

# **ELECTRONIC INSTALLATION AND MAINTENANCE TECHNOLOGY (DEMONSTRATION CONTEST)**

---

## **PURPOSE**

To evaluate each contestant's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of advertising design.

First, refer to General Regulations, Page 9.

## **CLOTHING REQUIREMENT**

**For men:** Official white polo shirt with black dress slacks, black socks and black leather shoes.

**For women:** Official white polo shirt with black dress slacks or skirt, black socks or black or skin-tone seamless hose, and black leather shoes.

These regulations refer to clothing items that are pictured and described at: [www.skillsusastore.org](http://www.skillsusastore.org). If you have questions about clothing or other logo items, call 800-401-1560 or 703-956-3723.

**Note:** Contestants must wear their official contest clothing to the contest orientation meeting.

## **ELIGIBILITY**

Open to active SkillsUSA members enrolled in career and technical programs with Electronics, appliance repair, computer networking or smart house technologies as the occupational objective.

## **EQUIPMENT AND MATERIALS**

1. Supplied by the technical committee:  
All necessary information for the judges and technical committee
2. Supplied by the contestant:
  - a. Multimeter
  - b. Telephone buttset
  - c. Toner

- d. Signal generation
- e. Cable tester
- f. Laptop computer
- g. All competitors must create a one-page résumé using a word processor and submit the résumé electronically at: [www.skillsusa.org/compete/updates.shtml](http://www.skillsusa.org/compete/updates.shtml). Check the Website for further instructions.

## **SCOPE OF THE CONTEST**

The contest is defined by industry standards as set by the current industry technical committee. The contest will be divided into two parts: general knowledge test, and a skilled performance.

### **Knowledge Performance**

The contest will include a written exam assessing general knowledge of residential electronics installation and maintenance including smart house technologies. Written portions may also exist during the skills portion of the contest.

### **Skill Performance**

The skills performance event assesses the ability of the contestant to install, maintain and troubleshoot a variety of devices encountered in a residential setting. A practical problem(s) will be given to evaluate the contestant's ability to function on a basic entry level.

## **Contest Guidelines**

1. The contests will have several hands-on skill scenarios that demonstrate one's ability to perform jobs or skills selected from the list of competencies as determined by the SkillsUSA Championships technical committee. Scenarios may include any or several of the following:
  - a. Diagnose and service personal residential electronic systems
  - b. Diagnose and resolve operational and startup problems
  - c. Locate and identify defective modules within residential electronic equipment
  - d. Demonstrate ability to use diagnostic utility software and equipment
  - e. Install, configure and demonstrate proper operations of devices within the residence.

2. The hardware problems will relate to any residential networked systems.
3. Contestants will be awarded points based on their ability to solve the provided problems within the allotted time. Partial points can be awarded for solving partial problems.
4. Competence in the provided tasks is considered when a contestant acquires 75 percent of the available points.
5. Contestants will be provided, as required, manufacturers' documentation of the devices to be installed and/or serviced.
6. Winners will be determined on the basis of their total scores (regardless of result on certification test), which includes diagnostic procedures, speed, standard industry procedures, accuracy of adjustments and correct component replacements.
7. Specific penalties will be assessed for the failure to properly utilize anti-static straps at all times when in contact with the computers and for the introduction of computer viruses into the contest computers. Penalties will be assessed at one point per occurrence, and notice of infractions will be communicated to the contestant when they occur.

