BULLETIN 2002 - 04   **Date: January 9, 2002**

U.S. Department of Labor Employment and Training Administration Office of Apprenticeship Training, Employer and Labor Services (OATELS) Washington, D.C. 20210	Distribution: A-541 Headquarters A-544 All Field Tech A-547 SD+RD+SAC+; Lab.Com	Subject: New Apprenticeable Occupation Electronic Systems Technician Code: 200
Symbols: DSNIP/FDK		Action: Immediate

PURPOSE: To transmit to the Office of Apprenticeship Training, Employer and Labor Services (OATELS), Bureau of Apprenticeship and Training (BAT) Staff the recognition of a new apprenticeable occupation:

Electronic Systems Technician
O*NET Code:49-2022.03
AIMS Code: 1041
Training Term: 8000
Type of Training: Time - based

BACKGROUND: Jeff Quint submitted the Electronic Systems Technician occupation on behalf National Systems Contractors Association. The Electronic Systems Technician's primary task are the design and/or integration and field, maintenance/service of cabling infrastructure and products that transport low voltage (less than 100 volts) voice, video, audio and data signals in a commercial or residential setting; products that capture and display or otherwise annunciate signals; products that control signals and products that use signals to control mechanical and electrical apparatus.

A copy of the work process schedule is attached for your information.

ACTION: OATELS staff should familiarize themselves with this new occupation.

If you have any additional questions please contact (202) 693-3813.

Attachment

WORK PROCESS SCHEDULE
ELECTRONIC SYSTEMS TECHNICIAN
O*NET Code: 49-2022.03   RAIS Code: 1041

DESCRIPTION: An Electronic Systems Technician is an individual whose primary occupation is the design and/or integration, installation and field maintenance/service of:
- cabling infrastructure and products that transport low voltage (less than 100 volts) voice, video, audio and data signals in a commercial or residential premises;
- products that capture and display or otherwise annunciate signals;
- products that control signals; and
- products that use signals to control mechanical and electrical apparatus.

On- The -Job Training

The apprentice will practice the following work processes, demonstrating competency in them over the course of the four years of the program. This constitutes the on-the-job training portion of the apprenticeship. Each general work process is further broken down into specific constituent processes for clarification.

Work Processes	Approx. Hours
Prepare for System Installation	**800**

- Review & understand electronic system requirements & documentation (blueprints, etc)
- Perform site survey
- Develop overall job plan
- Organize technical work plan
- Complete pre-assemblies & fabrication of sub systems
- Gather inventory/parts
- Pre-test components
- Inventory tools

Wire Buildings	**800**

- Use documentation to lay out components
- Secure area – drop cloths- safety cones, etc.
- Rough in device component locations
- Install cable support structure or drill wire paths
- Pull & secure wire
- Label tag wire /cable per documentation

Trim	**1500**

- Pre-termination functions
  - Prepare cable ends
  - Route cable
- Connect passive devices
  - Connectors
  - Outlets
  - Patch panels
- Splicing
- Intermediate termination

Work Processes	Approx. Hours
Install Components	**1500**

- Remote location components
- Central /main location

Configure- Program	**500**

- Calibrate & align electronically and physically
- Install or enter control programs, if applicable (complex)
- Setup system instructions labels, etc (simple)

Test, Troubleshooting, Debug	**800**

- Power up
- Operate and test functions
- Evaluate performance
- Identify problems, errors, discrepancies
- Diagnose causes of problems
- Take remedial action
- Document actions (See documentation section)

Train Users	**500**

- Review user documentation manuals & instructions
- Identify training objectives
- Confirm actual users and their requirements
- Procure – develop training & user aids manuals tip sheets
- Demonstrate system function- guide user through system
- Observe user using the system- have customer demonstrate knowledge of system
- Communicate results of training back to all relevant parties

Documentation	**800**

- Review final blueprints, wiring diagrams, and hookup instructions
- Complete work reports and time sheets
- Provide/prepare/deliver system documentation

  - User manual and training materials

  - As built drawings

  - Zone diagrams

  - Equipment lists

  - Warranty paperwork

Maintenance & Repair	**800**

- Maintenance

  - Perform scheduled preventive maintenance

- Repair

  - Diagnose problems

- Read documentation

TOTAL HOURS	**8000**

RELATED INSTRUCTION OUTLINE

The instructional portion of these EST apprenticeship standards is designed to employ the "Electronic Systems Technician" program in the "Wheels of Learning" series of publications and materials developed by the Consortium for Electronic Systems Technician Training and the National Center for Construction Education & Research (NCCER). There are four levels of instructional materials, including a trainee guide and an instructor guide for each level.

