



# Computer Service Technician- CST

## Competency Requirements

This Competency listing serves to identify the major knowledge, skills, and training areas which the Computer Service Technician needs in order to perform the job of servicing the hardware and the systems software for personal computers (PCs). The present CST COMPETENCIES **only** address operating systems for Windows **current version, plus three older**. Included also are general common Linux and Apple competency information, as proprietary service contracts still keep most details specific to in-house service. The Competency is written so that it can be used as a course syllabus, or the study directed towards the education of individuals, who are expected to have basic computer hardware electronics knowledge and skills.

Computer Service Technicians must be knowledgeable in the following technical areas:

### 1.0 SAFETY PROCEDURES / HANDLING / ENVIRONMENTAL AWARENESS

- 1.1 Explain the need for physical safety:
  - 1.1.1 Lifting hardware
  - 1.1.2 Electrical shock hazard
  - 1.1.3 Fire hazard
  - 1.1.4 Chemical hazard
- 1.2 Explain the purpose for Material Safety Data Sheets (MSDS)
- 1.3 Summarize work area safety and efficiency
- 1.4 Define first aid procedures
- 1.5 Describe potential hazards in both in-shop and in-home environments
- 1.6 Describe proper recycling and disposal procedures

### 2.0 COMPUTER ASSEMBLY AND DISASSEMBLY

- 2.1 List the tools required for removal and installation of all computer system components
- 2.2 Describe the proper removal and installation of a CPU
  - 2.2.1 Describe proper use of Electrostatic Discharge (ESD) equipment and procedures:
    - 2.2.1.1 bench pads
    - 2.2.1.2 ESD mat
    - 2.2.1.3 anti-static wrist strap
    - 2.2.1.4 constant monitoring station
    - 2.2.1.5 precautions when handling components
    - 2.2.1.6 why components must be stored in anti-static packaging
  - 2.2.2 List the harmful effects of EMI (electromagnetic interference)
  - 2.2.3 Describe removal and installation procedures for CPU heatsink/fan
  - 2.2.4 Explain the importance of heatsink grease/thermal material
- 2.3 Describe proper removal and the correct installation procedures for RAM (Random-Access Memory)
  - 2.3.1 Proper banking positions
  - 2.3.2 Correct RAM utilized with proper banking keyway
  - 2.3.3 Proper force used to install RAM
- 2.4 Explain the precautions and routines involved in the removal and installation of the following:
  - 2.4.1 Power Supplies
  - 2.4.2 Expansion cards
  - 2.4.3 Motherboard jumpers
  - 2.4.4 Cables and wiring harnesses
  - 2.4.5 Secondary storage devices
- 2.5 Explain the proper removal and installation procedures for a motherboard and/or daughterboard

### 3.0 MOTHERBOARDS / MAINBOARD AND BUSES / SYSTEM RESOURCES

- 3.1 Describe and compare the differences between common mainboard design characteristics:
  - 3.1.1 ATX
  - 3.1.2 SSI CEB
  - 3.1.3 BTX
  - 3.1.4 Micro-ATX and FlexATX
  - 3.1.5 Mini-ATX