## Standards and Competencies

### Networking

#### **EIMT 1.0 — Identify basic networking protocols and their uses and know when / how to apply them**

- 1.1 DHCP
- 1.2 UDP
- 1.3 DNS
- 1.4 TCP/IP
- 1.5 Subnet masks

#### **EIMT 2.0 — Recognize and implement methods of network security**

- 2.1 Personal Computer (PC) security
- 2.2 Antivirus
- 2.3 Home networking security
- 2.4 Firewall knowledge

#### **EIMT 3.0 — Configure setup and maintain a residential LAN (Local Area Network)**

- 3.1 Client Configuration

- 3.1.1 Resource sharing
- 3.1.2 Peer-to-Peer
- 3.2 Remote access setup
- 3.3 Network device setup and integration
  - 3.3.1 Broadband configuration (e.g. DSL, Cable, and Satellite)
  - 3.3.2 Routers
  - 3.3.3 Hubs
  - 3.3.4 Switches
  - 3.3.5 PoE (Power over Ethernet)

#### **EIMT 4.0 — Configure setup and maintain a secure wireless network**

- 4.1 Differentiate applications of hardwired vs. wireless networks.
- 4.2 Assess networking security and encryption standards.
  - 4.2.1 WEP
  - 4.2.2 WPA
  - 4.2.3 MAC filtering
  - 4.2.4 SSID
  - 4.2.5 WPA2
- 4.3 Wireless networking integration and troubleshooting
  - 4.3.1 Frequency management
- 4.4 Wireless protocol standards
  - 4.4.1 802.11 a/b/g/n

#### **EIMT 5.0 — 1.5 Identify and define network cabling characteristics and performance**

- 5.1 Cable types
  - 5.1.1 CAT5
  - 5.1.2 CAT5e
  - 5.1.3 CAT6
  - 5.1.4 Fiber
  - 5.1.5 COAX
- 5.2 Cable length limitations
- 5.3 Protocols
  - 5.3.1 10BaseT
  - 5.3.2 100BaseT
  - 5.3.3 1000BaseT
- 5.4 Shielded (STP) vs. Unshielded (UTP)
- 5.5 Plenum vs. Non-plenum
- 5.6 Importance of conductor colors

### Audio/Video

#### **EIMT 6.0 — Implement, maintain and troubleshoot multiroom audio systems. Identify common interference sources**

- 6.1 Control devices
  - 6.1.1 Keypads
  - 6.1.2 Rotary volume controls
  - 6.1.3 Sliders

- 6.1.4 Push button controls
- 6.1.5 Touch screen
- 6.1.6 Wireless keypads
- 6.1.7 Handheld devices
- 6.2 Differentiate and define single source, multi-source, and local source.
  - 6.2.1 Analog audio system
  - 6.2.2 Analog CAT5 audio system
  - 6.2.3 Digital CAT5 audio system
- 6.3 Proper cable use
  - 6.3.1 Line level vs. speaker level
- 6.4 Amplification
  - 6.4.1 Ohm's Law (e.g. Impedance matched or non-impedance matched)
  - 6.4.2 Watts vs. dB
  - 6.4.3 Local amplification
  - 6.4.4 Centralized amplification
- 6.5 Speaker types
  - 6.5.1 Inwall
  - 6.5.2 Surface mounted
  - 6.5.3 Ceiling mounted
  - 6.5.4 Freestanding
  - 6.5.5 Fixed
  - 6.5.6 Animated
- 6.6 Speaker specifications
  - 6.6.1 Frequency response
  - 6.6.2 Efficiency
  - 6.6.3 Power handling

**EIMT 7.0 — Install, configure and maintain a residential home theater system.**

- 7.1 Audio Components
  - 7.1.1 Define basics of acoustics (e.g. Sound reflection, speaker placement, sound cancellation, sound balance)
  - 7.1.2 Audio/Video components setup and integration (e.g. Digital signal cables and lengths, Legacy devices)
  - 7.1.3 Multichannel Surround (e.g. SACD, DVDA, DTS, DTSES, DDEX, DD, etc.) (e.g. Crossovers and speaker setup)
- 7.2 Video components
  - 7.2.1 Display types (e.g. Plasma, DLP, LCD, LCOS, CRT, Rear projection, Front projection, Direct view.)
  - 7.2.2 Hi Definition resolutions options (e.g. 720p, 1080i, 1080p, etc.)

