
<td>Identify the functions, operation, and characteristics of grounding systems.</td>
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<td>96</td>
<td>Wire a series circuit.</td>
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<td>97</td>
<td>Troubleshoot circuits.</td>
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<td>98</td>
<td>Explain the intent of the NEC (Article 90).</td>
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<td>99</td>
<td>Interpret the NEC requirements for electrical installation.</td>
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<td>100</td>
<td>Describe the purpose and location of overcurrent devices (OCDs).</td>
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<td>101</td>
<td>Select OCDs.</td>
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<td>102</td>
<td>Install OCDs.</td>
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<td>103</td>
<td>Identify the wire size and breaker size used for 220-volt appliance circuits.</td>
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<td>104</td>
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<td>Install a water closet flange.</td>
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<td>107</td>
<td>Test the drainage system by performing a standing water test.</td>
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<td>108</td>
<td>Install a water distribution system of hard-drawn copper, chlorinated polyvinyl chloride (CPVC), and PEX.</td>
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<td>Identify procedures for installing a building’s water service.</td>
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</table>
Identify the types of main shut-off valves.

Install a main shut-off valve.

Perform an air- or water-pressure test.

Identify the need for backflow prevention devices.

Install nail plates for the protection of piping.

Install a lavatory (wall-hung and cabinet installation).

Install a tank-type water closet.

Install a kitchen sink.

Install a garbage disposal.

Install a dishwasher.

Install a water heater.

Install various fixture shut-off valves.

### Green Building Infusion Units

The Green Building Infusion Unit (GBIU) was designed to encourage teachers to infuse instructional units on green building knowledge and skills into designated CTE courses. The infusion unit is not mandatory, and, as such, the tasks/competencies are marked as “optional,” to be taught at the instructor’s discretion. Teachers can find the infusion/unit in the course listing.

### 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.” Teachers can find the infusion/unit in the course listing.
Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- Building Construction Occupations Assessment
- Building Science Principles Examination
- Building Trades Maintenance Assessment
- Carpentry Level One Entry-Level Assessment
- College and Work Readiness Assessment (CWRA+)
- Construction Assessment
- Construction Technologist Entry-Level Assessment
- Core: Introductory Craft Skills Entry-Level Assessment
- Customer Service Examination
- Customer Service Specialist (CSS) Examination
- Design and Pre-Construction Assessment
- Electrical Construction Technology Assessment
- Electrical Occupations Assessment
- Electrician Level 1 Entry-Level Assessment
- Fundamentals of Construction Assessment
- HBI/NAHB Residential Construction Academy (RCA) Series Student Certification Assessments
- ICC Certificates of Completion Examinations
- International Code Council Residential Building Inspector (B1) Examination
- International Code Council Residential Electrical Inspector (E1) Examination
- International Code Council Residential Plumbing Inspector (P1) Examination
- Masonry Level One Entry-Level Assessment
- National Career Readiness Certificate Assessment
- Plumbing Assessment
- Plumbing Examination
- Plumbing Level One Entry-Level Assessment
- Plumbing-Heating-Cooling Contractors Educational Foundation Examinations
- Pre-Apprenticeship Certificate Training (PACT) Core Examinations
- 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.

- Building Trades I (8515/36 weeks, 140 hours)
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<td>Mason</td>
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<td>Plumber, Pipefitter</td>
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<td>Design/Pre-Construction</td>
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