

# Competency Requirements CEST— 2007

## Consumer Electronics Service Technician specialty—C.E.S.T.

*Consumer Electronics Service Technicians are expected to have knowledge and abilities to operate, install and service home electronics products. These include television, VCR's, CD's, DVD's, radio, audio and video equipment, not including computers, satellite reception systems or home security/environment components. With minimal training in areas unique to this specialty the CEST should become proficient in consumer electronics servicing.*

*Consumer Electronics Service Technicians must be knowledgeable and have abilities in the following technical areas: Prerequisite for CEST training is an approved BASIC Electronics course.*

### 1.0 TV ANTENNAS

- 1.1 Explain the major segments of Cable TV signals, preferred levels for consumer product and common faults
- 1.2 Describe TV antenna construction, types, gain, polar patterns and frequency characteristics
- 1.3 Illustrate TV - radio wave propagation—electrostatic and electromagnetic fields
- 1.4 Characterize reflected signals and multi-source interference
- 1.5 List major types of broadcast TV-radio signal interference
- 1.6 Outline the differences in satellite and other common terrestrial TV-radio signals
- 1.7 Outline rooftop antenna installation theory and procedures
- 1.8 Define antenna resonant frequency
- 1.9 Enumerate antenna-heights safety practices
- 1.10 Describe the purposes and installation procedures for towers, rotors, pre-amplifiers and accessories
- 1.11 Explain signal range and sensitivity and the differences between 8VSB, DBV and analog signals
- 1.12 Detail digital TV signal reception considerations (direct & multi-path effects on digital and analog)
- 1.13 Set down the reasons for and standard procedures used in grounding (antennas and cables)

### 2.0 HAND TOOLS—SUPPLIES

- 2.1 Demonstrate skills and safety practices for basic tools (pliers, wrenches, screwdrivers, hack saws, hand drills—(wood and masonry), hammers, files, clamps, ratchets and socket sets, levels, vises, pipe cutters, staplers and side-cuts).
- 2.2 Perform crimping and stripping of coax and telephone cables using common prep tools
- 2.3 Demonstrate proper and safe use of power drills, including outside, floor and wall cable accessing
- 2.4 List common wall fish equipment
- 2.5 Demonstrate proficiency in soldering and desoldering, including use of equipment, heat shunts and solder
- 2.6 Enumerate safety and usage practices for electric bench grinders
- 2.7 List the precautions and proper uses of cleaners & chemicals commonly used in consumer electronic servicing
- 2.8 Describe protective gear while using tools and the reasons for using it

### 3.0 CABLING

- 3.1. Set forth the common uses for coaxial cable and explain its properties and types
- 3.2 Define twisted pair cabling and compare classifications as they relate to frequency limits
- 3.3 Interpret the phrase 'Impedance matching' and explain its relationship to cable termination-standing waves
- 3.4 Characterize frequency tilt and compensation and explain its importance in balancing signal levels
- 3.5 Demonstrate proper waterproofing of outdoor cable connections
- 3.6 Measure cable signal levels and explain testing procedures for finding faults
- 3.10 Explain methods and precautions for wall fishing and routing cables in attics and crawl spaces

- 3.11 Explain the reasons for grounding, lightning and surge protection
- 3.12 Describe the purposes of splitters, fittings and diplexers and set forth the expected losses for each
- 3.13 Express the reasons for NEC and NFPC standards and list those of major concern to C.E. technicians
- 3.14 Explain shielding and define RFI ingress and egress and their detrimental effects

#### **4.0 SAFETY**

- 4.1 Detail electrical safety practices
- 4.2 Express TV-CRT handling safety precautions
- 4.3 Set down a list of truck and service vehicle dangers
- 4.4 Outline working at heights dangers and explain OSHA rules
- 4.5 Enumerate machinery and tools dangers and list proper safety precautions for each
- 4.6 Describe heavy/bulky products lifting hazards and special moving equipment
- 4.7 List chemicals commonly used in consumer electronics service work and precautions for each
- 4.8 Describe environment hazardous materials and proper handling/disposal
- 4.9 Characterize in-home hazards and precautions for service workers
- 4.10 Detail special precautions when working with TV high voltage and power supplies
- 4.11 Demonstrate special precautions required to prevent static damage to electronic components
- 4.12 Explain reasons for and method used to achieve electrical line isolation
- 4.13 List types of protective gear and clothing and reasons for each
- 4.14 Characterize First Aid, its proper usage and precautions