- 7.2.3 Tuner types (e.g. NTSC, PAL, ATSC, QAM, Cable card, VSB, NDVBT, DVBS)
- 7.2.4 Video Processing (e.g. Scalers, processors, up-conversion)
- 7.2.5 Aspect Ratios
- 7.2.6 Video setup (Calibration e.g. color balance, contrast, brightness, etc.)
- 7.2.7 Digital video cable and connector types (e.g. DVI and HDMI—compatibility and interoperability issues)
- 7.3 Use MRAV (Multi-Room Audio/Video) standards if/when applicable.

**EIMT 8.0 — Assess, install and configure content management systems and describe their applications in a residential environment.**

- 8.1 Describe typical applications and physical connections of sources
  - 8.1.1 Media servers
  - 8.1.2 Media PC
  - 8.1.3 MP3 players
  - 8.1.4 DVD players
  - 8.1.5 Satellite
  - 8.1.6 Cable
  - 8.1.7 DVR
  - 8.1.8 Gaming systems
  - 8.1.9 Satellite radio
  - 8.1.10 Legacy devices
  - 8.1.11 Streaming media
- 8.2 Summarize types of media storage, methods to transfer and backup data.
  - 8.2.1 Memory cards
  - 8.2.2 NAS devices (Network Attached Devices)
  - 8.2.3 Remote storage
  - 8.2.4 Local storage
  - 8.2.5 Frequency of backup
- 8.3 Other connection considerations
  - 8.3.1 Digital Rights Management

**EIMT 9.0 — Implement, maintain and troubleshoot multiroom video systems.**

- 9.1 Define signal types and their applications
  - 9.1.1 Digital Distribution (e.g. Analog to IP converters, IP to Analog converters, Wireless distribution, IEEE 1394)
  - 9.1.2 RF Distribution characteristics. Identify and troubleshoot noise and interference. (e.g. Splitters

- and taps, active and passive, Attenuators, Bidirectional, Modulation and filtration, Amplification, IR over COAX.)
- 9.1.3 Analog Distribution (e.g. Composite, Component, and S-Video, Balun.)
- 9.2 Identify cable types and their applications
  - 9.2.1 COAX (e.g. RG-59, RG-6, RG-6 QS, DV, Serial data, CCS, BC)
  - 9.2.2 CAT5/5e/6
- 9.3 Termination (e.g. RCA, BNC, and F)
- 9.4 Satellite
  - 9.4.1 Multi-switches
  - 9.4.2 Diplexer
  - 9.4.3 LNB (Low Noise Block Down Converter)

### **Telephony / VoIP**

#### **EIMT — 10.0 Differentiate and describe POTS vs. VoIP delivery. Identify and troubleshoot common issues.**

- 10.1 VoIP
  - 10.1.1 Compatibility issues
  - 10.1.2 Whole house distribution of VoIP
  - 10.1.3 Performance and Quality of Service (QoS)
- 10.2 POTS
  - 10.2.1 Cross talk
  - 10.2.2 Radio interference
  - 10.2.3 Dead ports
  - 10.2.4 REN (Ringer Equivalence Number)

#### **EIMT 11.0 — Describe and define fundamentals of telephone systems.**

- 11.1 Multi-line
- 11.2 Paging
- 11.3 Intercom
- 11.4 Voice messaging / Unified messaging
- 11.5 Door entry / gate entry
- 11.6 PBX
- 11.7 Key systems
- 11.8 Telecommunication services (e.g. caller ID, voice mail, Rollover)

### **Security and Surveillance Systems**

#### **EIMT 12.0 — Maintain, configure and troubleshoot basic security systems and applications.**

- 12.1 Define monitored and notification methods.
  - 12.1.1 Phone line
  - 12.1.2 Cell phone
  - 12.1.3 Radio frequency
  - 12.1.4 IP based