- 3.1.6 LPX and NLX
- 3.1.7 Mini-ITX, Nano ITX and Pico ITX
- 3.1.8 Mobile ITX and Neo-ITX
- 3.1.9 ISX
- 3.2 Compare chipset architecture, features and differences of:
  - 3.2.1 Northbridge / Southbridge
  - 3.2.2 Sandy bridge
  - 3.2.3 Ivy bridge
  - 3.2.4 Haswell
  - 3.2.5 Broadwell
- 3.3 Define the function of the Control, Data, and Address Buses
- 3.4 Explain Bus function and compare addressing differences
  - 3.4.1 Front side bus replaced by DMI, QuickPath Interconnect and HyperTransport
  - 3.4.2 Back side bus
  - 3.4.3 Memory bus
  - 3.4.4 I/O buses
  - 3.4.5 Universal serial bus (USB)
- 3.5 Describe AGP, AMR, CNR, PCI, PCI Express (PCIe), Extended PCI and PCMCIA expansion slot differences
- 3.6 Explain the difference between Programmable Interrupt Controller (PIC) and IRQs
  - 3.6.1 Describe Advanced Programmable Interrupt Controller (APIC) and x2APIC
  - 3.6.2 Describe legacy IRQ assignment/priority addressing
- 3.7 List common selections for ports architecture
- 3.8 Explain the purpose and use of Direct Memory Access (DMA)
  - 3.8.1 32bit and 64bit
  - 3.8.2 PIO
  - 3.8.3 Scratchpad RAM
  - 3.8.4 Cache coherency
- 3.9 Describe the architecture and use of I/O interfaces and addresses
- 3.10 Explain Device Drivers and how they work within the computer system
- 3.11 Identify memory module sockets
  - 3.11.1 SIMM
  - 3.11.2 DIMM
  - 3.11.3 RIMM
  - 3.11.4 SODIMM
- 3.12 Describe EFI (Extensible Firmware Interface) and UEFI (Unified EFI) features
- 3.13 Describe BIOS (Basic Input Output System) functions including:
  - 3.13.1 why beep codes are used
  - 3.13.2 how to set/clear passwords
  - 3.13.3 procedures to upgrade/update/flash the BIOS
  - 3.13.4 changing the boot order in the BIOS
- 3.14 Explain the configuration of CMOS
- 3.15 Explain the differences between riser card and daughterboard
- 3.16 Explain the use of dipswitch configurations and settings
- 3.17 Explain the purpose of mainboard jumpers
- 3.18 Describe the difference between Serial ATA (eSATA) and old Parallel ATA connections

#### **4.0 PROCESSOR CHARACTERISTICS**

- 4.1 Explain the purpose and characteristics of CPUs used in specific sockets and slots
  - 4.1.1 AMD
  - 4.1.2 Intel
- 4.2 Compare and contrast the differences between all multicore CPU architectures
- 4.3 State the Word Size (Internal Data Bus) and External Data Path bit widths for various CPUs
- 4.4 Explain the differences between the L1, L2 and L3 cache
- 4.5 Describe Advanced Transfer Cache bus width and its benefits
- 4.6 Explain the differences between simultaneous multithreading and hyperthreading
- 4.7 Explain the factors that determine CPU speed
- 4.8 Describe the advantages and disadvantages for CPU underclocking and overclocking
- 4.9 Explain why it is important to have CPU cooling
- 4.10 Describe the advantages and disadvantages for different methods of CPU cooling:

- 4.10.1 Heatsinks
- 4.10.2 Thermal grease/compound
- 4.10.3 Liquid cooling
  - 4.10.3.1 Nitrogen
  - 4.10.3.2 Water
  - 4.10.3.3 Oil
- 4.10.4 Fans

## 5.0 MEMORY CHARACTERISTICS

- 5.1 Identify the differences in SIMM, DIMM, RIMM and SODIMM RAM packages
- 5.2 Describe SRAM, SDRAM, DRAM, DDR, and RAMBUS characteristics and installation procedures
- 5.3 Compare RAM bit widths and speed over the generations from SDRAM through DDR4
- 5.4 Identify generational differences between DDRs and Graphics DDRs
- 5.5 Describe the proper 'Banking' procedures when installing various RAM modules with various processors
- 5.6 Explain Non-parity, Parity and ECC memory
- 5.7 Explain memory requirements for different operating systems, including minimum and maximum memory requirements