#### **5.0 COMPONENTS**

- 5.1 Describe and compare common consumer electronics display devices
- 5.2 Explain loudspeaker technology, power, frequency and usages
- 5.3 Describe remote hand unit theory, operation and service practicalities
- 5.4 List types of fuses, circuit breakers, ground fault circuit interrupters and uses of each
- 5.5 Detail precautions and procedures for replacement of special fire and X-ray circuitry parts
- 5.6 Sketch the major sections of a TV/VCR tuner and calculate the frequencies involved
- 5.7 Depict the purpose of degauss coils, both built-in and as a service tool
- 5.8 List the special purposes of thyristers SCRs, triacs, diacs and opto-isolators
- 5.8 Illustrate how an audio module works and show a procedure for troubleshooting a fault in it
- 5.10 Identify the pin connections on common C.E. chips and modules
- 5.11 Interpret special color coding and identifications used in C.E. repair
- 5.12 External AC power modules
- 5.13 Special IC circuits (Integrators, differentiators and digital chips)
- 5.14 Explain how audio & video tape recording/play heads work and methods of fault finding
- 5.15 Detail surface-mount board troubleshooting and parts replacement procedures
- 5.15 Interpret component rating and measurement specifications
- 5.16 Compare component testing, in and out of circuit

#### **6.0 AMPLIFIERS**

- 6.1 Describe the purposes of TV-radio signal boosters and common locations for them
- 6.2 Describe the differences between TV amplifiers (RF, IF, Video, Audio)
- 6.3 Sketch the functional sections of a radio tuner and show signal levels and frequencies
- 6.4 Express the differences between phono, CD, Mic and P.A. amplifiers
- 6.5 Analyze the need for and methods used for equalizers and tone controls
- 6.6 Identify the mechanical control devices used in VCRs, CDs and DVDs
- 6.7 Compare the differences in stereo & multi-channel sound systems
- 6.8 Explain the technology of wireless speaker systems
- 6.9 Depict the methods used in multistage amplifier coupling circuits (direct; capacitive, transformer, etc.)
- 6.10 Explain the uses for Operational Amplifiers and show how to increase or decrease gain

- 6.11 Set down methods used in amplifier protection circuits
- 6.12 Describe the purposes for degenerative and regenerative feedback in amplifier circuits
- 6.13 Explain amplifier gain and signal to noise (S/N) ratios
- 6.14 Sketch the most common power output circuit configurations

## **7.0 TV POWER SUPPLIES**

- 7.1 Depict the purposes of power interlocks and fusing
- 7.2 Sketch and compare common low voltage regulated power supply circuits
- 7.3 Explain the concept of integrated high voltage power supply circuits and list precautions
- 7.4 Describe switching power supplies and active filters
- 7.5 Detail the components and operation of projection TV power supplies
- 7.6 Explain and compare the differences between AC-operated and portable TV & battery power supply circuits
- 7.7 Describe shutdown and protection circuits used in TV and other C.E. products
- 7.8 List uses for optical coupling in power supplies

## **8.0 BLOCK DIAGRAMS & SCHEMATICS**

- 8.1 Identify the major sections of a radio
- 8.2 Identify the major sections of audio products (phono, tuner, VCR, aux. circuits)
- 8.3 Analyze the block diagram and schematic for a direct-view TV and a TV tuner-only system
- 8.4 Locate the components used in TV projection systems
- 8.5 Describe the technology of LCD, plasma and HDTV systems
- 8.6 Compare the circuitry of a complete TV set and that of a video monitor
- 8.7 Compare digital circuitry and other (analog) flow charts
- 8.8 Explain the 'Black Box' troubleshooting concept

## **9.0 SPECIAL CE CIRCUITRY AND DEVICES**

- 9.1 Explain how to troubleshoot a faulty TV degauss circuit
- 9.2 Describe the switching and control circuitry for multiple tuner and PIP (picture in picture) circuitry
- 9.3 Compare analog with DTV and HDTV reception systems
- 9.4 Depict the methods for troubleshooting TV—Satellite—VCR combination receivers/recorders
- 9.5 Explain DVD and CD technology and list ways to troubleshoot faults in each
- 9.6 Describe the operation of AGC and AVC circuits
- 9.7 Describe the operation of boost, flyback and buck regulators
- 9.8 Characterize how special monitoring circuits (pressure, temperature, moisture, etc.) may be used in consumer electronics products

