NATIONAL CENTER FOR AEROSPACE & TRANSPORTATION TECHNOLOGIES

Aircraft Electronics Technician (AET) Study Guide

NCATT
4801 Marine Creek Parkway
Fort Worth, TX 76179

(817) 515-7264 www.ncatt.org

THIS PAGE INTENTIONALY LEFT BLANK

National Center for Aircraft Technician Training (NCATT)
Aircraft Electronics Technician (AET)

Study Guide

DESCRIPTION

This **AET Study Guide** is designed to be used in preparing for the NCATT AET Certification examination. The study guide addresses each NCATT AET knowledge "Standard" and the required level of understanding for passing the AET examination. The AET examination will ask one or more questions from each of the standards areas. Use of this study guide coupled with a serious review of the references and study materials that are provided on the NCATT website (www.ncatt.org) will ensure the technician is adequately prepared to join the ranks of "Certified Aircraft Electronics Technicians".

REFERENCES

- Applicable Textbooks (i.e. Electronics)
- FAA Advisory Circulars
  - AC 65-9A – General Handbook
  - AC 65-15A – Airframe Handbook
- Manufacturer Technical Data
- NCATT Web Resources www.ncatt.org

TESTING INFORMATION

- LaserGrade Testing Centers administer the NCATT Certification Exams nationally. For exam information and a LaserGrade center near you, contact LaserGrade online at www.lasergrade.com or by phone at 1-800-211-2754.

- Upon successful completion of the exam test results will be sent to the office of NCATT and the certification packet will be processed. Allow 60 days for processing.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

NCATT LEVEL DEFINITIONS

	Scale Value	Definition: The Individual
Task Performance Levels	1	***IS EXTREMELY LIMITED.*** (Can do simple parts of the task. Needs to be told or shown how to do most of the task)
	2	***IS PARTIALLY PROFICIENT.*** (Can do most parts of the task. Needs only help on hardest parts.)
	3	***IS COMPETENT.*** (Can do all parts of the task. Needs only a spot check of completed work.)
	4	***IS HIGHLY PROFICIENT.*** (Can do the complete task quickly and accurately. Can tell or show others how to do the task.)
Task Knowledge Levels	a	***KNOWS NOMENCLATURE.*** (Can name parts, tools, and simple facts about the task.)
	b	***KNOWS PROCEDURES***. (Can determine step-by-step procedures for doing the task.)
	c	***KNOWS OPERATING PRINCIPLES.*** (Can identify why and when the task must be done and why each step is needed.)
	d	***KNOWS ADVANCED THEORY.*** (Can predict, isolate, and resolve problems about the task.)
*Subject Knowledge Levels	A	***KNOWS FACTS.*** (Can identify basic facts and terms about the subject.)
	B	***KNOWS PRINCIPLE.*** (Can identify relationship of basic facts and state general principles about the subject.)
	C	***KNOWS ANALYSIS.*** (Can analyze facts and principles and draw conclusions about the subject.)
	D	***KNOWS EVALUATION.*** (Can evaluate conditions and make proper decisions about the subject.)

Explanations

A task knowledge scale value may be used alone or with a task performance scale value to define a level of knowledge for a specific task. (Example: b and 1b)

*A subject knowledge scale value is used alone to define a level of knowledge for a subject not directly related to any specific task, or for a subject common to several tasks.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

NCATT Standards for Aircraft Electronics Technician (AET)

1. Basic Terms and Definitions
2. Basic Circuits
3. Basic Circuit Calculations
4. Resistors
5. Inductors
6. Capacitors
7. Transformers
8. Analog Circuits
9. Power Supply Circuits
10. Frequency Sensitive Filters
11. Wave Generation Circuits
12. Limiter Circuits
13. Digital Numbering Systems
14. Digital Logic Functions
15. Hazard/Safety Practices
16. Hazardous Materials Handling
17. Technical Publications
18. Use Common Tools
19. Handling of Electrostatic Devices
20. Identify and Perform Corrosion Control
21. Use Safetying Devices
22. Aircraft Wiring
23. Perform Wire Maintenance
24. Use Test Equipment/Special Tools
25. Aviation Terminology
26. Basic Aviation/Aircraft Fundamentals and Safety
27. Basic Troubleshooting Theory
28. Identify Flight Controls
29. Safety (Operational Risk Management/Fall Protection)

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Introductory and General Requirements

1. Basic Terms NCATT Training Standard Level (A)
(a) Direct Current (DC) Terms

Objective:

Identify basic facts about and define Direct Current (DC) terms.

Content – Direct Current (DC) Terms:

Explain common DC facts and definitions with reference to the following terms:

- *Direct Current*—Flow of electrons in one direction throughout a circuit with constant voltage and current. Direct current is caused by a constant difference of potential, both negative and positive.
- *Electron*—Negatively charged subatomic particles that are located and travel around (orbit) the nucleus in an imaginary sphere or shell at the speed of light (186,000 miles/second). Electrons are involved in the conduction of electricity.
- *Proton*—Positively charged subatomic particles that exist within the nucleus of all atoms. Protons are not involved in the conduction of electricity.
- *Neutron*—Neutral subatomic particles that exist within the nucleus of all atoms. Neutrons are not involved in the conduction of electricity.
- *Conductor*—Common building block of electrical circuits that easily permits the movement of electrons from an electrical source to a load and back to the electrical source with a minimum of resistance. Resistance depends on such factors as cross sectional area, length, temperature, and conductor material.
- *Insulator*—Material or device used to prevent the passage of heat, electricity, or sound from one medium to another.
- *Static Electricity*—Electrical charge that may be built up on a non-conductive surface by friction. Static electricity serves no useful purpose.
- *Current*—Flow of electricity. Electrical current is the rate of flow of electrons that pass a given point in a specific amount of time.
- *Coulomb*—Basic unit of electrical quantity. A coulomb is equal to 6.28 billion - billion electrons (6.28 X 10 to the 18th or 6.28 quintillion).
- *Ampere (A, amp)*—Unit of measurement used to express the flow of electrons (current). One amp is the amount of current that can be forced through one ohm of resistance by the pressure of one volt. Current is represented by the international symbol "I".
- *EMF (E)*—Electron moving force measured in volts. EMF is the force causing electrons to move through a conductor.
- *Volt (V)*—Basic unit of electrical pressure. A volt is the amount of force required to cause one amp of current to flow through one ohm or resistance. Volt is often expressed by such terms as voltage, voltage drop, potential difference, EMF, or IR drop.
- *Resistance (R)*—Electrical characteristic of a conductor. Opposition that a circuit, component, or substance presents to the flow of electricity. Resistance is force that opposes or slows down another force, drops voltage, and consumes power. Resistance is measured in ohms.
- *Ohm's Law*—Ohm's Law states that "the amount of current flowing in a circuit is directly proportional to the circuit voltage and inversely proportional to the circuit resistance."

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Ohm (Ω)*—Unit of electrical opposition to the flow of current. A circuit has one ohm of resistance when it limits the flow of current to one amp under a voltage pressure of one volt.
- *Watts (W)*—Basic unit of power that is the product of voltage multiplied by current. One watt (1/746 horsepower) is the power produced in a circuit that has one amp of current flowing under a pressure of one volt.
- *Capacitor*—Electrical component used to store electrical energy in the form of an electrostatic field. A capacitor is a device made of two parallel conductors separated by an insulator.
- *Working Voltage*—Maximum amount of DC voltage that can be safely applied across a capacitor.
- *Inductor*—Coil or other device used to introduce inductance into a circuit. An inductor is a winding, or coiling, of multiple turns of wire.
- *Battery*— A device made of one or more individual electrochemical cells used to store chemical energy and make the energy available in the electrical form. There are two categories of batteries, primary and secondary. Batteries can store DC power.
- *Left-hand Rule*—Refers to generators. This rule is for determining the direction of movement of a current-carrying conductor in a magnetic field.
- *Magnetism*—Ability of a magnet to attract certain materials containing iron and to influence electrons. Magnetism is the principal way to effectively produce AC electricity.
- *Magnetic Permeability*—Measure of ease that lines of flux travel through a material.
- *Scientific Notation*—Short way of expressing a given number as a number between 1 and 10 multiplied by 10 to the appropriate power.
- *Metric Prefixes*—Measurements relating or using the metric system of measurement.
- *Henry (H)*—Basic unit of measurement for inductance. One Henry is the amount of inductance a current change of one ampere per second induces a voltage of one volt.
- *Farad*—Basic unit of capacitance. One farad holds one coulomb under a pressure of one volt.

1. Basic Terms NCATT Training Standard Level (B)
(b) Alternating Current (AC) Terms

Objective:

Identify the relationship of basic facts about and state general principles of Alternating Current (AC) terms.