## 6.0 SECONDARY STORAGE DEVICES

- 6.1 Identify differences among Hard Disk Drives (HDD)
  - 6.1.1 Serial ATA
  - 6.1.2 Legacy Parallel ATA
- 6.2 Explain the operational characteristics of a Solid-State Drive (SSD)
  - 6.2.1 Describe hybrid drive technology such as Solid-State Hybrid Drive (SSHD) or Dual-Drive systems (Linux' bcache and dm-cache along with Apple's Fusion Drive)
- 6.3 Describe the differences between Enterprise Flash Drives (EFDs) and SSDs
- 6.4 Explain how data is stored on a hard drive
- 6.5 Compare and contrast the different Serial ATA specifications
- 6.6 Describe PIO (Programmed Input/Output) modes used in ATA interfacing
- 6.7 Describe EIDE cable differences for PIO mode/ATA33 and ATA66/ATA100 and ATA133
- 6.8 Compare the various modes and transfer rates of UDMA (Ultra Direct Memory Access)
- 6.9 Describe SCSI hard drive technology and how it differs from the EIDE interface
- 6.10 Describe the differences between NTFS and FAT
- 6.11 List and explain the applications for removable storage:
  - 6.11.1 Jump drive, flash drive, thumb drive, and SD cards
  - 6.11.2 External DVD-RW, CD-RW hard and solid state drives
  - 6.11.3 Tape drives
- 6.12 Describe the CD-ROM/CD+/-RW technology and state its advantages and uses
- 6.13 Compare DVD, DVD-RAM and DVD+/-RW technologies
- 6.14 Explain Blu-ray technology

## 7.0 ADAPTER CARDS AND PERIPHERAL DEVICES

- 7.1 Explain how to install and use biometric devices:
  - 7.1.1 Thumbprint reader
  - 7.1.2 Facial recognition scanner
  - 7.1.3 Retinal scanner
  - 7.1.4 Signature analyzer
- 7.2 Explain the standards for Network Interface Card (NIC)
- 7.3 Explain how to install a NIC and a wireless NIC
- 7.4 Explain how to install and use soundcards
- 7.5 Explain how to install and use various types of video graphics cards:
  - 7.5.1 AGP
  - 7.5.2 PCI
  - 7.5.3 PCIe
- 7.6 Describe the principles and characteristics of a TV tuner
- 7.7 Compare the different printer technologies used in PCs
- 7.8 Describe scanner technology, installation and operation
- 7.9 Explain TWAIN image acquisition compliance for scanners and digital cameras

- 7.10 Explain how to install multimedia devices:
  - 7.10.1 MIDI
  - 7.10.2 Digital cameras
  - 7.10.3 Web cameras
  - 7.10.4 PDMI
- 7.11 Explain keyboard theory
- 7.12 Explain mouse theory
- 7.13 Compare peripheral technologies
  - 7.13.1 Legacy PS/2
  - 7.13.2 USB
  - 7.13.3 wireless
- 7.14 Describe the monitor basic features and differences between a CRT, LCD, LED, 4K and Plasma
  - 7.14.1 Explain the differences between SVGA, DVI, HDMI and DisplayPort
  - 7.14.2 Explain Scalable Link Interface (SLI) when used with dual video boards

## 8.0 I/O PORTS

- 8.1 Explain the differences and functions for various port architectures:
  - 8.1.1 Serial and Parallel
  - 8.1.2 USB 1.x, 2.0, 3.0 and 3.1
  - 8.1.3 IEEE 1394/FireWire®
  - 8.1.4 Network Interface Card (NIC)
  - 8.1.5 Display - HDMI, S-Video, DVI, VGA and DisplayPort
  - 8.1.6 LAN
  - 8.1.7 PS/2
  - 8.1.8 Audio - MIDI
  - 8.1.9 PDMI
  - 8.1.10 COMs and LPTs
  - 8.1.11 Thunderbolt (Apple)
- 8.2 Describe the difference between wireless, USB and legacy RS232c standards for ports
- 8.3 Explain the generational specifications of parallel ports SPP, EPP and ECP
- 8.4 Compare USB 1.x, 2.0, 3.0 and 3.1 port transfer rates and intended uses
- 8.5 Identify the transfer rates and intended uses for IEEE 1394 FireWire® (iLink) operation
- 8.6 Explain how infrared communications take place in PCs
- 8.7 Describe Game/MIDI ports
- 8.8 Explain how to identify various legacy ports by their connectors on a PC