## **10.0 DISPLAY DEVICES**

- 10.1 List common usages for LEDs
- 10.2 List common usages for LCDs
- 10.3 Describe the theory of plasma displays and precautions for installation or troubleshooting
- 10.4 Sketch the electron gun of a cathode ray tube and expected voltages on CRT connectors
- 10.5 Describe precautions for projection TV servicing
- 10.6 Compare the operation and circuitry of a video projector with a slide or overhead projector
- 10.7 Demonstrate the proper method of degaussing a TV set
- 10.8 Explain OLED (organic LEDs) technology and why it is used
- 10.9 Illustrate the use of DMD (digital mirror devices)
- 10.10 Describe the concept of LCoS (liquid crystal on silicon) and list products which incorporate LCoS

## 11.0 DIGITAL CIRCUITS & DEVICES

- 11.1 Compare the usage of digital circuitry used today with historical circuits used for similar purposes
- 11.2 Interpret the symbols used to identify digital circuits and components
- 11.3 List digital integrated circuits commonly found in consumer electronic products
- 11.4 Detail digital gates & truth tables and explain tri-state logic
- 11.5 Explain memory methods & data storage as used in computerized CE equipment
- 11.6 Compare sinusoidal and nonsinusoidal oscillators
- 11.7 Explain the purpose and locations for registers & counters
- 11.8 Explain the purpose and locations for clock & timing circuits
- 11.9 Compare common digital display methods
- 11.10 Explain the usages of multiplexers and demultiplexers
- 11.11 Detail the operation of DACs, ADCs and matrix circuits
- 11.12 Describe the need for and usages of decoders and encoders
- 11.13 Sketch the block diagram of a microprocessor and explain its functions
- 11.14 Sketch the block diagram of a microcontroller and list where it might be used in CE products
- 11.15 Compare digital data compression schemes (RLC (Round House Coding), Huffman encoding, etc.)
- 11.16 Describe the purposes of programmable logic devices and gate arrays
- 11.17 Compare digital serial & parallel protocols used in CE devices

## 12.0 COMPUTER APPLICATIONS

- 12.1 Explain how computers may be used as troubleshooting tools
- 12.2 Demonstrate the accessing of product-maker repair assistance
- 12.3 Detail how to utilize Internet product-parts-service literature sources
- 12.4 Demonstrate database entry of customer and service information
- 12.5 Demonstrate ability to use a word processing computer program
- 12.6 Explain programming concepts required by various CE products
- 12.7 Demonstrate online research for parts, tech info and reference data
- 12.8 Locate and demonstrate use of an online training resource
- 12.9 Detail how personal convenience products (PDA's, dictionaries, etc.) may be interconnected with other CE equipment and explain the technology and operation of such units

## 13.0 INTERFACING

- 13.1 Describe problems which may be encountered when interfacing: printers, scanners, FAXs, etc.
- 13.2 Set forth signal levels to be expected at input and output ports of CE products
- 13.3 Explain potential sources of signal conflicts
- 13.4 List symptoms of power source and grounding conflicts
- 13.5 Explain photo-optical video and audio sources and methods of converting from optical to electronic
- 13.6 Depict an example of product incompatibility conflicts
- 13.7 List common types of plug and connectors common to CE products
- 13.8 Describe how and where computer interconnects—modems are used & protocol requirements
- 13.9 List locations and reasons phone and cable hookups may be needed with CE products
- 13.10 Describe optical interfaces (coupling between 2 or more units) and list products in which they are used
- 13.11 Explain where different types of modulation schemes (QAM, VSB, etc.) are used

## 14.0 OPTICAL ELECTRONICS

- 14.1 List locations where laser technology is used in audio or video CE equipment
- 14.2 Explain CD signal recovery techniques and name the components used. Describe RCD technology
- 14.3 Explain DVD signal recovery techniques and name the components used.

- 14.4 List the major sections of electronic camcorders & cameras
- 14.5 Describe basic fiber optics cabling theory and components
- 14.6 Describe the theory of LCD displays and identify components required
- 14.7 Describe the theory of LED displays and unique circuitry used
- 14.8 Explain remote control hand unit basics of operation and one unit control of multiple products
- 14.9 Define CCD (charge coupled devices) and name products they are used in
- 14.10 Compare Infrared uses (CE, auto-focus, intrusion alarms, etc.)