Content – Alternating Current (AC) Terms:

Explain the relationship of basic AC facts and general AC principles with reference to the following terms:

- *Alternating Current*—Flow of electrons that continuously changes its value in magnitude and periodically reverses direction (sine-wave). Alternating current is much easier to produce in large quantities as compared to DC. The time required for one cycle of AC to occur is called the period.
- *Frequency*—Number of cycles of AC completed in one second. Frequency is expressed in hertz (Hz), 1 Hz = 1 cycle of AC/Second. The frequency of most AC used in aircraft applications is 400 Hz.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Impedance (Z)*—Electrical characteristic of a conductor. Impedance is the total opposition to the flow of AC in an electrical circuit (resistance, capacitance, and inductance). Values are given in ohms.
- *Capacitive Reactance (*X_C)—Opposition to current flow in a circuit. The affect that capacitance has on an AC circuit is termed capacitive reactance. Capacitance causes current to lead voltage in phase (ICE). Values are given in ohms.
- *Inductive Reactance (*X_L*)*—Opposition to current flow in a circuit. The affect that inductance has on an AC circuit is termed inductive reactance. Inductance causes current to lag voltage in phase (ELI). Values are given in ohms.
- *Sine-Wave*—Alternating current wave form produced by a rotary generator. Sine-waves are values of voltage and current that start at zero and smoothly rise to a peak value; the waves smoothly fall from a peak back to zero. Then, the waves rise to a peak value in a negative direction and smoothly return to zero. One AC cycle is produced by 360 degrees of rotation.
- *Root Mean Square (RMS)*—Effective value of sine-wave alternating current. The RMS value is .707 of the peak value.
- *Effective Voltage*—Amount of AC that produces the same amount of heat as a corresponding value of DC. The effective voltage of AC is referred to as the RMS value. Effective value is always less than the peak value of AC. Unless otherwise specified, all values of AC are considered effective values.
- *Phase Angle*—Angle between two similarly varying quantities (sine-waves). A phase angle is the difference in angle between two sinusoidally varying quantities that have the same frequency.
- *Resistance (R)*—See Basic Terms/Direct Current (DC).
- *Power Factor*—Ratio of the actual power dissipated in an electrical system to the input power of volts multiplied by amps. The power factor is the ratio of power dissipated over input.
- *True Power*—Power actually available in an AC circuit. True power is the product of the circuit voltage and the current in phase with this voltage. Values are given in watts.
- *Apparent Power*—Product of effective voltage and effective current which is expressed in Volt Amps (VA) rather than Watts (W) without reference to phase shift, if any, between voltage and current.
- *Wye Wound*—Windings arranged in the shape of a Y. For example, on a three-phase generator or transformer, one end of each of the three windings is connected to form a common point.
- *Delta Wound*—Windings arranged in the shape of a triangle. For example, on a three-phase generator, motor, or transformer, two of the phase windings are in a series, across the third (phase) winding.
- *Polyphase*—Production of two or more phases of AC, or of two or more alternating voltages of the same frequency. The most common type of polyphase uses three phases.
- *Rectifier*—Electronic device that converts AC to DC. For example, a set of semiconductor diodes connected in a bridge circuit is a rectifier.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

2. Basic Circuits NCATT Training Standard Level (B)
(a) Theory of Operation

Objective:

Identify the relationship of basic facts and state general principles about basic circuit theory of operation.

Content – Theory of Operation:

Explain basic circuits with reference to the following terms:

- *Volts (V)*—See Basic Terms/Direct Current (DC).
- *Ampere (A, amp)*—See Basic Terms/Direct Current (DC).
- *Resistance (R)*—See Basic Terms/Direct Current (DC).
- *Ohm's Law*— See Basic Terms/Direct Current (DC).
- *Power*—Product of applied voltage and current power in a DC circuit. Product of applied voltage and the current in phase with the voltage in an AC circuit.
- *Watts*—See Basic Terms/Direct Current (DC).
- *Joules*—International measure of energy expended in the kilogram, meter, and second system of units. Also known as a Newton-meter, a Joules is the amount of work done when a force of one newton moves an object one meter along the direction of the force.
- *Series Circuits*—Contains only one path for current, making current common through all components. Series circuit components are connected end-to-end.
- *Parallel Circuits*—Contains more than one path for current. Circuit components are connected directly across each other. Current is divided between each branch in the circuit.
- *Complex Circuits*—Contains a combination of series and parallel circuits.
- *Voltage Drop*—Reduction in voltage caused by current flowing through a resistor. Voltage drop is called an IR (current X resistance) drop.
- *Resistors in Series Circuits*—Causes a reduction of current in one circuit.
- *Resistors in Parallel Circuits*—Causes a reduction of current in multiple circuits.
- *Kirchhoff's Current Law (KCL)*—Kirchhoff's Current Law states that "the algebraic sum of the current flowing away from any point in an electrical circuit is equal to the sum of the current flowing to that point."
- *Kirchhoff's Voltage Law (KVL)*—Kirchhoff's Voltage Law states that "the algebraic sum of all of the voltage drops in any closed circuit is equal to zero."
- *Kirchhoff's Resistance Law (KRL))*—Kirchhoff's Resistance Law states that "the total resistance in a series circuit is the sum of the individual resistances or loads in the circuit."
- *Bridge Circuits*—Contains four impedances that form a square. Two diagonally opposite corners are connected to an input device. The other two diagonally opposite corners are connected to an output device.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

2. Basic Circuits NCATT Training Standard Level (2b)
(b) Troubleshooting Circuits

Objective:

The student will determine procedures for troubleshooting basic electrical circuits.

Content – Troubleshooting Circuits:

Explain that troubleshooting is the ability to diagnose and repair a defective circuit. There are different techniques to use while troubleshooting a circuit depending on the type of circuit being tested. The most common problems encountered while troubleshooting circuits are the following:

- Open resistors or contacts.
- Shorts between conductors.

Demonstrate to the student how to test the following circuits for defects using a multimeter.

- *Series Circuits*
- *Parallel Circuits*
- *Complex Circuits with a Voltage Drop*
- *Resistors in Series Circuits*
- *Resistors in Parallel Circuits*
- *Bridge Circuits*

3. Basic Circuit Calculations NCATT Training Standard Level (B)
(a) DC

Objective:

Identify the relationship of basic facts and state general principles for DC circuit calculations.

Content – DC Circuit Calculations:

Explain how Mathematics is an integral part of electronics by using formulas based on Ohm's Laws and Kirchhoff's Laws to show the relationship between the following terms:

- *Volts (V)*
- *Ampere (A, amps)*
- *Ohm (Ω)*
- *Watts (W)*

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

3. Basic Circuit Calculations NCATT Training Standard Level (B)
(b) AC

Objective:

Identify the relationship of basic facts and state general principles for AC circuit calculations.

Content – AC Circuit Calculations:

Explain the formulas used in AC circuit calculations with reference to the following terms:

- *Phase angle*—See Basic Terms/Alternating Current (AC).
- *Frequency*—See Basic Terms/Alternating Current (AC).
- *Capacitive Reactance* (X_C)—See Basic Terms/Alternating Current (AC).
- *Inductive Reactance* (X_L)—See Basic Terms/Alternating Current (AC).
- *Power Factor*—See Basic Terms/Alternating Current (AC).
- *Period*—Amount of time for one complete cycle of oscillation to take place.
- *Peak Voltage*—Voltage measured from zero voltage to the maximum number of volts generated.
- *Effective Value*—Value of sine-wave alternating current needed to produce the same amount of heat as the value of the direct current.
- *Inductance*—Electrical characteristic of a conductor. Inductance causes voltage to be produced when it is cut or crossed by lines of magnetic flux. Inductance causes the current to lag the applied voltage.
- *Resonance*—Electrical characteristic of a conductor. Resonance occurs in an electrical circuit when the inductive and capacitive reactances are equal.
- *Capacitance*—Electrical characteristic of a conductor. Capacitance is the amount of electrical charge that can be stored in a capacitor under a given amount of electrical pressure (voltage). Capacitance causes the current to lead the applied voltage.
- *Reactance*—Electrical characteristic of a conductor. Reactance is opposition to AC flow by coils and capacitors. Values are given in ohms.
- *Impedance (Z)*—See Basic Terms/Alternating Current (AC).
- *True Power*—See Basic Terms/Alternating Current (AC).
- *Apparent Power*—See Basic Terms/Alternating Current (AC).

3. Basic Circuit Calculations NCATT Training Standard Level (2b)
(c) DC/AC Measurement

Objective:

Determine procedures for calculating basic DC and AC measurements.

Content – DC/AC Measurement:

Explain the advantages and disadvantages of DC/AC measurement. Emphasize the problems associated with improper use and storage of the meters, as well as safety issues. Explain and demonstrate how to use the following meters with an emphasis on which meters work best for various measurements and tests.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Multimeter*—Multi-function meter used to test current values, voltage values, or ohmic values (resistance). With the flip of a switch, a multimeter can be set up as an ammeter, voltmeter, or ohmmeter. Displays on a multimeter are provided in both analog and digital format. Use a multimeter whenever possible.
- *Ammeters*—Electrical testing instrument used to measure the amount of current flowing through a load. Values are given in amps. Some ammeters measure milliamps and microamps.
- *Voltmeters*—Electrical testing instrument used to measure electrical voltage across components. Values are given in volts. Use a voltmeter for measurements and calculations to find a probable defect.
- *Ohmmeters*—Electrical testing instrument used to measure resistance in a circuit or component. Values are given in ohms. An ohmmeter provides an effective and quick way to test the condition of a switch.
- *Oscilloscopes*—Electronic test instrument that displays the waveforms of electrical signals. Oscilloscopes measure voltages (AC peak-to-peak values), measure time to determine frequencies, and display phase relationships (comparisons of waveforms in time) to identify equipment malfunctions.

4. Resistors NCATT Training Standard Level (A)
(a) Color Codes

Objective:

Identify basic facts and terms about resistor identification (values) using color codes.