## 9.0 POWER CONCEPTS AND POWER SUPPLIES

- 9.1 Compare the usage and capabilities of AT, ATX, ATX12V power supplies
- 9.2 Identify AT, ATX, and ATX12V power supplies
- 9.3 List the major differences between AT, ATX and ATX12V
- 9.4 Describe TFX12V configuration for small form factor computers
- 9.5 Explain the purpose of an uninterruptible power supply (UPS)
- 9.6 Compare ATX vs. BTX power supply family
- 9.7 Describe switch-mode power supplies (SMPS)

## 10.0 BASIC NETWORKING CONCEPTS

- 10.1 Topologies
  - 10.1.1 Identify and describe the different characteristics of each LAN topology:
    - 10.1.1.1 Point-to-Point
    - 10.1.1.2 Bus
    - 10.1.1.3 Ring
    - 10.1.1.4 Star
    - 10.1.1.5 Hybrid
    - 10.1.1.6 Mesh
  - 10.1.2 Differentiate between a physical and logical topology
  - 10.1.3 Explain the need for network connectivity devices:
    - 10.1.3.1 Network interface adapter
    - 10.1.3.2 Hub/Repeater
    - 10.1.3.3 Switch
    - 10.1.3.4 Router

- 10.1.4 Explain media access control (MAC) addressing
- 10.1.5 Explain the use of a network bridge
- 10.2 Cabling
  - 10.2.1 Describe noise immunity, bandwidth, latency and attenuation
  - 10.2.2 Differentiate between the basic transmissions modes:
    - 10.2.2.1 Simplex
    - 10.2.2.2 Half Duplex
    - 10.2.2.3 Full Duplex
  - 10.2.3 Describe the different media use to transmit data:
    - 10.2.3.1 Unshielded twisted pair (UTP) cabling
    - 10.2.3.2 Shielded twisted pair (STP) cabling
    - 10.2.3.3 Fiber-optic cabling
    - 10.2.3.4 Infrared light
    - 10.2.3.5 Wireless RF; Wi-Fi
  - 10.2.4 List the different applications and bandwidth for CAT5, CAT5e, CAT6<sub>A</sub>, CAT7, CAT7<sub>A</sub> and CAT8
  - 10.2.5 Differentiate between TIA/EIA-568A and TIA/EIA-568B standards
  - 10.2.6 Explain when to use an 8P8C (RJ45) and 6P4C (RJ14) connector
  - 10.2.7 Describe the design difference between a crossover cable and a straight through cable
  - 10.2.8 Define 10/100/1000BaseT (Twisted pair) and its use
  - 10.2.9 Describe 10/100 Gigabit Ethernet
  - 10.2.10 Compare the differences and advantages between fiber-optic cable and Twisted Pair
  - 10.2.11 Describe methods of troubleshooting cabling systems
- 10.3 Protocols
  - 10.3.1 Define network protocol
  - 10.3.2 Differentiate between each network environment and the protocol used
    - 10.3.2.1 Apple Filing Protocol (AFP)
    - 10.3.2.2 IPX/SPX
    - 10.3.2.3 TCP/IP
  - 10.3.3 Explain why TCP/IP Protocol is widely used and the configuration process
  - 10.3.4 Explain the basic differences between IPv4 and IPv6
- 10.4 Architectures
  - 10.4.1 Explain the OSI model and its applicable layers
  - 10.4.2 Differentiate between CSMA/CD vs. CSMA/CA
    - 10.4.2.1 Explain token passing
  - 10.4.3 List the throughput, range and frequencies associated with IEEE 802.11x:
    - 10.4.3.1 IEEE 802.11a
    - 10.4.3.2 IEEE 802.11b/g/n
    - 10.4.3.3 IEEE 802.11ac
  - 10.4.4 Describe the differences between Bluetooth and IEEE 802.11x Cellular RF properties
  - 10.4.5 Compare the differences between Broadband, Digital Line Subscriber (DSL) and satellite technologies.
  - 10.4.6 Explain the basics of Network Operating Systems (NOS)
  - 10.4.7 Explain how Directory/File/Drive Sharing is accomplished
- 10.5 Network Security:
  - 10.5.1 Describe the principles of data integrity and protection
  - 10.5.2 Describe the principles of network security for wired and wireless networks
    - 10.5.2.1 RADIUS
    - 10.5.2.2 EAP and IEEE 802.1X
    - 10.5.2.3 WEP, WPA, WPA2
  - 10.5.3 Explain the need for a network firewall
  - 10.5.4 Explain the purpose for wireless encryption keys
    - 10.5.4.1 Temporal Key Integrity Protocol (TKIP)
    - 10.5.4.2 Advanced Encryption Standard (AES)
    - 10.5.4.3 Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (CCMP) (IEEE 802.11i)