#### **EIMT 13.0 — Describe basic security terminology and apply installation procedures and methodologies.**

- 13.1 Installation and configuration of security panel
  - 13.1.1 Zone types
  - 13.1.2 Delays
  - 13.1.3 Battery backup and power supply requirements
- 13.2. Monitoring formats
  - 13.2.1 SIA and Contact ID
  - 13.2.2 4/2 and 3/1
- 13.3 Define types of peripherals and accessories.
  - 13.3.1 Motion sensors
  - 13.3.2 Glass break detectors
  - 13.3.3 Magnetic contacts
  - 13.3.4 Smoke fire (e.g. smoke detection, heat detection)
  - 13.3.5 Environmental sensors (e.g. carbon monoxide, gas, water, temperature)
  - 13.3.6 Vehicle detection
  - 13.3.7 Photo-electric beam devices
  - 13.3.8 Microwave beam devices
  - 13.3.9 Pressure sensors
  - 13.3.10 Sirens, strobes
  - 13.3.11 Security keypads
  - 13.3.12 Keyfobs
  - 13.3.13 Panic buttons
- 13.4 Describe security infrastructure types.
  - 13.4.1 Wired\_22/4- standard power devices\_22/2- Magnetic contacts\_2 and 4 conductor fire wire (e.g. keypads, sounders, Power supplies, smoke and fire detectors)\_ Power supervision relays\_ Polarity reversal relays\_ Line seizure\_ End of line resistors.)
  - 13.4.2 Wireless
- 13.5 Identify access control devices and protocols
  - 13.5.1 Devices (e.g. Keypads, Card readers, Biometric readers, Proximity readers, Door strikes,

- Electronic deadbolts, Magnetic Locks.)
- 13.5.2 Protocols (e.g., Weigand)

**EIMT 14.0 — Identify, configure, install, maintain and troubleshoot security and surveillance cameras.**

- 14.1 Camera Types
  - 14.1.1 IP
  - 14.1.2 Analog
  - 14.1.3 Hybrid
- 14.2 Camera specifications
  - 14.2.1 Lens type
  - 14.2.2 Lux rating
  - 14.2.3 Resolution
  - 14.2.4 B&W vs. Color
  - 14.2.5 IR illumination
  - 14.2.6 Power consumption
- 14.3 Camera applications
  - 14.3.1 Indoor/outdoor
  - 14.3.2 Day/Night
  - 14.3.3 Fixed vs. animated
  - 14.3.4 Surveillance (e.g. door cams, nanny cams)
  - 14.3.5 Recording (e.g. DVR, Triggers – internal vs. external detection)
  - 14.3.6 Sequencing vs. multiplexing

**Home Control and Management**

**EIMT 15.0 — Identify user interfaces and their appropriate applications**

- 15.1 Device types
  - 15.1.1 Remote controls
  - 15.1.2 Keypads
  - 15.1.3 Touchscreens
  - 15.1.4 Keyfobs
  - 15.1.5 Telephones
  - 15.1.6 Smartphones
  - 15.1.7 Cell phones
  - 15.1.8 PDA's
  - 15.1.9 Web tablets
  - 15.1.10 Personal computers
  - 15.1.11 laptops
- 15.2 Describe the importance of simplicity and ease of use as it pertains to the end user.

**EIMT 16.0 — Define and recognize control systems which integrate subsystems in the home. Describe their functionality, characteristics and purpose**

- 16.1 Embedded control systems and Personal computer (PC) based control systems
  - 16.1.1 Compatibility and interoperability issues

**EIMT 17.0 — Identify commonly used communication protocols and their application**

- 17.1 IR
- 17.2 Serial
- 17.3 IP
- 17.4 RF
- 17.5 Bluetooth
- 17.6 Contact closure
- 17.7 Inputs (zones)
- 17.8 Z-wave and Zigbee
- 17.9 ASCII
- 17.10 Proprietary protocols

**EIMT 18.0 — Describe basic HVAC (Heating Ventilation and Air Conditioning) terminology and install peripheral control devices.**

- 18.1 Control layer
  - 18.1.1 Compatibility
- 18.2 Communication layer
  - 18.2.1 Compatibility
  - 18.2.2 IP based, wireless, serial and proprietary
- 18.3 Zones HVAC
  - 18.3.1 Master slave configuration
  - 18.3.2 Microprocessor controlled configuration
- 18.4 Programmable thermostats
- 18.5 Importance of referencing manufacturer specification and compatibility.