Content – Color Codes:

Explain three methods for finding a resistor's value. The following methods are acceptable to find a resistor's value.

- Refer to a schematic diagram where the value of the resistor is printed.
- Measure the individual resistor with an ohmmeter.
- Read the value (color code band) from the resistor itself, if it is legible.

Optional - Explain how the mnemonic, "Big **B**ears **R**omp **O**n **Y**ellow **G**rass **B**ut **V**iolets **G**row **W**ithout **G**etting **S**tomped **G**ood **S**tory? – "**N**ot!", to assist students in reading the color code bands.

Big	- Black - 0	Grow	- Gray - 8
Bears	- Brown - 1	Without	- White - 9
Romp	- Red - 2	Getting	- Gold - 0.1
On	- Orange - 3	Stomped	- Silver - 0.01
Yellow	- Yellow - 4	Good	- Gold - ± 5%
Grass	- Green - 5	Story	- Silver - ± 10%
But	- Blue - 6	Not	- no Color - ± 20%
Violets	- Violet - 7		

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

4. Resistors NCATT Training Standard Level (2b)
(b) Isolate Faulty Resistors

Objective:

Determine procedures for isolating faulty resistors within a circuit.

Content – Isolate Faulty Resistors:

Explain the procedures (visual and non-visual) for troubleshooting resistors with reference to the following terms:

- *Open Resistors*—Fault caused by an incomplete path for current to flow from one terminal to another. It is possible for a resistor or fuse to open without showing any visible signs of damage.
- *Shorted Resistors*—Fault that allows electrical current to flow across a part of the circuit that should act as an insulator. Circuits with multiple components or circuit traces close together on a printed circuit board commonly have faults. Short circuits caused by foreign materials are common.
- *Resistors of Incorrect Value*—Fault caused by resistors that are outside of their specified values.
- *Improperly Installed Resistors*—Fault caused by resistors that are not installed correctly or installed non-compliant to industry standards.

5. Inductors NCATT Training Standard Level (B)
(a) Theory of Operation

Objective:

Identify the relationship of basic facts and state general principles about inductor theory of operation.

Content – Theory of Operation:

Explain how current flows through a conductor and how conductors are coiled into loops to add strength to the total magnetic field. A conductor wound into coils or loops (specifically designed coils of wire) is known as an inductor.

Explain the physical factors*, operation, and use of inductors with reference to the following terms:

- Correct operation of inductors (coils)
- Use of multiple Inductors
- Calculation of inductive reactance

*Physical Factors that affect inductance:

- Number of turns of the coils
- Core cross-sectional area (diameter)
- Length of the coil (space between the coils)
- Type of core material (permeability)

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

5. Inductors NCATT Training Standard Level (B)
(b) Isolate Faulty Inductors

Objective:

Identify the relationship of basic facts and state general principles for isolating faulty inductors.

Content – Isolate Faulty Inductors:

Explain the procedures (visual and non-visual) for troubleshooting inductors, also called a coil or choke, with reference to the following terms:

- *Open Inductor*—Fault caused by an open circuit (no continuity) between the two leads. There will be no current.
- *Shorted Inductors*—Fault that allows the current to travel from one lead to the other lead without going through the coil (winding) of the inductor.
- *Improperly Installed Inductors*—Fault caused by inductors that are not installed correctly or installed non-compliant to industry standards.

6. Capacitors NCATT Training Standard Level (B)
(a) Theory of Operation

Objective:

Identify the relationship of basic facts and state general operating principles about capacitor theory of operation.

Content – Theory of Operation:

Explain the use and operation of capacitors with reference to the following terms:

- *Time constant*—Amount of time, measured in seconds, needed for the voltage across a capacitor to advance to 63.2% of the voltage applied to the circuit.
- *Fixed Capacitors*—Constructed of plates and dielectrics placed firmly together and covered with a protective material such as waxed paper, plastic, ceramic material, or insulated casing.
- *Variable Capacitors*—Changes capacitance in a circuit by changing the area of its plates. The dielectric in a variable capacitor is normally air. Variable capacitors are used in radios and other electronic devices when it is necessary to change the capacitance to meet circuit requirements.
- *Electrolytic Capacitors*—Uses a liquid or paste dielectric that has a considerably higher dielectric strength as compared to air or other dry materials used as the dielectric in other capacitors. Electrolytic capacitors, used only in DC applications, are polarity sensitive and connecting them incorrectly in a circuit will destroy them.
- *Dielectric*—Insulating material that stores electrical energy in an electrostatic field.
- *Farad*—See Basic Terms/Direct Current (DC).
- *Correct Operation of Capacitors*—Stores electrical energy in an electrostatic field. The ability of a capacitor to store a charge is called capacitance. Capacitance offers resistance to the flow of current by continuously charging and discharging.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Uses of Multiple Capacitors*—Includes the following:
  - Reduce electrical arcing at breaker points or switch contacts.
  - Reduce the emanation of electromagnetic waves in some electrical circuits.
  - Allow certain frequencies in AC circuits to pass or block certain frequencies (filtering) when combined with resistors and or inductors.

- *Capacitive Reactance (*X_C)—See Basic Terms/Alternate Current (AC).

- *Calculation of Capacitive Reactance*—Calculation formula and factors are:

  Formula: $X_c = \frac{1}{2\pi fC}$

  X_c = Capacitive Reactance in Ohms (Ω)
  π (pi) = 3.142
  f = Frequency in Hertz (H_z)
  C = Capacitance in Farads (F)

6. Capacitors NCATT Training Standard Level (2b)
(b) Isolate Faulty Capacitors

<u>*Objective*</u>:

Determine procedures for isolating faulty capacitors in a circuit.

<u>*Content – Isolate Faulty Capacitors*</u>*:*

Explain the procedures (visual and non-visual) for troubleshooting capacitors with reference to the following terms:

- *Open Capacitors*—Fault caused when continuity is lost to one of the plates. There is no current in the circuit. Voltage applied to the circuit or branch of a circuit appears across the component that is open.
- *Shorted Capacitors*—Fault caused when two conductive surfaces (plates) come into physical contact with each other. Electrical qualities of the capacitor no longer exist.
- *Improperly Installed Capacitors*—Fault caused by capacitors that are not installed correctly or installed non-compliant to industry standards.

7. Transformers NCATT Training Standard Level (B)
(a) Theory of Operation

<u>*Objective*</u>:

Identify the relationship of basic facts and state general principles about transformer theory of operation.

<u>*Content – Theory of Operation*</u>*:*

Explain classificatons*, operation, and use of transformers with reference to the following terms:

- *Primary Winding*—Input winding of a transformer connected across a power line.
- *Secondary Winding*—Winding of a transformer that supplies energy to the load device.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Eddy Current*—Current loss due to heating of the core that alters the overall distribution of current flowing through the conductor. As the current flows, the core heats up and resistance increases due to the core positive temperature coefficient.
- *Hysteresis*—Current loss due to a lag between the physical action occurring and the cause of loss.
- *Counter EMF*—See Basic Terms/Direct Current (DC).
- *Step-up*—Increases the voltage and decreases the current. Step-up transformers have more turns in the secondary coil than the primary coil, or winding.
- *Step-down*—Decreases the voltage and increases the current. Step-down transformers have more turns in the primary coil than in the secondary coil, or winding.

*Transformer classifications:

- Winding style
- Frequency range
- Power application

7. Transformers NCATT Training Standard Level (2b)
(b) Isolate Faulty Transformers

Objective:

Determine procedures for isolating faulty transformers in a circuit.

Content – Isolate Faulty Transformers:

Explain the procedures (visual and non-visual) for troubleshooting transformers with reference to the following terms:

- *Open or Shorted Primary Coil*—Fault caused when the fuse or the circuit breaker (CB) in the power source is open because of excess current.
- *Open or Shorted Secondary Coil*—Fault is zero volts because there is no coupling action (imperfect coupling).
- *Improperly Installed Transformers*—Fault caused by transformers that are not installed correctly or installed non-compliant to industry standards.
- *Resistance Testing*—Fault caused by a breakdown of insulators or conductors of primary and secondary coils.

8. Analog Circuits, Devices, and Switches NCATT Training Standards Level (B)

Objective:

Identify the relationship of basic facts and state general principles about use and operation of analog circuits, analog devices, and analog switches.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Content – Analog Circuits, Analog Devices, and Analog Switches:

Explain the use and operation of analog circuits, devices, and switches with reference to the following terms:

- *Switches*—Switch devices that control circuits include the following:
  - Electromechanical Switches (e.g., toggle, plunger, push-button, rocker, knob)—Designed for high-level loads. Electromechanical switches are selected based on the design or type of aircraft service needed.
  - Proximity Switches (Sensor-type Switches)—Usually solid-state devices that detect the presence of a predetermined target without physical contact.
- *Relays*—Electrically controlled device that opens and closes electrical contacts to effect the operation of other devices in the same or another electrical circuit.
- *Solenoids*—Electro magnet device with a movable iron core that can be pulled into a coil.
- *Derating Factors*—Method for derating nominal ratings to obtain reasonable switch efficiency under reactive load conditions.
- *Normally Open*—Relay contacts that are held open by a spring.
- *Normally Closed*—Relay contacts that are held closed by a spring.
- *DPST*—Double Pole Single Throw switch.
- *SPDT*—Single Pole Double Throw switch.
- *DPDT*— Double Pole Double Throw switch.
- *Rocker Switch*—Switch that opens and closes an electrical circuit by pushing the switch up and down with the thumb.
- *Toggle Switch*—Switch that is the most susceptible to shock and vibration in a plane. Toggle switch contacts may open momentarily, and then close.
- *Rotary Switch*—Switch capable of selecting any of several circuits.
- *Micro Switch*—Precision electrical switch used to control the movement of mechanical devices.
- *Push Button Switch*—Switch that makes contact when a button is pressed and breaks contact with the release of the button.

