

**Certified Satellite Installer—CSI – 2004E  
COMPETENCIES listing (for NCEE)**

Proposed Skills Standards and Competencies for workers studying to become satellite systems installers and technicians and for use as a curriculum outline for educational institutions providing training for satellite industry personnel.

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**A. BASIC SMALL DISH CAPABILITIES**

**1.0 Satellite Communications History & Theory**

- 1.1 Demonstrate an understanding of electrostatic and electromagnetic wave propagation.
- 1.2 Identify common frequencies utilized by various common services - frequency bands and relationships - TV lo-hi-UHF bands - FM - AM.
- 1.3 Identify C, Ka and Ku frequency bands and the services provided by each
- 1.4 Identify common satellite services available from DBS systems
- 1.5 Describe the process of encoding and decoding satellite programming
- 1.6 List the orbital slots and names of DirecTV and DISH satellites
- 1.7 Explain the term: footprint
- 1.8 Describe the Clarke Belt

**2.0 Satellite Dish Reflectors**

- 2.1 Explain gain of a dish reflector
- 2.2 Explain how the LNBF operates and why it is needed.
- 2.3 Demonstrate ability to track the Clarke belt and aim a DBS dish properly
- 2.4 Explain how the North Star Polaris is related to dish aiming
- 2.5 Describe declination and elevation adjustments required for DBS systems
- 2.6 Explain the terms: FOCAL POINT and FOCAL DISTANCE
- 2.7 Explain how reflector and LNB gain is related to receiver gain
- 2.8 Explain the advantages of offset feed-horns and LNBF's

**3.0 Cabling**

- 3.1 Calculate and measure the signal loss in lengths of RG 6 vs 59 coax cable and compare the two
- 3.2 Demonstrate proper waterproofing of cabling at the dish reflector
- 3.3 Explain building entry - crawl space and attic precautions - wall fishing – carpet-cutting precautions and wall plate usage
- 3.4 Demonstrate the ability to properly install coaxial fittings and splices
- 3.5 Explain methods of overcoming obstacles such as walks, driveways, underground wiring, roots and other impediments in underground cabling
- 3.6 Explain unnecessary length and tight coiling or bending of coaxial cable

**4.0 Amplifiers**

- 4.1 Describe the function of line boosters - in-line amplifiers and distribution amplifiers and where they are used
- 4.2 Explain how in-line amplifiers are powered
- 4.3 Describe amplifier gain options
- 4.4 Explain why rooftop antenna preamplifiers and amplifiers are used and describe potential problems they may present for satellite installers
- 4.5 List where bandsplitters, diplexers and attenuators are used
- 4.6 Describe Video Switch Boxes and list their usages
- 4.7 Name 5 types of equipment where RF modulators may be used and explain the functions of an RF modulator

- 4.8 Explain the function of band pass filters, signal combiners, multi-switches and amplified signal combiners

**5.0 Satellite Dish Feed-horns – LNBs & LNBFs**

- 5.1 Describe fixed-diode, tone switching, and dual feeds
- 5.2 Explain wave-guide theory - LNBF's, and why scaler rings are used on feed-horns
- 5.3 Explain the difference between horizontal/vertical polarity and circular signal transmission and reception

**6.0 Satellite System Installation – Site Surveys**

- 6.1 Demonstrate use of common and special satellite, antenna, cable and Telco hand tools
- 6.2 Describe trenching of satellite and antenna cables and special precautions
- 6.3 Describe how to locate and mark buried cables
- 6.4 Explain boring principles (street, sidewalks, etc.)
- 6.5 List building-entry precautions and decision-making pertaining to dish wiring
- 6.6 Describe types of roof mounts for antennas and satellites, including non-penetrating mounting procedures
- 6.7 List important concepts when making a satellite site survey
- 6.8 Explain anti-twist pole modification - concrete calculation and work procedures waterproofing - safety - wall mounts - chimney and tri-pod mounts
- 6.9 Explain in-ground water runoff and cable routing for concrete pole mounts

