



**ETA<sup>®</sup> International**  
**Associate C.E.T. - COMPREHENSIVE BASICS**

**BASIC ELECTRONICS CERTIFICATION COMPETENCIES—2009**

(As suggested for segmenting the Associate CET Competencies into 5 BASIC areas: DC; AC; Analog; Digital; and **Comprehensive**)

**1.0 Soldering, Desoldering and Tools**

- 1.1 Describe solder safety as it pertains to burns and potential fires or damage to facilities or customer products
- 1.2 Explain the cause of solder fumes and the effects of lead poisoning
- 1.3 List causes and precautions to prevent or reduce solder splatter
- 1.4 Explain the reasons for flux usage and describe types
- 1.5 List types of solder and reasons for choosing each
- 1.6 Explain heat shunts, why and how they are used
- 1.7 Describe cold solder joints and explain causes
- 1.8 Describe the differences between good and bad mechanical and electrical solder connections
- 1.9 Describe proper care of solder and de-solder equipment and aids
- 1.10 Explain de-soldering principles
- 1.11 Describe various types of de-soldering equipment and how they are used
- 1.12 Describe the use of braid-wick solder removers

**2.0 Electrical Conductors**

- 2.1 Define insulation resistance and dielectric strength
- 2.2 Define mil-foot, square mil, circular mil and the mathematical equations for calculations for each
- 2.3 Explain the meaning of “resistivity”
- 2.4 Explain the American Wire Gauge system and how to measure wire using the AWG system
- 2.5 Explain the factors required in selecting proper size wire
- 2.6 State the advantages and disadvantages of copper, aluminum, and silver as conductors
- 2.7 Describe the effects that temperature coefficient of a given wire type can have on its operation
- 2.8 Describe types of insulation and factors in their selection for use
- 2.9 Describe conductor types, both solid and stranded, as well as the various bundling techniques
- 2.10 Describe the proper splicing and termination techniques for both solid and stranded conductors
- 2.11 Describe each of the following cable types, their construction, use, and termination:
  - 2.11.1 Coaxial cable
  - 2.11.2 Unshielded twisted pair
  - 2.11.3 Shielded twisted pair

**3.0 AC Power Distribution**

- 3.1 Describe the design of both single phase and multiphase AC power distribution
- 3.2 Describe the typical use of both single phase and multiphase AC power distribution
- 3.3 Describe the typical control and circuit protection devices used for AC power distribution

**4.0 Circuit Protection**

- 4.1 Describe the physical design of fuses and their current and voltage rating systems
- 4.2 Describe the numbering marking system used with fuses and their schematic symbols
- 4.3 Describe the physical design and current and voltage rating system of circuit breakers
- 4.4 Describe the numbering marking system used with circuit breakers and their schematic symbols

**5.0 Circuit Controls**

- 5.1 List the general types of circuit control devices and their use
- 5.2 Identify the schematic symbol for a switch, solenoid, and relay
- 5.3 Describe the operating principles and characteristics of a solenoid, relay, and switch
- 5.4 State the meaning of current and voltage ratings for a switch, solenoid, and relay

**6.0 Generators**

- 6.1 DC generators
  - 6.1.1 State the principal by which generators convert mechanical energy to electrical energy
  - 6.1.2 State the left hand rule for generators
  - 6.1.3 Explain the process of commutation in DC Generators
  - 6.1.4 Describe the design and operation of a DC generator
  - 6.1.5 Describe the voltage and current variation from no load to full load in a DC generator
  - 6.1.6 Describe how and why field strength can and may be varied in a DC generator
  - 6.1.7 Describe the construction and operation of series wound, shunt wound, and compound wound generators
- 6.2 AC generators
  - 6.2.1 Describe the principle of magnetic induction as it applies to AC generators
  - 6.2.2 Describe the construction and operation of both rotating-armature and rotating-field alternators, and the advantages of each design
  - 6.2.3 Describe the construction and operation of single-phase, two-phase, and three phase alternators
  - 6.2.4 Describe the construction, operation and advantage of both delta and wye three-phase connections for AC generators
  - 6.2.5 Explain the principles of voltage control with AC generators