## 15.0 INTERNET

- 15.1 Demonstrate accessing the Internet and utilizing Worldwide Web resources
- 15.2 Illustrate communications with others via Internet
- 15.3 Access product, parts, literature procurement resources
- 15.4 Access a repair-fix data base and describe its usage
- 15.5 Access Industry companies, associations, or information sources and interact
- 15.6 Demonstrate the use of tutorials and on-line training resources

## 16.0 TEST EQUIPMENT

- 16.1 Explain how variacs and isolation transformers are used and the differences between them
- 16.2 Properly connect and operate a pattern generator
- 16.3 Properly connect and operate an Audio and RF signal generator
- 16.4 Measure TV or radio frequencies with a frequency counters and explain the limitations
- 16.5 Explain the uses of each control button of an oscilloscope and explain how oscilloscopes are used
- 16.6 Compare the specification of DC power supplies and explain proper usage
- 16.7 Measure radio, cable and TV signals using a signal level meter
- 16.8 Explain the proper use of pulsers & logic analyzers
- 16.9 Explain the functions and proper usage of video display color temperature measurement/analyzers
- 16.10 Describe how magnifiers can aid board-level electronics technicians
- 16.11 Demonstrate use of an IC extractor
- 16.12 Explain where RF analyzers (signal level meter, spectrum analyzer) are used

## 17.0 TROUBLESHOOTING

- 17.1 Demonstrate proper use of a DMM (digital multimeter)
- 17.2 Explain how to verifying symptoms and make visual checks as the first steps in troubleshooting
- 17.3 Demonstrate making voltage checks
- 17.4 Explain the 'divide & conquer' troubleshooting concept
- 17.5 Detail proper parts substitution & cross referencing to exact specifications (where required)
- 17.6 Explain static & safety issues for bench-level troubleshooter technicians
- 17.7 Describe VCR mechanical cleaning and adjustment
- 17.8 Demonstrate the use of diagnostic programs for troubleshooting assistance
- 17.9 Draw on a product maker's help-desk for repair assistance
- 17.10 Enumerate sources which may offer troubleshooting help
- 17.11 Express the use of flow charts in troubleshooting
- 17.12 Demonstrate proper CRT convergence procedures
- 17.13 Depict the methods of signal injection and tracing

## 18.0 CONTROL CIRCUITRY

- 18.1 Explain where control processes may be used in CE equipment
- 18.2 Explain the electronics technology used in VCR mechanical and control functions
- 18.3 Explain CD functions and how the electronic and mechanical actions are intermeshed
- 18.4 Explain DVD functions and how the electronic and mechanical actions are intermeshed

- 18.5 Describe various TV control circuits and methods
- 18.6 Explain how video control boxes—source selectors may be used to connect multiple signal sources and viewing areas
- 18.7 Sketch the receive circuitry activated by remote control hand units

## 19.0 WORK PRACTICES

- 19.1 Enumerate the electronics shop environment safety and security aspects needed by technicians
- 19.2 List concerns field techs should be aware of in the In-home environment
- 19.3 Detail efficiency, security and safety aspects of vehicle operation by technicians
- 19.4 Itemize the pitfalls which can occur in the process of billing customers for service incidents
- 19.5 Depict the routines which service technicians require in the parts procurement process
- 19.6 Characterize both good and bad examples of cash handling procedures by technicians
- 19.7 Prepare a detailed flow chart which explains warranty claims processing requirements
- 19.8 Outline work bench—work area safety & efficiency 'good' and 'bad' technician practices
- 19.9 Demonstrate obtaining a parts by using supplier reference and data books or catalogs
- 19.10 Special tools and equipment (lifting—power tools—digging equipment)
- 19.11 Describe the detrimental and/or beneficial aspects of disseminating privileged industry information to competitors, suppliers, other employees or product owners
- 19.12 Explain the need to have emergency telephone numbers available in the work environment
- 19.13 Produce an example of good practices 'testing & cleaning' of repaired units after service

### Suggested Study Guides:

- How to Test Almost Everything Electronic; Delton Horn; 304 pp; \$19.95; ISBN 0070304068, McGraw Hill; 1-800-2-MCGRAW
- Maintaining and Repairing VCRs and Camcorders, 5th Ed., 518 pp; \$34.95; 1-800-2-MCGRAW; ISBN 0070248346
- TV Repair for Beginners, 5th Ed; 360 pp; \$44.95; Homer L. Davidson, CET; ISBN 0070158053; 1- 800-2-MCGRAW
- Troubleshoot and Fix Even the Toughest CD Player; Homer L. Davidson, CET;
- Mastering Technical Mathematics, 2nd Ed; 592 pp; \$34.95; ISBN 007024821; Gibilisco & Crowhurst; 1-800-2-MCGRAW

Course length suggestions have not been reevaluated for the CEST specialty course. That is another step in the NCEE efforts to assist public and private educational institutions.

The NCEE C.E.S.T. CURRICULUM—Skills Standards all-industry advisory team will soon be listed on the NCEE web site: [www.NCEE-edu.org](http://www.NCEE-edu.org)