**7.0 Satellite Receivers – Digital Technology**

- 7.1 Explain the differences between C/Ku - DirecTV, DISH Network and commercial system receivers
- 7.2 Demonstrate how to authorize consumer or commercial programming
- 7.3 Describe the fuses commonly used in receivers
- 7.4 Explain special codes, parental supervision functions and remote hand unit use
- 7.5 Describe basic (block diagram) receiver circuitry (IF input - decoding - audio & video processing - baseband signals - and stereo)
- 7.6 Describe satellite receiver gain and receiver input signal ranges as they relate to the entire dish system
- 7.7 Describe secondary audio programs - subcarriers - SCPC and pay-per-view services
- 7.8 Describe captioning and on-screen graphics
- 7.9 Describe the purpose of telephone connections to the receiver and computer interfacing with the satellite receiver
- 7.10 Explain how channel tuning voltages perform their functions within the receiver
- 7.11 Demonstrate the uses for menus, programming information and receiver/set up functions of the receiver
- 7.12 Draw an installation diagram showing proper hookup for multi-LNBF, multi-satellite, multi-receiver reception of DirecTV and DISH HDTV programming

**8.0 Interfacing With Other Consumer Electronics Equipment**

- 8.1 Explain and demonstrate ability to properly utilize interconnections for TV and other consumer electronics equipment
- 8.2 Describe the TV requirements for audio and video signals, RF-out (on channel 3/4) and list proper signal levels expected from receiver ports
- 8.3 Explain how signal modulators work and list appropriate circumstances for them
- 8.4 Describe the usage of video switch boxes, combiners & reverse splitters
- 8.5 Explain the use for cable/normal and VCR/TV switches
- 8.6 Describe telephone wiring and interconnection to satellite receivers

**9.0 Transmission – Internet Systems**

- 9.1 Describe mounting precautions and rules for transmission outside units
- 9.2 Explain transmission theory and power levels
- 9.3 Compare StarBand, DirectWay, DISH and competing systems features

**10.0 Troubleshooting, Repairs, Sun Outage**

- 10.1 Describe rain fade and sun outage
- 10.2 List typical distribution system problems such as open and shorted connections
- 10.3 Explain standing waves and identify their presence in a video picture
- 10.4 Describe interference types and methods of prevention or reduction
- 10.5 List possible UHF remote control problems and their solutions
- 10.5 Identify rooftop antenna problems
- 10.6 List problems that are frequently caused when interconnecting various customer-owned equipment
- 10.7 Demonstrate proper use of satellite service equipment including dish alignment tools, electronic service and substitution test equipment
- 10.8 Describe how signal splitters, taps, diplexers and similar cabling equipment can cause problems with the customer's satellite system
- 10.10 Demonstrate proper soldering and de-soldering techniques

**11.0 Safety**

- 11.1 Explain ESD, its causes and potential dangers to electronics equipment
- 11.2 Explain the safety rules OSHA dictates for workers at heights
- 11.3 List safety rules for ladder usage
- 11.4 Describe proper grounding procedures for satellite equipment
- 11.5 List some possible hazards to electronic equipment caused by defects in building wiring or in associated and connected equipment
- 11.6 Describe grounding rules set by the N.E.C.
- 11.7 Explain potential problems involved in equipment usage and storage in service vehicles

**12.0 ROOFTOP ANTENNA SYSTEMS**

**12.0 Antenna Theory**

- 12.1 Demonstrate an understanding of electrostatic and electromagnetic wave propagation
- 12.2 Identify common frequencies utilized by various broadcast services – frequency bands and relationships between bands of frequencies
- 12.3 Describe polar patterns of common TV and radio antennas; directivity and ghosts reflections
- 12.4 Explain different types of antennas and special usages for each
- 12.5 Describe the dipole antenna – horizontal, circular & vertical polarity – ground plane – physical length and thickness considerations of antenna elements
- 12.6 Define parasitic elements – directors – reflectors – resonators
- 12.7 Explain antenna gain – front-to-back ratios and their usages
- 12.8 Perform calculations using dB's; 0 dBmV reference; dBmV relationship and use wavelength formula to calculate antenna length or resonant frequency
- 12.9 Describe antenna and OSHA safety rules for working at heights
- 12.10 Describe how towers and rotors are utilized
- 12.11 Properly demonstrate safe use of linemans belts and ladders