**7.0 Motors**

- 7.1 DC motors
  - 7.1.1 State the factors that determine the direction of rotation of DC motors.
  - 7.1.2 State the right hand rule for motors
  - 7.1.3 Explain the process of commutation in DC motors
  - 7.1.4 Describe the construction and operational characteristics of series, shunt, and compound DC motors
  - 7.1.5 Describe speed and direction control techniques for DC motors
- 7.2 AC motors
  - 7.2.1 Describe the construction and operational characteristics of single-phase, two-phase, and three-phase AC motors
  - 7.2.2 Describe the construction, operation and advantage of both delta and wye three-phase connections for AC motors
  - 7.2.3 State the primary application of synchronous motors
  - 7.2.4 Describe the construction and operational characteristics of induction motors

**8.0 Interfacing of Electronics Products**

- 8.1 List input circuit signal levels which may be expected for various common electronics products or test equipment
- 8.2 List anticipated signal or voltage levels for output circuits in audio and video equipment
- 8.3 Explain the importance of impedance matching; list causes of mismatches
- 8.4 Explain the purposes of plugs and connectors and why it is necessary to use the proper ones
- 8.5 Explain grounding, proper and improper methods, and the results of power source mismatch
- 8.6 List potential signal conflict symptoms
- 8.7 List common wiring and splicing conventions for POTS (plain old telephone service)

**9.0 Technician Work Procedures**

- 9.1 Explain major invoice and billing concepts for service businesses
- 9.2 Describe ways to procure service literature
- 9.3 Describe how to locate and cross-reference parts and products in catalogs
- 9.4 Explain the purposes and requirements for proper record keeping
- 9.5 Calculate individual and departmental productivity for a specific period
- 9.6 Describe how to contact product maker help desks and service departments
- 9.7 Explain estimate concepts for service work
- 9.8 Describe field technician work procedures which may differ from in-shop routines
- 9.9 Explain project management and list steps to follow to achieve maximum results

End of Basic Electronics Competencies Listing (with 9 major Categories, 73 ITEMS and Competencies)

Notes:

The purpose in distributing the above Competencies list is to provide a detailed syllabus for electronics educational institutions and instructors. Also to go further and explain what the student should be able to do with each of the items included in the Competencies listings.

The NCEE (National Coalition for Electronics Education) and allied associations encourage the nation's school systems to adopt these competencies for their basic electronics courses.

**Suggested study texts:**

**The 2008 Associate CET Study Guide;** 2008 Ed.; ETA® International 800-288-3824; ISBN 189174903x; softcover; 214 pgs.

**Electronics: Principles and Applications;** 6th Ed.; Schuler; McGraw-Hill/Glencoe; ISBN 0078288932; Sept 2002; hardcover; 549 pgs.

**Introduction to Electricity, Electronics, and Electromagnetics;** 5<sup>th</sup> Ed.; Robert Boylestad, Louis Nashelsky; Prentice Hall; ISBN 0130105732; Oct 2001; hardcover; 666 pgs.

**Introductory DC/AC Electronics;** 5<sup>th</sup> Ed.; Nigel Cook; Prentice Hall; ISBN 0130310859; Mar 2001; hardcover; 991 pgs.

**Basic Electronics Theory with Projects and Experiments;** 1<sup>st</sup> Ed.; Delton Horn; McGraw-Hill; ISBN 0830642005; Sept 1993; hardcover; 692 pgs.

**How to Test Almost Everything Electronic;** 3rd Ed.; Delton Horn; McGraw-Hill/TAB Electronics; ISBN 0830641289; Aug 1993; hardcover; 304 pgs.

**Electronic Communication;** 6th Ed.; Robert Shrader; Career Education; ISBN 0070571570; Dec 1990; hardcover; 864 pgs.

**Soldering Handbook;** 3rd Ed.; Paul T. Vianco; American Welding Society; ISBN 0871716186; 550 pgs. ([www.SMTnet.com](http://www.SMTnet.com))

**Mastering Technical Mathematics;** 3rd Ed; Stan Gibilisco, Norman Crowhurst; McGraw-Hill/TAB Electronics; ISBN 0071494480; Oct 2007; paperback; 627 pgs.

**Introduction to Electronics;** Patrick Crozier; Breton; ISBN 0534012434; Jan 1983; 484 pgs.

**There Are No Electrons: Electronics For Earthlings;** Kenn Amdahl; Clearwater Publishing; ISBN 0962781592; Oct 1991; paperback; 322 pgs.

**Becoming an Electronics Technician;** 4<sup>th</sup> Ed.; Ronald A. Reis; Prentice Hall; ISBN 0130826510; Aug 2001; paperback; 348 pgs.

**Electronic Principles;** 7<sup>th</sup> Ed.; Albert Malvino, David Bates; McGraw-Hill Higher Education; ISBN 9780072975277; Jan 2007; hardcover; 1116 pgs.