9. Power Supply Circuits NCATT Training Standard Level (B)
(a) Rectifiers

Objective:

Identify the relationship of basic facts and state general principles for power supply circuit rectifiers.

Content – Rectifiers:

Explain the use and operation of power supply circuit rectifiers with reference to the following terms:

- *Power Supply Circuits*—Keep the output voltage constant as the load current changes.
- *Solid-state*—Devices that are solid and contain no loose or moving parts. Semiconductor materials are often called solid-state devices.
- *Germanium/Silicon*—Principle semiconductor materials. In their pure state, germanium and silicon are insulators. With the addition of a small amount of dopants (impurities) to

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

germanium or silicon, these materials are capable of carrying current and becoming semiconductors.

- *Forward bias*—Semiconductor condition of operation in which a low-resistant state exists. On average, it takes about 0.7 VDC of the correct polarity applied to a diode to cause the diode to conduct. This action is known as forward biasing the diode.
- *Reverse bias*—Semiconductor condition of operation in which a high-resistance state exists. If voltage is applied in the reverse direction to a diode, the diode will not support the conduction of electricity.
- *Insulator*— See Basic Terms/Direct Current (DC).
- *Diode*—Simplest electrical semiconductor device formed when an N-type material is joined with a P-type material. Diodes are commonly used to change AC electricity into DC electricity (rectification). Diodes allow current to flow in one direction only.
- *Full-wave Rectifier*—Commonly used to change AC electricity into DC electricity. Output DC voltage is ½ of the input AC voltage.
- *Half-wave Rectifier*—Commonly used to change AC electricity into DC electricity. Output DC voltage is pulsating with ½ the frequency of the input AC voltage.
- *Three-phase Rectifier*—Commonly used to change AC electricity into DC electricity. Output DC voltage is the same as the input AC voltage.
- *Ripple amplitude*—Frequency of a ripple in the output of a rectifier circuit.

9. Power Supply Circuits NCATT Training Standard Level (A)
(b) Filters

Objective:

Identify basic facts and terms about power supply circuit filters to include active filters and passive filters.

Content – Power Supply Circuit Filters:

Explain the use and operation of power supply circuit filters with reference to the following terms:

- *Active filters*—Produces a current or voltage gain.
- *Passive filters*—Produces no gain in an electrical circuit.

10. Frequency Sensitive Filters NCATT Training Standards Level (A)
Theory of Operation

Objective:

Identify basic facts and terms about the theory of operation for frequency sensitive filters.

Content – Theory of Operation:

Explain the use and operation of frequency sensitive filters with reference to the following terms:

- *Filtering*—Frequency-sensitive filter circuits are designed to pass a certain range of frequencies from the generator to the load device and reject all other frequencies. Filters are placed between the signal source (generator) and the load device. These filters act as frequency sensitive voltage dividers.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Low-pass*—Allows low frequencies to pass from the generator to the load device and blocks, or attenuates, high frequencies.
- *High-pass*—Passes high frequencies and attenuates low frequencies.
- *Band-pass*—Passes certain bands of middle frequencies while attenuating high and low frequencies through the use of resonant circuits.
- *Band-reject*—Attenuates a certain band of middle frequencies while passing the high and low frequencies through the use of resonant circuits.
- *Tuning Circuit*—Resonant electronic circuit containing both capacitance and induction that can be adjusted to change the frequency.
- *Demodulation*—Electronic filter that decreases the amplitude of some frequencies relative to other frequencies.
- *Detection*—Another term for demodulation.
- *Crystals*—Material used in filters to assist in the rejection of unwanted signals. Filters contain thin slivers of quartz crystals that vibrate at a specific resonant frequency when voltage is applied. Crystal can be cut and ground for various frequencies. These are called piezoelectric crystals.
- *Cutoff Frequency*—Frequency at which attenuation starts to increase rapidly.

11. Wave Generation Circuits NCATT Training Standard Level (A)
(a) Oscillators

Objective:

Identify basic facts and terms about the theory of operation for wave generation circuit oscillators.

Content – Oscillators:

Explain the use and operation of wave generation oscillators with reference to the following terms:

- *Oscillator*—Electronic circuit that converts DC into AC at predetermined frequencies and amplitudes. Without the amplifier, electronic oscillation would be quickly dampened out by the resistance in the wiring of the circuit. The primary purpose is to generate a repetitive waveform at a constant (peak to peak) amplitude and specific frequency and to maintain this waveform within certain limits.
- *LC Tank Oscillator*—Electronic circuit for communications receivers. This type oscillator produces useful power at two or three times the frequency of the fundamental pulse rate. The LC tank oscillator stores energy alternately in the inductor and the capacitor. This storage method produces an output that is sinusoidal.
- *Crystal-controlled Oscillator*—Electronic circuit that contains a piezoelectric crystal. Output frequency is determined by the resonant frequency of the piezoelectric crystal in the oscillator. A crystal-controlled oscillator produces a sine-wave.
- *Hartley Oscillator*—Electronic circuit that uses a tapped coil in parallel with a capacitor to control the AC frequency of a circuit.
- *Regenerative Feedback Path*—Positive feedback. A regenerative feedback path makes any amplifier an oscillator.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

11. Wave Generation Circuits NCATT Training Standard Level (A)
(b) Wave Shaping Circuits

Objective:

Identify basic facts and terms about the theory of operation for wave shaping circuits.

Content – Wave Shaping Circuits:

Explain the use and operation of wave generation wave-shaping circuits with reference to the following terms:

- *Oscillator*—See Wave Generation Circuits/Oscillators.
- *LC Tank*—See Wave Generation Circuits/Oscillators.
- *Crystal-controlled Oscillator*—See Wave Generation Circuits/Oscillators.
- *Transistor*—Semiconductor devices that have three or more electrodes. Transistors are used for switches and amplifiers.
- *Multivibrator*—Electronic circuit that produces or generates square or rectangular waveshapes.
    - Monostable Multivator—One permanent stable mode of operation.
    - Astable Multivibrator—Two conditions of temporary stability and no permanent condition of stability.
    - Bistable Multivibrator—Two transistors that alternate conducting. One transistor conducts until an external pulse stops its conducting. Then, the other transistor takes over conducting.

12. Limiter Circuits NCATT Training Standard Level (B)
(a) Diodes

Objective:

Identify the relationship of basic facts and state general principles about operation of limiter circuit diodes.

Content - Diodes:
Explain the use and operation of limiter circuit diodes with reference to the following terms:

- *Schematic Diagram and Symbols*—Electric or fluid power system graphical presentation. Components of the system are represented by symbols, not pictures or drawings. A schematic diagram is used mainly for troubleshooting a system or device.
- *Proper Use and Installation*—Handle a device safely and properly. Use industry standards to install a device correctly.
- *Forward Bias*—See Power Supply Circuits/Rectifiers.
- *Reverse Bias*—See Power Supply Circuits/Rectifiers.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

12. Limiter Circuits NCATT Training Standard Level (B)
(b) Zener Diodes

Objective:

Identify the relationship of basic facts and state general principles about operation of limiter circuit zener diodes.

Content – Zener Diodes:

Explain the use and operation of limiter circuit zener diodes with reference to the following terms:

- *Zener Diodes*—Special application diode in which electricity is conducted under certain voltage conditions. The primary purpose of the zener diode is to regulate voltage.
- *Schematic Diagram and Symbols*—See Limiter Circuits/Diodes.
- *Proper Use and Installation*—See Limiter Circuits/Diodes.

12. Limiter Circuits NCATT Training Standard Level (B)
(c) Transistors

Objective:

Identify the relationship of basic facts and state general principles about operation of limiter circuit transistors.

Content – Transistors:

Explain the use and operation of limiter circuit transistors with reference to the following terms:

- *Schematic Diagram and Symbols*—See Limiter Circuits/Diodes.
- *Proper Use and Installation*— See Limiter Circuits/Diodes.
- *Bipolar Transistors*—Includes the following:
  - *PNP Transistor*—Three-element semiconductor formed by placing a lightly doped, very thin region of N-type silicon or germanium between two regions of P-type material which affects current.
  - *NPN Transistor*—Three-element semiconductor formed by placing a lightly doped, very thin region of P-type silicon or germanium between two regions of N-type material which affects current.
- *Polarity of Connections*—PNP and NPN transistors are not interchangeable because of their opposite polarities.
- *Collector Current*—Electrode from which conventional current leaves the transistor. The collector collects the current.
- *Base Current*—Electrode between the emitter and the collector. The base controls the amount of current passed.
- *Emitter Current*—Electrode that compares with the cathode in an electron tube. The emitter emits the current carriers.
- *Junction*—Point at which two materials are in contact with each other.
- *Emitter Base Junction*—Must be forward-biased for a transistor to conduct current.
- *Collector Base Junction*—Must be reverse-biased for a transistor to conduct current.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

13. Digital Numbering Systems NCATT Training Standard Level (B)
(a) Binary

Objective:

Identify the relationship of basic facts and state general principles about binary digital numbering systems.