**13.0 Components**

- 13.1 Name the uses of splitters – taps – filters – and terminators
- 13.2 List where hi/lo and U/V bandsplitters, diplexers, tilt compensators and attenuators are used
- 13.3 Describe Video Switch Boxes and list their usages
- 13.4 Name 5 types of electronic equipment where RF modulators are used and explain the RF modulator function
- 13.5 Explain the function of band pass filters, signal combiners, diplexers, multi-switches and amplified signal combiners

**14.0 Installation Procedures**

- 14.1 Demonstrate use of common and special antenna, cable and Telco hand tools
- 14.2 Explain trenching of satellite and antenna cables and precautions
- 14.3 Describe how to locate and mark buried cables
- 14.4 Describe wall and chimney mounts
- 14.5 Describe types of roof mounts for antennas and satellites, including non-penetrating mounting procedures
- 14.6 Describe N.E.C. antenna grounding rules and building wiring standards

**15.0 Antenna Positioners**

- 15.1 Explain the operation of an antenna rotator system
- 15.2 Explain the voltage readings or resistance readings to be expected on rotor cables
- 15.3 Describe methods used to re-synchronize an antenna rotor
- 15.4 List anticipated difficulties when replacing either unit of a rotor

**16.0 Towers**

- 16.1 Describe the parts of an antenna tower
- 16.2 Explain how concrete bases should be installed to prevent metal rot
- 16.3 Explain mounting procedures for installing rotor, preamplifier and antennas on towers
- 16.4 Explain proper grounding of antenna towers
- 16.5 Describe procedures for co-locating scanner, FM, ham, satellite or other equipment on antenna towers
- 16.6 Explain what a gin pole is and how it is used
- 16.7 Demonstrate the proper use of a lineman's belt and body harness

**17.0 Interference**

- 17.1 Explain the difference between co-channel and adjacent channel interference
- 17.2 Describe the symptoms indicating overdrive signal levels
- 17.3 Define signal egress and ingress
- 17.4 Describe anticipated problem when combining signals
- 17.5 Explain the uses for signal traps and filters
- 17.6 Describe power line hash and its causes

**18.0 Troubleshooting & Repairs**

- 18.1 List typical antenna reception problems caused by open and shorted connections
- 18.2 Explain standing waves and identify their presence in a video picture
- 18.3 Describe interference types and methods of prevention or reduction
- 18.4 Identify and solve rooftop antenna problems caused by RF or power interference
- 18.5 List problems which are frequently caused when interconnecting various customer-owned equipment

- 18.6 Demonstrate proper use of antenna signal measurement service equipment including volt-ohm-meter; signal strength meter; signal generating equipment and signal substitution equipment

## **C. C/Ku LARGE DISH SYSTEMS**

### **19.0 Dish Reflector Theory**

- 19.1 Explain gain of a dish reflector
- 19.2 Explain how the LNBF operates and why it is needed. Define skew alignment
- 19.3 Calculate Focal Point and F/D ratio of a prime focus satellite dish reflector
- 19.4 Properly center the feed-horn of a C/Ku satellite dish and check warpage
- 19.5 Demonstrate ability to track the Clarke belt and aim a C/Ku band dish properly
- 19.6 Describe declination and elevation adjustments required for satellite reflectors

### **20.0 Line Amplifiers**

- 20.1 Describe the function of line boosters, in-line and distribution amplifiers and where they are used
- 20.2 Explain the use of pre amplifiers – powering – gain – traps – tilt and installation requirements and precautions
- 20.3 Explain the symptoms and causes of signal overdrive

### **21.0 Components**

- 21.1 Explain wave-guide theory, scaler rings and polarity aspects of feed-horn types
- 21.2 Describe servo motor operation, supply and control circuitry
- 21.3 Compare various types of LNBFs, down converters, LNBS and LNAs
- 21.4 Explain how terrestrial interference filters work
- 21.5 Describe the functions of diplexers, multi-switches and signal combiners

### **22.0 Feedhorns, LNA's, LNB's, LNBF's, Downconverters**

- 22.1 Explain the differences between LNB's, Down Converters, LNA's and LNBF's
- 22.2 State the supply voltages required to operate LNB's and LNBF's
- 22.3 Explain switching voltages contained on the LNBF signal coax
- 22.4 List the approximate gain expected of various LNB or LNBF types and the DC or AC current requirements.
- 22.5 Explain dual vs single LNBF's
- 22.6 Explain the difference between analog and digital signal transmission
- 22.7 Describe coaxial cable requirements for proper LNB operation
- 22.8 Explain the splitting of LNB signals and how to connect LNB line amplifiers

### **23.0 Cabling Installation Procedures**

- 23.1 Calculate and measure the signal loss in lengths of RG 6 vs 59 coax cable and compare the two
- 23.2 Demonstrate precautions important in long cable runs
- 23.3 Demonstrate proper polarotor (servo motor), drive motor wiring and weather-proofing
- 23.4 Explain home/building entry - crawl space and attic precautions - wall fishing - carpet cut precautions and wall plate usage
- 23.5 Demonstrate the ability to properly install and use diplexers and to configure multiple receiver installations
- 23.6 Explain cable signal leakage requirements by law and how the CSI could contribute to leakage violations if he were ignorant of the rules
- 23.7 Explain signal leakage and its possible effects to the system that has the leaks and the effects on adjacent equipment.
- 23.8 Describe flat cable for tight entry, under rugs and thru glass technology

**24.0 IRD's, Integrated Receiver - Descrambler/Positioners**

- 24.1 Explain the differences between C/Ku - DirecTV, DISH Network and commercial systems
- 24.2 Describe how GI stand-alone decoders are installed and how to operate VC II menus
- 24.3 Demonstrate how to obtain consumer or commercial programming
- 24.4 Describe the fuses commonly used in IRD's (Integrated Receiver/Decoders)
- 24.5 Explain special codes, parental supervision functions and remote hand unit use
- 24.6 Describe basic receiver circuitry (IF input - decoding - audio & video processing - baseband signals - remote control circuitry basics and stereo processing)
- 24.7 Explain, properly connect and adjust servo and motor-drive circuits and connections
- 24.8 Describe secondary audio programs - subcarriers - SCPC and pay-per-view services
- 24.9 Describe captioning, on-screen graphics, telephone connections and computer interfacing with the satellite receiver
- 24.10 Explain how channel and audio tuning voltages function
- 24.11 Describe the effects dried out electrolytic capacitors in the video circuits may have

**25.0 Troubleshooting – Installation/Tools, Test Equipment, T.I.**

- 25.1 List typical distribution system problems such as open and shorted connections
- 25.2 Explain standing waves and identify their presence in a video picture
- 25.3 Describe interference types and possible methods of prevention or reduction
- 25.4 List possible UHF remote control problems
- 25.5 List problems that are frequently caused when interconnecting various customer-owned products
- 25.7 Demonstrate proper use of satellite service equipment including dish alignment tools, electronic service and substitution test equipment such as DMM, Signal Level meter, in-line satellite RF meters and spectrum analyzer
- 25.8 List common problems associated with drive-positioning arms

**26.0 Positioners and Aiming**

- 26.1 Describe power requirements for positioners
- 26.2 Explain how various types of sensors operate
- 26.3 Explain resolution and positioner accuracy
- 26.4 Properly connect drive system to IRD or positioner control
- 26.5 Explain common fusing of positioners
- 26.6 Describe proper limit switch setting procedures

**D. COMMERCIAL SYSTEMS**

**27.0 VSAT Theory (C, Ka, Ku)**

- 27.1 Define VSAT and name various services
- 27.2 List frequencies used by Ku and Ka bands
- 27.3 Explain the use of single-purpose receivers
- 27.4 Describe cross polarization (cross-pole) and polarization (co-pole) requirements
- 27.5 Describe Internet two-way satellite systems
- 27.6 Identify the transmit power utilized by 2-way Internet dish services
- 27.7 Define MAC - Media Access Control
- 27.8 Define IDU and ODU; AZ/EL and SKEW
- 27.9 Define PING and explain the term CW
- 27.10 Explain the reasons for telecommunications connections to transceivers and the differences between USB and RJ45 or other telecom cable connectors