First Year   **Approx. Hours**

Introduction to the Trade   **10 hours**
Reviews the purpose and scope of the electronic systems industry. Explains the technician's role in the industry. States the rules for professional and ethical conduct. Describes the importance of codes and standards and explains how they affect the work of an EST (Electronic Systems Technician).

Basic Safety   **15 hours**
Provides a comprehensive overview of safety rules and precautions for working on construction job sites.

Basic Math   **15 hours**
Provides refresher practice in addition, subtraction, multiplication, and division of whole, decimal, and fractional numbers.

Introduction to Hand Tools   **10 hours**
Explains the selection, inspection, use and maintenance of common hand tools.

Introduction to Power Tools   **5 hours**
Explains the selection, inspection, use and maintenance of common power tools.

Introduction to Blueprints   **7.5 hours**
Reviews the basic components of blueprints, including title blocks, lines, symbols, and revision symbols.

Basic Rigging   **20 hours**
Explains rigging safety, allows for practice. Reviews types of rigging equipment, inspection procedures. Reviews crane hand signals, types of derricks and cranes. How to tie different types of knots. How to estimate size, weight, and center of gravity.

Construction Materials & Methods `   **15 hours**
Covers the uses and composition of common types of residential and commercial building materials. Reviews the major structural components of residential and commercial buildings and common methods of construction, including suspended ceilings, cable raceways. Explains how to select the appropriate drills, bits, and cutting tools for making openings in various types of construction materials. Explains how to install plywood on a gypsum board wall.

Pathways and Spaces   **15 hours**
Orients apprentice to various types of cable trays, raceways, fittings, and provides strategies for selecting the appropriate size and type for a given application. Reviews methods used to install raceways. Reviews NEC® raceway requirements. Reviews procedures for installing and leveling D-rings and mushrooms, making a conduit-to-box connection, selecting cable support hardware for a given application, and installing an outlet box in drywall.

Fasteners & Anchors   **5 hours**
Reviews and explains the use of threaded and non-threaded fasteners, anchors. Reviews the

correct application of fasteners and anchors and how to install them.

Hand Bending of Conduit   **7.5 hours**
Reviews the various methods of hand-bending and installing conduit. Reviews how to use math formulas to determine conduit bends. Provides practice in making various kinds of conduit bends, and cutting, reaming, and threading of conduit.

Electrical Theory One   **7.5 hours**
Covers atomic structure as it is related to electricity. Reviews the definition of voltage and the ways in which it can be produced. Reviews the difference between conductors and insulators. Defines the units of measurement that are used to measure the properties of electricity. Explains how voltage, current, and resistance are inter-related. Reviews Ohm's Law and describes how to calculate an unknown value. Reviews the different types of meters used to measure voltage, current, and resistance. Describes how to use the power formula and calculate the amount of power used by a circuit.

Electrical Safety   **12.5 hours**
Reviews safe working procedures in a construction environment. Explains the purpose of OSHA and how it promotes safety on the job. Reviews electrical hazards and how to avoid or minimize them in the workplace. Explains safety issues concerning lockout/tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection systems.

Low-Voltage Cabling   **20 hours**
Explains the various sizes and gauges of wire in accordance with the American Wire Gauge (AWG) standards and describes how to determine the proper gauge for an application. Reviews how to read and identify markings on conductors and cables. Describes the different materials from which conductors are made. Describes the different types of conductor insulation. Describes the color-coding of insulation. Reviews selected NEC low-voltage cable classifications. Reviews procedures to plan and set up for a cable pull. Explains how to properly install a pull line for a cable pulling operation. Explains how to prepare the ends of conductors for pulling and safely pull cable through conduit in vertical and horizontal pathways. Reviews how to wrap, tie, fasten, label, and protect cable, and explains the importance of maintaining the proper slack. Describes the installation of cables in cable trays. Reviews the restrictions imposed by the NEC® on the uses of various types of cable.