**EIMT 19.0 — Describe basic lighting terminology and install peripheral control devices**

- 19.1 Identify lighting control applications
  - 19.1.1 Indoor and outdoor
  - 19.1.2 Centralized and distributed
  - 19.1.3 Dimming
  - 19.1.4 Scenes
  - 19.1.5 Relay/ switching
  - 19.1.6 Occupancy / motion sensing
  - 19.1.7 Time and event driven
  - 19.1.8 Window treatments
  - 19.1.9 Energy management
  - 19.1.10 Security interface
  - 19.1.11 Lighting connectivity
  - 19.1.12 Motor speed control
- 19.2 Communication interface/bridge
  - 19.2.1 Power line phase Couplers
- 19.3 Identify lighting control protocols (Open standards)
  - 19.3.1 Z-wave
  - 19.3.2 ZigBee
  - 19.3.3 Powerline carrier (X10 protocol /PLC)

- 19.3.4 UPB (Universal Powerline Bus)
- 19.4 Proprietary RF and proprietary low voltage
- 19.4.1 Recognize compatibility issues

**EIMT 20.0 — Identify and install component power protection devices**

- 20.1 Identify whole house protection options
  - 20.1.1 Surge Suppression
  - 20.1.2 Power Conditioning
- 20.2 Identify and install point protection
  - 20.2.1 Surge protectors (high voltage and ancillary low voltage devices: e.g. satellite, CATV, etc.)
  - 20.2.2 UPS (Uninterruptible Power Supply)
  - 20.2.3 Power Conditioning

***Troubleshooting Methodology and Documentation***

**EIMT 21.0 — Identify and apply the fundamentals of troubleshooting and diagnostics**

- 21.1 Use of testing equipment
  - 21.1.1 Multimeter
  - 21.1.2 Telephone buttset
  - 21.1.3 Toner
  - 21.1.4 Signal generation
  - 21.1.5 Cable tester
- 21.2 Refer to prior documentation
- 21.3 Demonstrate when to communicate with technical support and what information is relevant.
- 21.4 Troubleshoot common wireless interference issues: Infrared, Radio Frequency, etc.
- 21.5 Identify demarcation and responsibilities of associated trades and /or utilities.

**EIMT 22.0 — Given a scenario, demonstrate how to apply troubleshooting skills to integrate subsystems.**

- 22.1 Networking
- 22.2 Audio/Video
- 22.3 Telephony
- 22.4 Security
- 22.5 Home control

**EIMT 23.0 — List and describe the benefits of verification of installation.**

- 23.1 Properly label wires
- 23.2 Wire mapping
- 23.3 Importance of documenting work upon completion
  - 23.3.1 Input/Output verification for all

systems

- 23.3 2 Document wire placement
- 23.4 Certification of cable installation

**EIMT 24.0 — Deliver appropriate manuals and documentation to the end user upon completion of installation.**

- 24.1 Select, archive and appropriately distribute critical system information: Passwords, access codes, user ID's, credentials, etc.

**EIMT 25.0 — Ability to safely measure AC and DC voltages**

- 25.1 Measure AC and DC voltages using a digital multimeter (DMM).
- 25.2 Measure AC and DC current using a digital multimeter (DMM).
- 25.3 Measure the resistance of a circuit consisting of resistors using a digital multimeter (DMM).