Content – Binary:

Explain the use of the binary digital numbering system and practice conversions with reference to the following terms:

- *Decimal Numbering System*—Uses numbers 0 – 9. The decimal numbering system operates in Base 10.
- *Binary Numbering System (Binary Notation)*—Mathematical computation based on powers of two. The binary numbering system is composed of two digits (1 and 0). Binary notation operates in Base 2. Each digit in a binary number represents two bits.
- *Binary Digit (bit)*—Each zero or one in a binary number.
- *Byte*—Consists of eight bits.
- *Conversions*—Mathematical ways to express digital numbering systems. For example, a decimal number may be converted to its binary equivalent by sequentially dividing the number by 2 and recording each remainder.

13. Digital Numbering Systems NCATT Training Standard Level (B)
(b) Octal

Objective:

Identify the relationship of basic facts and state general principles about octal digital numbering systems.

Content – Octal:

Explain the use of the octal digital numbering system and practice conversions with reference to the following terms:

- *Octal Numbering System (Octal Notation)*—Mathematical computation based on powers of eight. The octal numbering system is composed of eight digits (0 – 7). Octal notation operates in Base 8. Each digit in an octal number represents three bits, a triad.
- *Conversions*—See Digital Numbering Systems/Binary.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

13. Digital Numbering Systems NCATT Training Standard Level (B)
(c) Hexadecimal

Objective:

Identify the relationship of basic facts and state general principles about hexadecimal digital numbering systems.

Content – Hexadecimal:

Explain the use of the hexadecimal digital numbering system and practice conversions with reference to the following terms:

- *Hexadecimal Numbering System (Hexadecimal Notation)*—Mathematical computation based on powers of 16. The hexadecimal numbering system is composed of 16 units (decimal numbers 0 – 9 and letters A – F for decimal numbers 10 – 15). Hexadecimal notation operates in Base 16. Each digit in a hexadecimal number represents four bits.
- *Conversions*—See Digital Numbering Systems/Binary.

14. Digital Logic Functions NCATT Training Standard Level (B)
(a) Main Logic Gates

Objective:

Identify the relationship of basic facts and state general principles about digital logic functions utilizing main logic gates.

Content – Main Logic Gates:

Explain the proper use, installation, and operation of main logic gates with reference to the following terms:

- *Main Logic Gate*—Can handle AND, OR, NOT, NOR, NAND, and EXCLUSIVE OR decisions. Main logic gates form logical input signals in various ways to produce the desired outputs.
- *Positive Logic*—The more positive (higher) voltage stands for 1; the less positive (lower) voltage stands for 0.
- *Negative Logic*—The more positive (higher) voltage stands for 0; the less positive (lower) voltage stands for 1.
- *Display of Digital Data*—Alphanumeric characters produced by visible segments on LED or LCD devices. Normally, seven or less segments are used to form the numbers 0–9.
- *Function Table*—Describes the electrical states.
- *Truth Table*—Describes the behavior of a logic gate.
- *Logic Gates*—Switching circuits connected together to make a variety of digital systems.
- *AND Logic Gate*—The AND logic gate has two or more inputs and one output.
- *OR Logic Gate*—The OR logic gate has two or more inputs and one output.
- *Inverter*—Circuit that performs the respective negator, NOT logic, function. An inverter has one input and one output that are always in opposition. An inverter is a logic device, not a gate.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *NOR Logic Gate*—Means NOT OR. The NOR logic gate has two or more inputs and one output. It is usually followed by an inverter.
- *NAND Logic gate*—Means NOT AND. The NAND logic gate has two or more inputs and one output. It is usually followed by an inverter.
- *EXCLUSIVE OR Logic Gate*—The EXCLUSIVE OR logic gate requires inputs to be different to obtain an output.

14. Digital Logic Functions NCATT Training Standard Level (B)
(b) Flip-flops

Objective:

Identify the relationship of basic facts and state general principles about digital logic functions utilizing flip-flops.

Content – Flip-flops:

Discuss the advantages and disadvantages of flip-flops. Explain the use and operation of flip-flops with reference to the following terms:

- *Flip-flop*—Bi-stable (stable in either of two alternative states) or static memory element used to store information. Bi-stable means one output for the normal value and one output for the complement value of a stored bit.
- *Latch*—Two cross-coupled NAND or NOR logic gates where the output of each gate is applied to the input of the other gate. A latch can have data input, clock input, and output.
- *R-S Latch*—Two cross-coupled NOR logic gates where supplying a 1 at either input causes the output to be 0.
- *Data-type Latch*—Stores the status of its "D" input whenever the clock input makes a certain transition (low to high or high to low). Latch input is fed from its own inverted output.
- *Clock Pulse*—Pulse generator used to synchronize the timing of switching circuits. The clock determines when certain actions can occur in a digital system.
- *J-K Flip-flop*—During clocking, the inputs and outputs toggle between 1 and 0.
- *Asynchronous*—Change occurs at a speed determined by circuit functions, not a timing device.
- *Synchronous*—Change occurs at the same instant using a timing device.

14. Digital Logic Functions NCATT Training Standard Level (B)
(c) Counters

Objective:

Identify the relationship of basic facts and state general principles about digital logic functions utilizing counters.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Content – Counters:

Explain the use and operation of counters with reference to the following terms:

- *Counter*—Memory register with special features. A counter is a flip-flop interconnection having an input that enables binary counting. Every time an input is received, the register changes in a regular pattern. Changes are also prearranged by the system.
- *Frequency Division/Divider*—Electronic circuit that takes an input signal with a frequency and generates an output signal with a frequency. Frequency dividers can be implemented for both analog and digital applications.
- *Counter Triggering Method*—Output number increases by one at every pulse due to a toggling effect.

14. Digital Logic Functions NCATT Training Standard Level (B)
(d) Adders

Objective:

Identify the relationship of basic facts and state general principles about digital logic functions utilizing adders.

Content – Adders:

Explain the use and operation of adders with reference to the following terms:

- *Adder*—Digital circuit that performs the addition of numbers. The most common adders operate on binary numbers.
- *Half-adder*—Digital circuit that performs an addition operation on two binary numbers.
- *Full-adder*—Digital circuit that performs an addition operation on three binary numbers.
- *Subtractor*—Digital circuit that performs the subtraction of numbers. The most common subtractors operate on binary numbers.
- *Adder-Subtractors*—Digital circuit capable of adding or subtracting numbers in a circuit.

Common Maintenance Practices

15. Hazards/Safety Practices NCATT Training Standard Level (A)
(a) RF Energy

Objective:

Identify basic facts and terms about hazards and safety practices concerning RF energy.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Content – RF Energy:

There are OSHA standards, other federal standards, and national consensus standards relevant to radio frequency and microwave radiation. Explain the use of RF energy, hazards, and safety programs with reference to the following terms:

- *RF Energy*—Radio frequency energy/radiation. RF energy is one form of electromagnetic energy that makes up the electromagnetic spectrum. Radio frequencies are used for providing radar and telecommunications services and for industrial heating and sealing.
- *Specific Absorption Rate (SAR)*—Common measure of exposure to RF energy.
- *Personal Protective Equipment (PPE)*—The use of PPEs takes into consideration key factors involved in the identification of hazards to employees (inhalation, skin absorption, ingestion, and eye or skin contact). Personal Protection Equipment is material-hazard specific and takes into account the performance of PPE materials (and seams) in providing a barrier to potential hazards.
- *RF Protection Program*—Includes training in normal operation of equipment, support such as periodic screening of employees and facilities, and applicable emergency procedures.
- *Residual Risks*—Most RF systems have some residual risks such as high voltages, hot surfaces, and toxic materials.

15. Hazards/Safety Practices NCATT Training Standard Level (A)
(b) Noise

Objective:

Identify basic facts and terms about hazards and safety practices concerning noise.

Content – Noise:

Explain noise hazards and safety programs with reference to the following terms:

- *Noise*—Refers to a sound, especially one that is noticeably unpleasant and very loud.
- *Noise Protection Program*—Includes training in normal operation of equipment, support such as periodic screening of employees and facilities, and applicable emergency procedures.
- *Allowable Daily Exposure*—OSHA has adopted a 90 dB (A) level limit within a daily 8-hour exposure.
- *Passive Hearing Protection*—Earplugs and earmuffs with low-level protection.
- *Active Hearing Protection*—Active Noise Reduction (ANR) earmuffs, headsets, and helmets containing electronic components that enhance communications. These devices substantially improve intelligibility and comfort, which decreases fatigue.