**28.0 Components**

- 28.1 Describe various V-SAT mounts
- 28.2 Compare V-Sat LNB's, LNBF's and feeds with consumer versions

**29.0 Offset Reflectors**

- 29.1 Compare size requirements for various satellite systems
- 29.2 Describe declination and elevation adjustments required for satellite reflectors and explain methods for aiming V-SAT reflectors
- 29.3 Demonstrate ability to install, aim and connect V-SAT commercial dish systems, including proper roof protection, penetration and waterproofing

**30.0 Feedhorns, LNB's, LNBF's, RFU's, OSU's**

- 30.1 Compare differences in TVRO and 2-way receive/transmit systems
- 30.2 State the supply voltages required to operate LNB's and LNBF's
- 30.3 Compare different reflector types used in V-SAT
- 30.4 Describe how both C and Ku LNB's are mounted and connected to a head-end
- 30.5 Describe multiple LNB arrays for multi-bird reception
- 30.6 Explain focal distance, F/D ratio and centering requirements for prime focus reflectors

**31.0 Special Installation Procedures**

- 31.1 Describe types of roof mounts for antennas and satellites, including non-penetrating mounting procedures
- 31.2 List important concepts when making a satellite site survey
- 31.3 Explain anti-twist pole modification - concrete calculation and work procedures -
- 31.4 Describe wall mounts and tri-pod mounts
- 31.5 Describe how to locate and mark dog fences, power and Telco cabling, gas lines, water supply lines, etc.

**32.0 Receivers, Decoders, Authorizations**

- 32.1 Explain the differences between C/Ku - DirecTV, DISH Network and commercial systems
- 32.2 Describe how GI decoders are installed and how to utilize VC II menus
- 32.3 Demonstrate how to obtain consumer or commercial programming
- 32.4 Draw a block diagram of a cable or SMATV head-end
- 32.5 Explain programming 'transport' systems
- 32.6 Describe secondary audio programs - subcarriers - SCPC and pay-per-view services
- 32.7 Describe captioning, on-screen graphics, telephone connections and computer interfacing with the satellite receiver
- 32.8 Describe the signal symptoms in a head-end that is too hot or too cold temperature-wise
- 32.9 Describe the problems rodents may cause inside the head-end facility
- 32.10 Explain advertising and EWS insertion principles
- 32.11 Describe billing and customer contact service and methods and Pay-per-view

**33.0 Transmitters**

- 33.1 List common uplink frequencies used for Internet services
- 33.2 Describe the power requirements and precautions for transmitters
- 33.1 Describe switching methods

**34.0 Troubleshooting Reception/Transmission Systems**

- 34.1 Explain causes for the need to reprogram or reauthorize programming
- 34.2 Describe unit substitution methods of location defective units
- 34.3 Explain decoder operation, checks and connections
- 34.4 List problems associated with cabling and connections in a head-end or to outdoor equipment
- 34.5 Describe multi-receiver LNB powering, DC Blocks and potential problems
- 34.6 Describe power measurements required to locate defective equipment

**E. SMATV – SIGNAL DISTRIBUTION SYSTEMS**

**35.0 Head-end Components and Environment**

- 35.1 Describe differences between consumer and commercial satellite receivers
- 35.2 Describe equipment used for off-air TV signal reception
- 35.3 Explain power requirements and UPS equipment
- 35.4 Explain how combiners work and how splitters may be used in their place
- 35.5 Describe heating-cooling requirements for head-end rooms
- 35.6 List problems caused by rodents and insect pests in head-ends
- 35.7 Describe channel deletion hardware
- 35.8 Describe different methods to provide backup power during outages
- 35.9 Explain why distribution or line amplifiers are required in SMATV systems
- 35.10 Describe the functions of band-pass filters and channel deletion filters
- 35.11 List all of the components required for proper lightning protection at the head-end
- 35.12 List the advantages of marking head-end equipment

**36.0 Head-end Signal Balancing**

- 36.1 List the uses of signal-level meters with head-end equipment
- 36.2 Identify head-end signals and signal levels using a spectrum analyzer
- 36.3 Explain requirements for audio levels
- 36.4 List problems that may occur with out-of-range video levels
- 36.5 Explain FCC rules for signal levels, aircraft frequencies and leakage
- 36.6 Describe proper bonding and grounding of head-end equipment
- 36.7 List causes of hum in channel video audio signals
- 36.8 Describe overdrive and list causes
- 36.9 Explain reasons for proper documentation of head-end signals

**37.0 Underground – Overhead Cabling**

- 37.1 List locations conduit is often used for distribution cabling
- 37.2 Explain how boring and trenching is accomplished
- 37.3 Describe splicing hardware and waterproofing techniques
- 37.4 Define 'Messenger' cable and drop cabling
- 37.5 List the tools needed and technology of Hard Line connectors
- 37.6 List reasons for using tilt devices
- 37.7 Describe how mid-span power insertion is accomplished

**38.0 Multi-channel Signal Combining**

- 38.1 Explain the difference between powered and non-powered combiners
- 38.2 Explain how channel deletion and conversion equipment is used
- 38.3 Describe methods of location and reducing interference
- 38.4 List uses for channel traps
- 38.5 Explain the need for balancing the channel levels throughout the system

**39.0 UPS, Uninterruptible Power Supplies**

- 39.1 Explain why temporary AC power may be needed
- 39.2 Explain the advantages of DC power-bus instead of AC UPS systems
- 39.3 Explain how gasoline-powered generators are used for power back up

**40.0 Daisy Chain Cabling Technology**

- 40.1 Draw a SMATV distribution system and show signal-power budget
- 40.2 List daisy chain system components
- 40.3 Explain how taps, splitters and terminators are used
- 40.4 Describe where and how line amplifiers may be used

**41.0 SMATV Trunk and Feeder Line Components**

- 41.1 Properly install a hard-line connector
- 41.2 Describe a Telecommunications pedestal and show how it is installed
- 41.3 Describe junction boxes where multiple subscriber drops may converge
- 41.4 Explain attic and crawl space hazards
- 41.5 Define strand and lashing cable and list where they are used
- 41.6 Explain when contracting underground or overhead plant is the best decision
- 41.7 Describe pole-mounted taps, splitters, tilt hardware
- 41.8 Explain AC power budgeting

**42.0 Test Equipment and Troubleshooting**

- 42.1 Demonstrate how to use a signal level meter
- 42.2 Explain the use of a TDR – Time domain reflectometer
- 42.3 List situations where signal injection equipment is required in troubleshooting
- 42.4 List 10 situations where a DMM is used in troubleshooting a system
- 42.5 Explain how 2-way radio communications can aid a crew in troubleshooting
- 42.6 Explain how signal leakage detectors work
- 42.7 List types of Interference detector equipment
- 42.8 Explain how substitution of equipment may be the quickest method of locating system defects

**43.0 Home Run Installation Techniques**

- 43.1 Identify the TIA-EIA standard for routing cables
- 43.2 Compare various multi-splitters used in SMATV systems
- 43.3 Describe traps and subscriber disconnect methods
- 43.4 Describe drop verification methods and documentation requirements
- 43.5 Explain the importance of labeling system components and drops

**44.0 Programming Providers**

- 44.1 Explain how to contract directly with program providers
- 44.2 List wholesale SMATV programming providers and the benefits of using
- 44.3 Explain transport service for SMATV systems
- 44.4 List special equipment requirements needed for subscriber services offered by SMATV system operators

**45.0 Line Sweeping, TDR, OTDR, FDR Equipment**

- 45.1 List problems caused by inadequate head end integrity
- 45.2 List ways to locate shorts and opens in cabling
- 45.3 Explain the need for proper cable terminations
- 45.4 List reasons for cable anomalies and types of problems they cause
- 45.5 Describe proper power wiring
- 45.6 Describe fiber optic cabling safety concerns
- 45.7 Describe various types of cabling jumpers and commons problems
- 45.8 Explain where and why gas filled transmission lines may be used

*(End of CSI COMPS listing E)*