**EIMT 26.0 — Ability to test basic analog and digital circuits and repair them**

- 26.1 Setup and operate test equipment for analog circuits
- 26.2 Troubleshoot switching power supplies
- 26.3 Analyze motor and phase control circuits
- 26.4 Apply logical and systematic approach to troubleshooting analog circuit devices

**EIMT 27.0 — Ability to use multimeters, oscilloscopes, and interpret results**

- 27.1 Solve basic trigonometric problems as applicable to electronics (prerequisite to AC)
- 27.2 Identify properties of an AC signal
- 27.3 Identify AC sources
- 27.4 Analyze and measure AC signals using oscilloscope, frequency meters and generators
- 27.5 Analyze, construct and troubleshoot AC capacitive circuits, AC inductive circuits, RLC circuits (Series, Parallel, Complex) series and parallel resonant circuits, filter circuits and polyphase circuits
- 27.6 Analyze basic motor theory and operation
- 27.7 Analyze basic generator theory and operation
- 27.8 Setup and operate oscilloscopes, frequency counters, signal generators, capacitor-inductor analyzers and impedance bridges for AC circuits

27.9 Analyze and apply principles of transformers to AC circuits

### Committee Identified Academic Skills

The technical committee has identified that the following academic skills are embedded in this contest.

#### Math Skills

- Solve practical problems involving percents
- Solve single variable algebraic expressions
- Solve multiple variable algebraic expressions
- Make comparisons, predictions and inferences using graphs and charts

#### Science Skills

- Plan and conduct a scientific investigation
- Use knowledge of the particle theory of matter
- Describe characteristics of types of matter based on physical and chemical properties
- Use knowledge of physical properties (shape, density, solubility, odor, melting point, boiling point, color)
- Use knowledge of classification of elements as metals, metalloids and nonmetals
- Understand Law of Conservation of Matter and Energy
- Describe phases of matter
- Describe and identify physical changes to matter
- Use knowledge of potential and kinetic energy
- Use knowledge of mechanical, chemical, and electrical energy
- Use knowledge of heat, light and sound energy
- Use knowledge of temperature scales, heat and heat transfer
- Use knowledge of work, force, mechanical advantage, efficiency and power
- Use knowledge of simple machines, compound machines, powered vehicles, rockets and restraining devices
- Use knowledge of principles of electricity and magnetism
- Use knowledge of static electricity, current electricity and circuits
- Use knowledge of magnetic fields and electromagnets
- Use knowledge of motors and generators

#### Language Arts Skills

- Demonstrate comprehension of a variety of informational texts
- Use text structures to aid comprehension

- Demonstrate knowledge of appropriate reference materials
- Use print, electronic databases and online resources to access information in books and articles

### Connections to National Standards

State-level academic curriculum specialists identified the following connections to national academic standards.

#### Math Standards

- Numbers and operations
- Algebra
- Geometry
- Measurement
- Data analysis and probability
- Problem solving
- Reasoning and proof

**Source:** NCTM Principles and Standards for School Mathematics. To view high school standards, visit: [standards.nctm.org/document/chapter7/index.htm](http://standards.nctm.org/document/chapter7/index.htm). Select "Standards" from menu.

#### Science Standards

- Understands the structure and properties of matter
- Understands the sources and properties of energy
- Understands forces and motion
- Understands the nature of scientific knowledge
- Understands the nature of scientific inquiry

**Source:** McREL compendium of national science standards. To view and search the compendium, visit: [www.mcrel.org/standards-benchmarks/](http://www.mcrel.org/standards-benchmarks/).

#### Language Arts Standards

- Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works
- Students apply a wide range of strategies to comprehend, interpret, evaluate and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies and their understanding of textual features (e.g., sound-

letter correspondence, sentence structure, context, graphics)

- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes
- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes
- Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language and genre to create, critique and discuss print and nonprint texts
- Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information)

**Source:** IRA/NCTE Standards for the English Language Arts. To view the standards, visit:

[www.readwritethink.org/standards/index.html](http://www.readwritethink.org/standards/index.html).