15. Hazards/Safety Practices NCATT Training Standard Level (A)
(c) Electrical Power

Objective:

Identify basic facts and terms about hazards and safety practices concerning electrical power.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Content – Electrical Power:

Explain the use of electrical power, hazards, and safety programs with reference to the following terms:

- *Job Briefings*—Meetings with employees involved before they start each job. A Job briefing covers the following subjects:
  - Hazards associated with the job.
  - Work procedures involved.
  - Special precautions.
  - Energy source controls.
  - PPE requirements.
- *Electrical Protective Devices*—Protective electrical insulated gloves and sleeves or other electrical protective equipment to be worn when employees are exposed to electrical shock hazards while working on electrical equipment.
- *Circuit Protection Devices*—Include fuses, current limiters, thermal protectors (switches), and circuit breakers.
- *Elimination/Termination of Circuit Power*—Specific procedural steps for shutting down, isolating, blocking, and securing machines or equipment to control hazardous energy sources. Lockout/tagout devices are often used. There are also procedures for the placement, removal, and transfer of these devices.
- *Electrical Power Protection Program*—Includes training in normal operation of equipment, job briefings, support of safety-related work practices, and applicable emergency procedures.

15. Hazards/Safety Practices NCATT Training Standard Level (A)
(d) ESD Protection

Objective:

Identify basic facts and terms about hazards and safety practices concerning ESD protection.

Content – ESD Protection:

Explain the ESD hazards, causes, and safety programs with reference to the following terms:

- *ESD*—Electrostatic Discharge is the instantaneous discharge of static electricity that has built up on one surface or point and is discharged to another surface or point.
- *ESD Control Program*—Four primary ESD control measures are the following:
  - Grounded workstation surfaces and equipment.
  - Personnel grounding.
  - Handling precautions.
  - Protective packaging for ESD items when transporting or storage.
- *Conductive Wrist Strap (Connected to Earth Ground)*—Worn by an individual to keep a workstation free of static charges.
- *MIL-STD-129*—ESD caution standard (military) that includes procedures for precautionary measures.
- *ESD Protection Program*—Includes training in examples of ESD failures, prevention, support of safety-related work practices, and applicable emergency procedures.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

15. Hazards/Safety Practices NCATT Training Standard Level (A)
(e) Microwave

Objective:

Identify basic facts and terms about hazards and safety practices concerning microwave energy.

Content – Microwave Energy:

Radio Frequency (RF) energy and microwave energy are forms of electromagnetic energy; they differ in frequency and wavelength. Explain the terms and safety programs with reference to the following terms:

- *Microwave (MW) Energy*—Microwave energy/radiation. Microwave energy is one form of electromagnetic energy that makes up the electromagnetic spectrum. Microwave frequencies are normally used for satellite communication and radar. These frequencies are also used for bonding composite sheets for the automotive and aerospace industries.
- *Microwave Protection Program*—Includes training in normal operation of equipment, support such as periodic screening of employees and facilities, and appropriate emergency procedures.

15. Hazards/Safety Practices NCATT Training Standard Level (A)
(f) Hazardous Liquids

Objective:

Identify basic facts and terms about hazards and safety practices concerning hazardous liquids.

Content – Hazardous Liquids:

Explain the importance of manufacturer's warnings and recommendations for hazardous liquid safety practices with reference to the following terms:

- *Hazardous Liquids*—Includes corrosives, ignitables, and reactives, as well as chemicals used as solvents, cleaners, caustic solutions, degreasers, strippers, adhesives, and coatings.
- *Solvents*—Substance that dissolves another substance or substances to form a solution. Solvents are usually, but not always liquid. Solvents can also be gases or solids. Two extremely hazardous solvents used in the aircraft industry are the following:
  - Methyl Ethyl Ketone (MEK)—Solvent used in the surface coating industry and in dewaxing of lubricating oils. Methyl Ethyl Ketone is commonly used with other solvents such as acetone, ethyl acetate, hexane, toluene, and alcohols.
  - *Acetone*—Organic solvent of industrial and chemical significance. Acetone is colorless, volatile, and extremely flammable.
- *Cleaners*—Substances that may contain solvents, corrosives, or any number of chemicals to clean an aircraft.
- *Caustic Solutions*—Substances that can burn and destroy living tissues or soft metals. Caustic solutions are usually strong acids and/or bases.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Degreasers and Strippers*—Substances that clean commercial and industrial parts. Many degreasers and strippers contain flammable and toxic elements.
- Adhesives—Substances that adhere or bond two components, or items, together. Many adhesives contain flammable and toxic elements.
- *Coatings*—Substances that function to protect surfaces. Coatings contain pigments, paints, solvents, drying oils, and other additives.
- *How to Obtain Proper Material Safety Data Sheet (MSDS) Information*—See Hazardous Material Handling/Material Safety Data Sheet.

15. Hazards/Safety Practices NCATT Training Standard Level (1a)
(g) Practice FOD Prevention

Objective:

Determine simple facts about Foreign Object Damage (FOD) prevention activities.

Content – Practice FOD Prevention:

Explain FOD prevention and accountability with reference to the following terms:

- *FOD (Foreign Object Debris)*—Substance, debris, or article alien to a vehicle or system that has invaded the product and could cause damage.
- *FOD (Foreign Object Damage)*—Any damage or incident attributed to a foreign object that can be expressed in physical or economic terms which may or may not degrade the product's required safety and/or performance characteristics.
- *FOE (Foreign Object Elimination)*—Program or process used to assure a FOD-free product/system.
- *Clean As You Go*—Includes the following:
  - Clean the immediate area when work cannot continue.
  - Clean the immediate area when work debris has the potential to migrate to an out of sight or inaccessible area and cause damage and/or give the appearance of poor workmanship.
  - Inspect and clean all tools after job completion or end of shift.
  - Clean the immediate area after work is completed and prior to inspection.
  - Clean at the end of each shift.
  - If you drop something or hear something drop - pick it up!
- *Tool Control and Management*—Methods of tool control and accountability include shadow box/board, tether, chit system, tool inventory sheets/logs, tool pockets, tool identification, consolidated tool kits, tool conditions, sponge count, and electronic tool accountability systems.
- *FOD Prevention Program*—Includes training in FOD control, management, and accountability, and support such as periodic screening of employees and facilities. Appropriate emergency procedures need to be followed when FOD becomes hazardous.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

15. Hazards/Safety Practices NCATT Training Standard Level (A)
(h) First Aid for Electrical Shock

Objective:

Identify basic facts and terms about First Aid for electrical shock.

Content – First Aid for Electrical Shock:

Electrical shock is always present when working with electronic equipment. Explain first aid for electrical shock with reference to the following safety precautions:

- *How to Rescue Someone from Electrical Shock*—When an individual receives an electrical shock, follow these steps:
  - TURN OFF THE POWER as quickly as possible.
  - If unable to locate the power switches, do not attempt to touch the victim. Touching the victim will pass the current through anyone who touches the victim.
  - If electrical power cannot be removed, use a dry wooden pole, wooden broom, or dry wooden chair to PUSH or ROLL the victim clear of the power source. Dry, non-conducting objects made of cardboard, plastic, or wood are suitable to use to remove the victim from the power source.
  - If clothing, belt, rope, or cord must be used, be careful to AVOID CONTACT WITH THE VICTIM! Form the rescue device into a loop, and slip the loop over the foot, leg, or arm of the victim (without touching the victim) to drag them away from the power source.
  - Once the victim is "free" of the power source, do not move them unless it is necessary.
- *Proper Steps to Take in Case of Need for First Aid*—When someone needs first aid after electrical shock, follow these steps:
  - Keep the victim lying down. Slightly elevate their legs and feet.
  - Cover the victim with a blanket to maintain body heat.
  - Do not move the victim unless it is necessary.
  - Seek qualified medical aid, but try not to leave the victim alone.
  - If the victim needs water, give them a few sips of water at first. Then, gradually increase water intake unless nausea is present.

Note: Describe first aid treatment for bleeding, burns, and broken bones. Never put ointments, grease, or butter on a burn. They will only have to be painfully removed once medical aid is obtained.

- *First Aid and CPR*—Check for signs of circulation (breathing, coughing, or movement). If absent, begin CPR immediately, only if you are trained in CPR or if an Emergency Dispatcher is guiding you.

Note: An employer shall ensure that each affected employee uses appropriate hand protection and other protective clothing where there is exposure to hazards such as skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns, harmful temperature extremes, and sharp objects. Consult federal, state, and local Hazardous Material procedures for disposal specifics.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

16. Hazardous Materials Handling NCATT Training Standard Level (A)
(a) Types of Hazardous Materials/Fluids

Objective:

Identify basic facts and terms about hazardous materials and fluids.

Instructional Content – Types of Hazardous Materials/Fluids:

Explain that hazardous materials and fluids may be toxic, corrosive, flammable, reactive (unstable), and explosive with reference to the following terms:

- *OSHA Standard 29 CFR 1910.120*—Hazardous Waste Operations and Emergency Response OSHA standard.
- *Workplace Communication Programs*—OSHA requires all employers to provide information to their employees about the hazardous materials and chemicals to which they are exposed by means of a hazard communication program. Workplace communications programs include labels and other forms of warning, Material Safety Data Sheets, and information and training. In addition, it is mandatory that distributors transmit OSHA required information to employers who purchase their products.
- *Physical Health Hazards*—Includes fires, dangerous reactions, and explosions.
- *Use of MSDS*—See Hazardous Materials Handling/Material Safety Data Sheets.
- *Personal Protective Equipment (PPE)*—Shields or isolates individuals from chemical, physical, and biologic hazards that may be encountered at a hazardous substance site. For example, respirators must be worn when employees are exposed to high levels of hazardous substances in the air.
- *Permissible Exposure Levels (PEL)*—Allowable level for a hazardous substance in the "breathing" air in which employees are exposed.

