

Electronics, Introduction

Exam Information	Description
Exam number 651 Items 39 National Career Cluster Manufacturing Science, Technology, Engineering, & Mathematics Certification available Yes	This entry-level course introduces the learner to the fundamental principles of electricity and electronics. Through hands-on activities and foundational theory, the learner will gain essential practical skills. The course focuses on circuit theory and safe component handling, enabling the learner to assemble, troubleshoot, and test electronic components and circuits. The learner will gain proficiency in operating standard electrical test equipment, preparing them for technical roles in engineering, product development, and manufacturing.

Exam Blueprint and Performance Skills

Standard	Percentage of exam score
1. Safety Practices	12%
2. Electricity & Electrical Theory	47%
3. Electronic Components	27%
4. Electrical Testing Equipment & Troubleshooting Techniques	14%

*Includes performance skill evaluation

Standard 1 - Safety Practices

Candidates will understand, demonstrate, and practice safe working habits in an electronics lab

Objective 1 Candidates will demonstrate a habit of Electrical Safety.

1. Candidates will demonstrate safety while using test equipment.
2. Candidates will properly care and maintain test equipment.

Objective 2 Demonstrate safe use of a Soldering Iron

1. Candidates will identify potential hazards before and during use and take proper precautions.
2. Candidates will properly care for, maintain, and store soldering irons and soldering materials (solder, wick, tips, etc.)

Objective 3 Candidates will recognize safety hazards and demonstrate the proper behaviors to remove or minimize hazards.

1. Clean as you go
2. Always wear safety glasses and appropriate PPE (Personal Protective Equipment).
3. Deenergize circuits/equipment before testing. Demonstrate proper safety while testing/trouble shooting.

Optional: Standard performance evaluations on the final page of this document

Standard 2 - Electricity & Electrical Theory

Candidates will understand the fundamental principles of electricity and electrical theory.

Objective 1 Candidates will learn the basic structure of an atom

1. Protons
2. Neutrons
3. Electrons

Objective 2 Identify conductors and insulators and understand their differences at an atomic level.

Objective 3 Understand how electricity is produced by the flow of electrons.

1. Candidates can identify voltage sources and explain/demonstrate their operation.
 - a. Battery cell
 - i. Primary
 - ii. Secondary
 - a. Thermocouple
 - b. Photovoltaic cell
1. Candidates can demonstrate application of batteries in series aiding and opposing configurations.
2. Candidates can demonstrate application of batteries in parallel configuration

Objective 4 Define electrical units of measure:

Term	Description	Symbol	Unit of Measure	Symbol of Base Units	
Charge	Quantity of Accumulated Electrons	Q	Coulombs	C	C
Voltage	Electrical Potential Difference	V	Volts	V	V
Current	Rate of Electron Flow	I	Amps	A	A
Resistance	Opposition to Electron Flow	R	Ohms	Ω	Ω
Power	Rate of doing Electrical Work	P	Watts	W	W

Objective 5 Define the difference between AC and DC electricity.

Objective 6 Understand the relation between voltage, current, resistance, and power using the following laws:

1. Ohm's Law
 - a. Current is directly proportional to voltage and inversely proportional to resistance.
 - b. $V=IR$
2. Watt's Law
 - a. Power in a component is the product of the voltage and the current.
 - b. $P=IV$

Objective 7 Candidate will understand the principles of a series circuit.

1. Kirchoff's Voltage Law
 - a. Sum of the voltage drops equals the voltage source.
 - b. Voltage drops are additive.
2. Current is constant in series circuits.
3. Resistance is additive.
4. Power is additive.

Objective 8 Candidates will understand the principles of a parallel circuit.

1. Kirchoff's Current Law
 - a. Sum of the current flowing into a node is equal to the current flowing out of a node.
2. Resistance is the inverse of the sum of the inverses of the individual branches.
3. Voltage is constant across each of the individual branches.
4. Power is additive.

Optional: Standard performance evaluations on the final page of this document

Standard 3 - Electronic Components

Candidates will be able to understand and demonstrate how to use, test, and select electronic components.

Objective 1 Identify the following electrical components and their schematic symbols:

1. Battery/Cell
2. Resistor
3. Incandescent light bulb
4. Light Emitting Diode (LED)
5. Motor
6. Normally-open (N.O) switch
7. Normally-closed (N.C) switch
8. Single-pole single-throw switch (SPST)
9. Single-pole double-throw switch (SPDT)
10. Wire

Objective 2 Candidates can read and understand the resistor color code.

Objective 3 Candidates will learn how to use a breadboard.

Objective 4 Candidates will learn how printed circuit boards are made and how they work.

Objective 5 Candidates will learn how to safely use a soldering iron to solder components to a printed circuit board.

1. Correctly tinning a soldering iron

2. Proper heating of pad and component lead
3. Proper care and maintenance of soldering irons and materials

Optional: Standard performance evaluations on the final page of this document

Standard 4 - Electrical Testing Equipment & Troubleshooting Techniques

Candidates will demonstrate the proper use of electrical testing equipment and troubleshooting techniques

Objective 1 Candidates will learn to make accurate measurements, use, and maintenance of an Ohmmeter.

Objective 2 Candidates will learn proper placement and use of a voltmeter.

Objective 3 Candidates will learn proper placement and use of an ammeter including placement for accurate measurement in a circuit.

Objective 4 Candidates will learn proper use and safety of a DC voltage source in testing circuits.

Objective 5 Candidates will understand the effects of an “open” on a series or parallel circuit.

Objective 6 Candidates will understand the effects of a “short” on a series or parallel circuit.

Optional: Standard performance evaluations on the final page of this document

Performance Skills Evaluation

Exam name: Electronics 1

Candidate Name: _____

Performance assessments may be completed and evaluated any time before the certification is issued. The following performance skills can be used in connection with the associated standards and exam. The evaluator will function as the subject matter expert to determine if the candidate meets the skills requirements with a Yes/No for passing.

Standard 1 – Safety Practices

- Candidates can complete a safety test without error (100%) before using any tools or shop equipment.
- Candidates will demonstrate proper use of PPE.
- Candidates will demonstrate safe practices while working with electricity.

Pass:

Standard 2 – Electronic Theory

- Candidates can identify and define:
 - Voltage: An electromotive force or the potential difference expressed in volts
 - Current: A flow of charged particles (electrons) moving through a conductor.
 - Resistance: is a measure of the object's opposition to electrical current.
 - Power: The rate of transfer of electrical energy in a circuit.
- Candidates can calculate power, voltage, current, and resistance in a series circuit.
- Candidates can calculate power, voltage, current, and resistance in a parallel circuit.
- Candidates can calculate voltage, current, or resistance when given only two of the three values using proper units.

Pass:

Standard 3 – Electronic Components

- Candidates can accurately read an electrical schematic drawing.
- Candidates can identify the value of a resistor using the resistor color code.
- Candidates can create a working circuit using a breadboard.
- Candidates can select the proper components based on an electrical schematic drawing.

Pass:

Standard 4 – Electrical Testing Equipment

- Candidates can use a digital multimeter to measure voltage, current, and resistance.
- Candidates can troubleshoot and correct open and short circuits.

Pass:

Evaluator Name:

Date:
