

**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.

(Draft copy for NCEE and SDA comment, July 28, August 18, 2003)

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

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