1st Year Instructional Hours Sub-Total   **165**

2nd Year   **Approx. hours**
Craft-Related Mathematics   **7.5 Hour**
This instruction expands on the knowledge gained in the Basic Math module. Emphasis is placed on the metric system, including how to convert between corresponding English and Metric system units. Also covered are the use of scientific notation, powers and roots, and the basic concepts of algebra, geometry, and right-angle trigonometry.

Electrical Theory II   **12.5 Hours**
Introduces series, parallel, and series-parallel DC circuits. Covers Kirchoff's Voltage and Current Laws, and circuit analysis. Also provides an introduction AC theory, components, and circuits.

Basic Electronics   **10 Hours**
Covers the principles of electronics and provides an introduction to semiconductor theory, components, and applications.

Electrical Test Equipment   **15 hour**
Covers selection, inspection, use, and maintenance of common electrical test equipment, including meters, oscilloscopes, meggers, wattmeters, frequency meters, time domain reflectometers, continuity testers, recording instruments, and RF analyzers.

Power Quality and Grounding   **20 hours**
Covers the purpose for grounding and bonding of electrical systems. NEC regulations pertaining to grounding and bonding are thoroughly covered. Equipment and devices used for grounding and bonding are covered including their methods of installation. Also introduced in this module is an explanation of power quality, along with the causes and effects of poor power quality. Equipment and devices used to maintain good power quality are covered.

Introduction to Electrical Blueprints   **7.5 hours**
Covers electrical prints, drawings, and symbols. Apprentices learn the types of information they can find on schematics, one-line drawings, and wiring diagrams.

Voice and Data Systems   **25 hours**
Presents background information for the installation and termination of telephone and data systems. Emphasis is placed on the different schemes used for premises wiring of these systems. Cables, cabling terminating devices, installation guidelines, and troubleshooting methods used with voice and data system cabling are also introduced.

Switching Devices and Timers   **10 hours**
Presents the principles of operation and describes the different types and configurations of switches, relays, timers, and photoelectric devices. Guidelines for the selection of appropriate devices using specification sheets are also covered.

Terminating Conductors   **15 hours**
Provides information and detailed instructions for selecting, installing, and testing connectors and other terminating devices on the various cables used in low-voltage work, including telecommunications, video and audio, and fiber optic.

Introduction to Codes and Standards   **10 hours**
This module describes the scope and content of the major codes and standards that apply to the telecommunications, life safety, security, and other low-voltage systems. Emphasis is placed on the familiarization and use of the National Electrical Code® (NEC®).

Computer Applications   **20 hours**
Reviews common terms related to computers and computer networks. Reviews the components of a personal computer and explains the function of each. Reviews the procedures for uploading and downloading files to security, lighting control, or fire systems. Explains how to build and test a null modem cable. Describes how to set up and configure a personal computer. Steps trainee goes through procedures on how to use the application of loading software onto a computer and on using the computer to perform a task. Explains the function of each level of the open systems, interconnection (OSI) and reference model for data communication. Describes the characteristics of and uses for various types of data transmission media. Describes the function of the internet as it relates to network protocols.

2nd Year Instructional Hours Sub-Total   **152.5**
3rd Year   **Approx. Hours**

Cable Selection **15 hours**

Covers the selection of cables for specific applications. Explains how to calculate voltage drop for various applications. Explains how to interpret and apply NEC regulations governing conductors and cables. Explains how to size cable conductors for a given load. Practice in applying various formulas and charts for load calculations.

Busses and Networks **25 hours**

Explains the function of each level of the open systems interconnection (OSI) reference model for data communication. Describes the characteristics of and uses for various types of data transmission media. Explains how communication devices are connected to a transmission medium. Explains the methods of providing access control. Explains the operating principles of network topologies and how information is transferred using them. Describes the functional interrelationship between the OSI model layers and the network protocol. Describes the function of the Internet as it relates to network protocols. Explains the composition of microcomputer-based local area networks (LANs). Describes the various proprietary control networks. Describes the functions of bridges, routers, and gateways. Reviews the protocols used with wide area networks (WANs).