16. Hazardous Materials Handling NCATT Training Standard Level (A)
(b) Handling Procedures

Objective:

Identify basic facts and terms about handling hazardous materials.

Content – Handling Procedures:

Explain that many materials and chemicals in the workplace are hazardous and should be handled properly with reference to the following terms:

- *Personal Protective Equipment (PPE)*—See Hazardous Materials Handling/Types of Hazardous Materials/Fluids
- *Proper Safety Equipment*—Includes respirators, gloves, eye protection, and dust masks.
- *Required Handling Knowledge*—Includes the following:
  - How to use substance.
  - Hazards.
  - Procedures to protect health and safety.
  - PPE use.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

16. Hazardous Materials Handling NCATT Training Standard Level (A)
(c) Storage and Labeling

Objective:

Identify basic facts and terms about storage and labeling of hazardous materials.

Content – Storage and Labeling:

Explain proper storage and labeling procedures with reference to the following terms:

- *Storage and Housekeeping*—Includes the following:
  - Bags, containers, and bundles shall be stacked, blocked, interlocked, and limited in height so they are stable and secure against sliding, falling, or collapse.
  - Storage areas shall be kept free of accumulation of materials that constitute hazards from tripping, fire, explosion, or pest harborage.
  - Incompatible substances shall be stored on different shelves or placed in non-flammable storage cabinets.
  - Aisles and passage ways shall be kept clear to provide for the free and safe movement of material handling equipment and employees.
- *Labels*—Written, printed, or graphic material displayed on or affixed to containers of hazardous substances. Labels frequently contain other information, such as precautions. This information is provided voluntarily and is not required. All containers must be properly labeled with waterproof labels that list the following:
  - Substance name and trade name.
  - Manufacturer.
  - Hazards.
  - Date.

16. Hazardous Materials Handling NCATT Training Standard Level (A)
(d) Proper Disposal

Objective:

Identify basic facts and terms about proper management and disposal of hazardous materials.

Content – Proper Disposal:

Explain that federal, state, and local environmental regulations require strict control of handling, storage, and disposal of all materials designated as hazardous or toxic to human health or to the environment. Explain proper management and disposal of hazardous materials with reference to the following terms:

- *Environmental Protection Agency (EPA)*—The EPA has the authority to control hazardous waste. EPA control includes the generation, transportation, treatment, storage, and disposal of hazardous waste.
- *Employer's Responsibility*—Follow guidelines set forth by federal, state, and local government agencies and properly train employees in the handling, storage, and disposal of hazardous materials.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Specifics to Follow at Jobsite*—Includes the following:
  - Never pour hazardous materials down the drain. The hazardous materials could cause damage to a waster water plant.
  - Never pour hazardous waste down a storm drain. Pouring hazardous waste down a storm drain often leads directly to a lake, stream, or other body of water. The hazardous waste could contaminate bodies of water such as lakes or streams.
  - Dispose of all solvent waste, oily rags, and flammable liquids in covered fire resistant containers until removed from worksite.

16. Hazardous Materials Handling NCATT Training Standard Level (A)
(e) Material Safety Data Sheet (MSDS)

Objective:

Identify basic facts and terms about use of Material Safety Data Sheets.

Content – Material Safety Data Sheet:

The demands for staying compliant are getting more difficult. Explain the use of Material Safety Data Sheets with reference to the following terms:

- *Material Safety Data Sheets (MSDS)*—Form containing data regarding the properties of a particular substance. Material Safety Data Sheets provide workers and emergency personnel with procedures for handling or working with a hazardous substance in a safe manner. These sheets include information such as physical data (e.g., melting point, boiling point, flash point) toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill handling procedures.
- *MSDS System*—Cataloging information on chemicals, chemical compounds, and chemical mixtures.
- *MSDS Compliance/Chemical Suppliers*—Hazardous chemical suppliers are required by law to supply MSDSs to purchasers.
- *MSDS Compliance/Employers*—Employers shall maintain any MSDSs received with incoming shipments of hazardous chemicals. Employers shall ensure that MSDSs are readily accessible during each work shift to employees when they are in their work areas. This information includes new chemicals or revised MSDSs.

17. Technical Publications NCATT Training Standard Level (A)
(a) Interpret Installation Manuals

Objective:

Identify basic facts and terms about interpreting installation manuals.

Content – Interpret Installation Manuals:

The aircraft installation and maintenance manuals are provided by the manufacturer for technicians who normally perform work on the systems or components of an aircraft. Explain how to interpret installation manuals with reference to the following:

- Locate, research, and interpret technical information from manuals for installing aircraft systems.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- Consult manuals for guidance when installing and maintaining aircraft systems and components. Select the most appropriate way to install or maintain the component.
- Use information in manuals to correct unsafe conditions found in/on aircraft.
- Consult aircraft specifications and standards to determine engine type design and limitations, as well as other important information.
- Other documents to consult are listed below:
  - Consult FAA Airworthiness Directives (ADs) for unsafe conditions found in aircraft engines, propellers, or appliances. These directives also provide the timeframe for compliance. A summary of ADs is published every two years.
  - Consult FAA document, AC 43.13-1B/2A, if no maintenance manual exists for maintaining an aircraft.
  - Consult Federal Aviation Regulation 14 CFR Part 43 for regulatory requirements concerning Maintenance, Preventive Maintenance, Rebuilding, and Alterations.
  - Consult Federal Aviation Regulation 14 CFR Part 65 for regulatory requirements for certified airmen (mechanic and repairman) privileges and limitations.

Interpretation Notes: Check the Table of Contents. Check the index for subjects and details. Read the title of the chapter and headings for the main idea. Break down the whole into parts. Refer to the symbols in the legend or key on a drawing or document. Read the labels and callouts on a drawing. Scan a drawing or document to quickly find information. Compare with other types of information to see relationships. Locate terms in the glossary or an aeronautical dictionary. Search the document online or on a CD or DVD, if available.

17. Technical Publications NCATT Training Standard Level (A)
(b) Interpret Technical Data

Objective:

Identify basic facts and terms about interpreting technical data.

Content – Interpret Technical Data:

Examples of technical data include manufacturer's service bulletins, service letters, and service instructions to notify aircraft owners of design defects and product improvements. Explain how to interpret technical data with reference to the following terms:

- *Diagram Information:*
  - *Schematic Diagrams*—Show an electrical or fluid power system. The components are represented by symbols rather than drawings or pictures of the actual devices. Schematic Diagrams do not necessarily show the locations of a system. These diagrams are used mainly for troubleshooting.
  - *Block Diagrams*—Shows functional units represented by blocks. Each block describes a function of a system and shows its relationship to other units in the system. The energy flow direction, or association, within the system is shown with arrows. Block diagrams are high level diagrams used for troubleshooting or teaching a process.
  - *Installation Diagrams*—Show a picture of aircraft systems, devices, and components. Each component relevant to a particular aircraft system is identified and located by callouts. Installation diagrams are used for aircraft maintenance and repair.
  - *Wiring Diagrams*—See Technical Publications/Wiring Diagrams.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Various Media Containing Information:*
  - *DVDs*—High-capacity optical disk containing video recordings or data.
  - *Videos*—Recording of a motion picture or presentation.
  - *Software*—Programs, usually on CDs, to instruct and teach concepts.
  - *Microfiche*—Sheet of microfilm that contains rows of images of printed matter.

17. Technical Publications NCATT Training Standard Level (A)
(c) Locate and Interpret Avionics Installation Data

<u>*Objective*</u>:

Identify basic facts and terms about locating and interpreting avionics installation data.

<u>*Content – Locate and Interpret Avionics Installation Data:*</u>

Explain how to locate and interpret avionics installation data with reference to the following terms:

- *Approved Flight Manual Supplements*—Document that supersede manufacture's initial manuals (e.g., installation manuals, maintenance manuals, Specifications, Standards). Most manuals are accessible on the manufacturer's website. However, a code (password) is usually needed to access the information
- *Aircraft Maintenance Records*—Document used for entering records of maintenance on a particular aircraft. This information is usually kept in a database on a computer.
- *Aircraft Equipment Lists*—See Technical Publications/Interpret Aircraft Equipment List Information.
- *Aircraft Weight and Balance*—Document that provides a method of determining the empty weight and empty-weight center of gravity (EWCG) of an aircraft. This document also furnishes the flight crew with information on loading and operating the aircraft to ensure its weight is within the allowable limit and the center of gravity (CG) is within the allowable range.
- *Supplemental Type Certificates (STC)*—Document issued by the FAA approving a product (e.g., aircraft, engine, propeller) modification.
- *Aircraft Service Manuals*—Document that cover all phases of aircraft operation from assembling the newly purchased aircraft, operating and maintaining the equipment, and storing of the equipment.
- *Manufactures Service Bulletins*—Document that contains a recommendation about a defect or an improvement to an aircraft. The bulletin may recommend a certain type of inspection, replacing certain components, performing maintenance in a specific manner, or limiting operation. Some bulletins may address a timeframe for the work to be completed. A service bulletin is sometimes called a mandatory service bulletin, technical service bulletin, service letter, or service instructions. Compliance with a service bulletin is not specifically required under the Federal Aviation Regulations (FAR) unless the service bulletin is accompanied by or includes an Airworthiness Directive (AD).