## 11.0 PORTABLES

- 11.1 Explain the differences between a Laptop and various Tablet architectures
- 11.2 Explain how to remove and install SODIMMs

- 11.3 Describe the purpose of a docking station
- 11.4 Explain the technology of an LCD versus LED display
- 11.5 Describe the various I/O ports available and their uses
- 11.6 Describe precautions and usage of batteries in laptop PCs
- 11.7 Explain common power management techniques
- 11.8 Explain the purpose for a touchpad, pointing stick and track point

## **12.0 TROUBLESHOOTING / PREVENTIVE MAINTENANCE / SECURITY MEASURES**

- 12.1 Describe purpose and the characteristics of a clean workspace/area
- 12.2 Explain the importance of visual inspections
- 12.3 Differentiate between hardware and software troubleshooting
- 12.4 Describe the use of diagnostic software used to diagnose and isolate PC problems
- 12.5 List utility software that technicians should be familiar with (Scandisk, Defragmentation, OEM specific utilities, etc.)
- 12.6 List environmental problems common to PCs (temperature, dust and dirt, smoke, etc.)
- 12.7 Explain the use of POST diagnostic cards for troubleshooting
- 12.8 Explain the use of FRU-level troubleshooting techniques
- 12.9 Explain the differences between manufacturers' BIOS Beep Codes
- 12.10 Explain the use of basic troubleshooting commands and utilities (such as Fdisk, Format, Sys, Xcopy, etc.) as used in the current + two older versions of Windows OS
  - 12.10.1 Describe inter-relations between commands on different file systems (i.e., IPCONFIG, IFCONFIG, WINIPCFG vs. DIR – Basic navigation)
- 12.11 Describe the Microsoft Management Console (MMC) snap-in utility and its application for managing system administrative tools
- 12.12 List applicable tools for PC maintenance and repair
  - 12.12.1 PC vacuums
  - 12.12.2 Compressed air
  - 12.12.3 Tool kit
  - 12.12.4 ESD protective devices
  - 12.12.5 Lint free cloth
- 12.13 Explain how to properly document and record a computer repair
- 12.14 Explain the importance of making timely backups in regards to preventative maintenance
- 12.15 List preventive maintenance procedures relating to static safety causes and effects; ESD
- 12.16 Describe the usage of PCAnywhere and Laplink
- 12.17 Describe the deployment and application of both software and physical firewalls
  - 12.17.1 Port Security
  - 12.17.2 Exceptions
  - 12.17.3 Filters
- 12.18 Explain how performance Utilities/Diagnostics software are used
- 12.19 Describe the usage of Adware, Malware Spyware, Rootkits, Trojans and Worms
- 12.20 Describe the function of Antivirus software