Fiber Optics **20 hours**

Explains the basic principles of fiber optic technology, including: fundamentals, benefits, and applications of a fiber optic system; operational considerations of a fiber optic system; construction of an optical fiber; and various types of fiber optic cable. Reviews the design, operation, and performance of a fiber optic transmitter and receiver. Reviews the types and construction of fiber optic detectors. Explains the desirable features and connector losses of a fiber optic connector or splice. Explains and demonstrates the installation of fiber optic cabling and support equipment, the applications and types of fiber optic splicing/termination, and testing procedures for fiber optic systems.

Maintenance and Repair **15 hours**

Explains the difference between maintenance and repair. Describes the general approach to troubleshooting a problem. Reviews the common causes of system and equipment failures. Reviews procedures for isolating common problems in a system or software and common faults in wiring and equipment. Reviews common preventive maintenance measures and the method used to determine the frequency and extent of preventive maintenance.

Wireless Communication **15 hours**

Describes the fundamental principles of wireless RF communication and wireless personal communication. Reviews the basic components used in wireless systems and explains the function of each. Explains the basic operating principles of infrared systems and reviews the various types of devices used in those systems. Explains the operating principles and applications of powerline carrier (PLC) systems, wireless computer networks, and satellite communication systems. Reviews the test equipment used in testing and troubleshooting wireless communications systems and the purpose of each piece of equipment. Covers the procedure for installing and testing an RF or IR wireless communication system and antennas.

Video Systems **15 hours**

Describes the basic components of a cable television system, including coaxial cable. Reviews the advantages and disadvantages of a flat transmission line. Reviews the requirements for impedance matching of cables, including standing wave ratio and signal-to-noise ratio. Explains the power and signal loss calculations for coax cable distribution systems. Describes the operation of equipment for signal analysis and level measurement. Describes the operation of satellite television systems, broadcast television antenna systems, closed-circuit television (CCTV) systems, master antenna and satellite master antenna television systems, and system grounding for interference suppression.

Audio Systems **20 hours**

Describes audio system components including sources, amplification equipment, signal processing devices and reproduction devices. Describes fundamental technical audio issues such as room acoustics, background noise, free space attenuation and echoes. Explains power requirements, cabling options, system configurations and basic design considerations. Covers standard procedures for system installation from a building code perspective and best practices for system testing and troubleshooting. Reviews the common test equipment used during installation and troubleshooting.

Media Management Systems **10 hours**
Explains the basic principles behind shared media resources and access to them via a computer network or hardwire application. Describes media types used for origination sources both on an analog and digital platform including optical storage devices. Explains cabling options including fiber optic interfaces, broadband and baseband systems and twisted pair topologies. Describes user interfaces and software commonly used for this application. Reviews installation practices, common testing and troubleshooting procedures and user training techniques.

Rack Assembly **15 hours**
Describes best practices for assembling electronic system enclosures including power sequencing, grounding, weight distribution and heat dissipation. Explains cable routing based on signal levels being transmitted within the rack. Describes structural requirements and seismic considerations for various environments and applications. Explains electrical power distribution and load calculation for equipment being housed within the rack. Covers electrical inspector's expectations for power and connection to the building grounding system.

User Training & System Commissioning **15 hours**
Describes the industry's best practices for project close-out and end-user required training. Explains documentation and owners manuals that are required. Describes levels of training required based on owners personnel ranging from system operators to facility managers. Covers the basics in final testing and close-out procedures on typical systems and how to build this in as part of the overall project. Describes customer satisfaction levels and expectations on what materials need to be turned over during the cut-over phase of the project.