## **13.0 OPERATING SYSTEMS (WINDOWS 7, 8 with XP AND LINUX)**

- 13.1 Explain how to load different operating systems:
  - 13.1.1 Windows XP
  - 13.1.2 Windows 7
  - 13.1.3 Windows 8
  - 13.1.4 Linux (openSUSE, Mandriva, Ubuntu, Redhat and Fedora)
  - 13.1.5 Apple MAC OS X
- 13.2 Describe the basic functions of an operating system
- 13.3 Explain multiuser, multitasking and multiprocessor operations
- 13.4 Describe the events that occur during boot-up for Linux and Windows operating systems
- 13.5 Describe general differences between Windows XP, 7, 8, Apple OS X and Linux
- 13.6 Identify and describe the purpose of command prompt/line utilities
- 13.7 Identify procedures for locating, accessing and retrieving information through a command line
- 13.8 Perform common functions of Windows Desktop
- 13.9 Explain the common steps in configuring Windows for Selective Startup and Networking
- 13.10 Describe the use of Windows Explorer for file and folder management
- 13.11 Explain how to use Windows Device Manager for installing and troubleshooting hardware
- 13.12 Explain Windows Registry Management as it pertains to editing, backup, and restoration

- 13.13 Explain how to unify and simplify system management tasks through the Microsoft Management Console (MMC)
- 13.14 Define purposes and usage of Virtual Memory
- 13.15 Explain how to calculate and adjust Virtual Memory settings
- 13.16 Explain the purposes and usage of Msconfig.exe (Windows)
- 13.17 Describe the purpose of and how System Restore is used in Windows 7 and 8
- 13.18 Describe Software Uninstall Procedures for Windows Applications
- 13.19 Describe Time Machine functions and procedures for Apple OS X
- 13.20 Explain how to use Linux Disk Management basics
- 13.21 Explain how to use Linux File Management commands

#### 14.0 FILE MANAGEMENT

- 14.1 Explain how to format a hard disk drive
- 14.2 Explain the purpose of managing partitions:
  - 14.2.1 Logical
  - 14.2.2 Primary
  - 14.2.3 Extended
- 14.3 Explain the use of a primary partition
- 14.4 Describe the procedure used to partition a hard disk drive
- 14.5 Explain the use of a Master boot record (MBR), GUID Partition Table (GPT), GRand Unified Bootloader (GRUB) and LInux LOader (LILO)
- 14.6 List the advantages and disadvantages of NTFS, FAT32, and exFAT
  - 14.6.1 MAC OS Extended (HFS+)
    - 14.6.1.1 Standard
    - 14.6.1.2 Journaled
- 14.7 Explain the procedures for directory (folder) creation and deletion
- 14.8 Describe procedures for file usage (saving, deleting, copying, moving, recovery)
- 14.9 Describe the defragmentation process, how it is accomplished and how often to use it
- 14.10 Describe how the Data Backup process works
- 14.11 Compare the various types of backups

### End of Computer Service Technician Competencies Listings

Suggested Prerequisite: Associate CET (CETa) or equivalent  
CST's **may** also pass the Associate CET exam and, by doing so, earn their Certified Electronics Technician (CET) designation (using the CST specialty area).

**Find An ETA Test Site:** <http://www.eta-i.org/testing.html>

#### **Suggested Additional Resource and Study Material:**

**As with most computer hardware, you will find details and information on Websites:** ieee.org; networkcomputing.com; pcworld.com; cnet.com; computerworld.com; pcmag.com; consumerreports.org; maximumpc.com; infoworld.com; intel.com; amd.com; Microsoft.com; itunes.apple.com; rmroberts.com; beyourownit.com; worldwidelearn.com; professorsmessenger.com; youtube.com; and many, many other websites

**Maintaining and Repairing PCs – Operating Systems;** Charles J. Brooks; ISBN 978-1581221367; Marcraft 2011; softcover; 530 pgs.

**A+ Guide to Managing and Maintaining Your PC, 8E;** Jean Andrews; Cengage Learning; ISBN 978- 1133135081; Jan. 2013; hardcover; 1328 pgs.

**Upgrading and Repairing PCs, 22E;** Scott Mueller; QUE Publishing; ISBN 978- 0789756107; April 2015; hardcover; 1200 pgs.

**Computer Service and Repair, 4E;** Richard Roberts; Goodheart-Willcox; ISBN 978-1619607958; April 2014; hardcover; 974 pgs.

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