3rd Year Instructional Hours Sub-Total **165**

Site Survey, Project Planning, and Documentation   **15 hours**

Describes the general procedure and steps involved when estimating a job for the purpose of submitting a bid, and the steps required to properly plan and complete a job once a contract for the job has been awarded. Reviews how to interpret contractual documents, working drawings, and specifications pertaining to a job to determine the requirements and scope of the work. Explains how to perform a site survey in order to establish or confirm the installed locations of new and/or existing equipment and the routing of the related cabling. Reviews how to develop a schedule for accomplishing a job or task from start to finish that efficiently accomplishes the work and is also compatible with the work performed by other trades. Describes the general procedures for accomplishing a job, including those that apply to assuring compliance with codes and standards and the control of materials, tools, and equipment.

Introduction to Supervision   **15 hours**

Describes the role of the supervisor in the construction industry. Defines an organization chart and explains why it is important to know where you fit in. Describes the personal qualities and various traits of an effective leader/supervisor. Explains how to communicate effectively. Describes motivational techniques and how they are used to get other to perform. Explains the various elements of leadership and how these are used by the supervisor on the job site. Describes the systematic problem-solving technique when dealing with personnel problems. Reviews some of the major construction documents, describes their purposes, and explains how certain documents affect the role of the supervisor. Describes how a job is closed out and how to staff a job. Explains how to develop a training program and orient a new employee to the company and job. Reviews scheduling and several types of project schedules. Describes the role the supervisor plays in job site safety.

Fire Alarm Systems   **40 hours**

Reviews the components of a fire alarm system. Explains how to calculate battery standby and total system load. Describes how to calculate voltage drop of a notification appliance circuit (NAC). Explains the difference between photo/ion/hear, multi, and uv/iv sensors. Demonstrates how to draw a 2-wire/4-wire initiating device circuit (IDC). Explains how to install and troubleshoot a 4-wire initiating device circuit. Covers how to use the National Fire Alarm Code to lay out the proper smoke detector location for a door-holder application. Covers how to use the NFA Code to determine the locations and number of detectors required in a newly-constructed residential dwelling.

Security Systems   **30 hours**

Reviews the types of services security systems provide, including burglar alarm (BA), Hold-up alarm (HUA), Access control, CCTV, and local vs. monitored services. Reviews the various types of sensors, their applications and connection methods--including hardwire (zone), multiplex (point), and wireless (point). Reviews the standard types of indicating devices (bells, sirens). Describes the various types of control panels. Explains the various types of wiring methods. Describes primary and standby power requirements. Reviews basic system design concerns, including detector location, UL requirements, and false alarm prevention. Reviews systems programming options (entry/exit delays). Covers procedures for testing and maintenance of security systems.

Nurse Call & Signaling Systems   **15 hours**

Covers basic emergency call and duress system requirements based on facility type. Explains the different system configurations and wiring schemes based on system type. Describes the installation procedures based on facility types and the U.L. and other building code specifications that dictate the use of these systems. Explains the connectivity options to auxiliary devices such as remote signaling systems, PBX and pagers, electronic beds and other systems. Describes the requirements for proper grounding and static discharge tolerance on the components. Covers system troubleshooting and testing procedures along with code compliance.

CCTV Systems   **15 hours**

Describes the basics for installation and configurations of closed circuit TV equipment. Explains

system components such as cameras, remote-positioning devices, sequential switches and monitors. Explains building code and laws governing the use of these systems and the basics on integration to graphic user interfaces. Covers the test equipment and procedures for testing and troubleshooting. Explains cabling options and the interfaces used for media conversion.

Broadband (MATV) Systems   **15 hours**
Describes the major elements of head-end design and installation including antenna or satellite options, receivers and modulators, and amplification and distribution devices. Explains coaxial and optical fiber distribution methods and the function of all devices used to distribute signals for an internal or external system. Covers proper signal levels, cable attenuation, insertion loss and acceptable carrier-to-noise levels. Explains the common test equipment and troubleshooting procedures.

Systems Integration   **20 hours**
Presents the big picture concepts for connecting two or more stand-alone systems together that will improve the capabilities of each system. Describes the best practices for interoperability and system performance. Explains the various interconnection options and protocols commonly used for integration. Covers network configurations used, wiring schemes and fault-tolerant procedures designed for system redundancy. Covers graphic user interfaces and custom application-driven solutions commonly used in today's high tech building automation systems.

4th Year Instructional Hours Sub-Total   **165**