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

17. Technical Publications NCATT Training Standard Level (A)
(d) Interpret Wiring Diagrams

Objective:

Identify basic facts and terms about interpreting wiring diagrams.

Content –Interpret Wiring Diagrams:

Explain how to interpret wiring diagrams with reference to the following:

- *Wiring Diagrams*—Show the wiring of an electrical system using standardized symbols that represent electrical components or devices. Wiring Diagrams show how the components (wiring, connectors, terminal boards, and other parts of a circuit) are connected together electrically. These diagrams are used to troubleshoot and repair electrical circuits.

17. Technical Publications NCATT Training Standard Level (A)
(e) Interpret Charts/Blueprints/Drawings/Sketches

Objective:

Identify basic facts and terms about interpreting charts, blueprints, drawings, and sketches.

Content –Interpret Charts, Blueprints, Drawings, and Sketches:

Charts, blueprints, drawings, and sketches present facts in a visual form. They help aircraft mechanics to pinpoint problems with in an aircraft. Sometimes this information needs to be compared with other types of information to see a relationship. Explain how to interpret charts, blueprints, drawings, and sketches with reference to the following terms:

- *Charts*—Includes information found in manuals, bulletins, or books.
- *Blueprints*—Includes detailed mechanical drawings or architectural plans for an aircraft.
- *Drawings*—See Technical Publications/Interpret Technical Data/Interpret Wiring Diagrams.
- *Sketches*—Includes a rough drawing representing aircraft systems or components.

17. Technical Publications NCATT Training Standard Level (A)
(f) Interpret Aircraft Equipment List Information

Objective:

Identify basic facts and terms about interpreting aircraft equipment list information.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Content – Interpret Aircraft Equipment List:

Explain how to interpret aircraft equipment lists with reference to the following:

- *Standard Aircraft Equipment Lists*— An aircraft's equipment list is a detailed listing of instruments and equipment that are installed in the aircraft. See CFR 14 Part 91.205 for FAA minimum requirements.
- *FAA Approved Minimum Equipment List* - An FAA approved list of installed instruments or equipment that may be inoperative while allowing the aircraft to continue to be operated. This list is referred to as a Minimum Equipment List (MEL). An FAA approved MEL is typically developed by a manufacturer for a specific aircraft. See CFR 14 Part 91.213 for details.

Fundamentals of On-Equipment Maintenance

18. Use common tools NCATT Training Standard Level (2b)

Objective:

Determine procedures for using common tools.

Content – Use Common Tools:

Explain the use of common tools with reference to the following terms:

- *Common Tools*—Includes various hammers, mallets, screwdrivers, pliers, plier-type cutting tools, punches, wrenches, special wrenches such as spanner, torque, and allen, hand snips, hacksaws, chisels, files, drills, twist drills, reamers, countersinks, wire strippers, crimpers, pin extractors, magnifying glasses, engineering scales, analog and/or digital multimeters, wire-marking machine/devices, rules, combination sets, scribers, calipers, micrometer calipers, vernier scales, taps, and dies.
- *Proficiency*—Includes the following:
  - Able to use various tools associated with aircraft wiring including measurement tools.
  - Able to distinguish that some tools can have more than one use.
  - Able to choose the tool best suited for the job.
- *Safety*—Able to properly handle and care for tools, as well as follow proper safety precautions. For example, improper use of a hammer can damage an aircraft and cause physical injury.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

19. Handling of Electrostatic Devices NCATT Training Standard Level (A)

Objective:

Identify basic facts and terms about handling of electrostatic devices.

Content – Handling of Electrostatic Devices:

Static-sensitive devices such as printed circuit boards and solid-state devices can be damaged by the electrostatic field around us. Explain basic facts and handling procedures with reference to the following terms:

- *Static Electricity*—Serves little useful purpose. Static electricity is more of a nuisance.
- *Electrostatic Field (Sometimes called a Dielectric Field)*—Invisible force that causes electrically-charged items to repel or attract each other.
- *Electrostatic Damage*—Includes total catastrophic failure, delayed failure, and degradation to the circuit.
- *Proper Grounding and Handling*—Includes the following:
  - Attach wrist strap that connects body to ground.
  - Touch only the components to be installed or removed.
  - Drain off charges that accumulate on your body by touching the grounded metal case.
  - Do not touch bare pins.
  - Use conductive covers when transporting devices.
  - Use electrostatic spray.

20. Identify and Perform Corrosion Control NCATT Training Standard Level (a)

Objective:

Identify simple facts about identification of corrosion and performance of corrosion control.

Content – Identify and Perform Corrosion Control:

Corrosion is a major contributing cause to the reduction of avionics equipment reliability. Explain procedures for corrosion control in aircraft electrical and avionics systems with reference to the following terms:

- *Corrosion*—Chemical or electrochemical deterioration of a material, usually metal, due to a reaction with its environment. Corrosion may be obvious; corrosion may not be obvious. Some types of corrosion occurrences include the following:
  - *Galvanic*—Different metals are in contact with each other in the presence of an electrolyte.
  - *Pitting*—Severe form of concentrated cell corrosion localized in a specific area containing pits usually accompanied by white or gray powder.
  - *Exfoliation*—Extreme form of intergranular corrosion along the grain boundaries. The strength of the metal is destroyed due to separation or poor bonding.
  - *Intergranular*—Cracks caused by stress corrosion.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Causes of Corrosion*—Includes the following:
  - Moisture.
  - Industrial chemicals.
  - Improper maintenance procedures.
- *Controlling Corrosion*—Includes the following:
  - Cooling air systems that remove moisture and particulate matter.
  - Proper packaging, handling, and storage of avionics equipment and components.
  - Insulation to prevent conductive paths.
  - Sealants that prevent moisture and chemicals from damaging metals.
  - Good housekeeping.

21. Use Safetying Devices NCATT Training Standard Level (1a)
(a) Safety Wire

Objective:

Identify simple facts about use of safety wire.

Content – Safety Wire:

The combination of constant vibration and changing temperatures in an aircraft are the primary causes for loosening of connectors and fasteners. All aircraft connectors and critical equipment fasteners that are not self-locking are safety wired with lock wire. Explain the use of safety wire with reference to the following terms:

- *Safety Device/Tool*—Safety wire pliers that lock and unlock by squeezing the handles. Wire is cut using side cutters on the pliers.
- *Types and Sizes of Safety Wire*—Safety wire, or lock wire, comes in many sizes ranging from 0.020 inch to 0.041 inch in diameter. The 0.032-inch safety wire is a general-purpose safety wire used mostly for securing equipment fasteners. Do not use the heavier wire on connectors because the wire will break out the holes drilled in the connector collars. Use the 0.020-inch safety wire on electrical connectors and small screws.
- *Acceptable Safety Wire Practices*—What type and size of safety wire to use, how many twists per inch, how tight, how loose, what direction to route the wire, and how to pigtail are concerns that must be dealt with to safety wire a component properly. Follow these safety practices:
  - Keep track of clippings and dispose of them properly because they pose a serious FOD hazard.
  - Do not let safety wire come into contact with adjacent parts or assemblies. Such contact can cause damage or operational malfunction to adjacent parts, assemblies, or safety wire.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

21. Use of Safetying Devices NCATT Training Standard Level (1a)
(b) Shear Wire

Objective:

Identify simple facts about use of shear wire.

Content – Shear Wire:

Explain the use of shear wire with reference to the following terms:

- *Shear Wire*—Type of 0.20 inch diameter safety wire made of copper or brass. Shear wire is used for safetying emergency equipment and is designed to break when a force is applied.
- *Emergency Equipment using Shear Wire*—Includes the following:
  - Switch handles.
  - Guards covering handles used as exits.
  - Fire extinguishers.

22. Aircraft Wiring NCATT Training Standard Level (A)
(a) Multiconductor

Objective:

Identify basic facts and terms about use of multiconductor aircraft wire.

Content – Multiconductor:

Explain multiconductor aircraft wire and its uses with reference to the following terms:

- *Multiconductor Aircraft Wire*—Two or more insulated wires in the same jacket.
- *Use of Multiconductor Aircraft Wire*—Used for aircraft electrical power distribution systems.
- *Sleeving Types*—Includes vinyl sleeving, nylon sleeving, silicon rubber, and silicon fiberglass.
- *American Wire Gage (AWG)*—Wire sizing standard. As the gage numbers become larger, the wire diameters get smaller. Wire sizing factors include the following:
  - Allowable power loss.
  - Permissible voltage drop.
  - Current carrying ability.
- *Conductors*—Includes conductors made of copper and aluminum. Silver is very expensive, but it is sometimes used for conductors. Conductor characteristics include the following:
  - *Copper Conductor Characteristics*—Copper conductors have higher conductivity than aluminum. Copper conductors are more ductile, have relatively high tensile strength, and are more easily soldered than aluminum. However, copper conductors are more expensive and heavier than aluminum conductors.
  - *Aluminum Conductor Characteristics*—Aluminum conductors have 60% of the conductivity of copper. They weigh less than copper.
- *Conductor Plating to Prevent Corrosion (Oxidation)*—Includes tin, silver, and nickel.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Common Insulating Materials*—Includes plastic, rubber, glass, ceramics, air (vacuum), or oil.
- *Criteria for the Selection of Electrical Wire*—Includes the following:
  - Abrasion resistance.
  - Arc resistance (non-carbon tracking).
  - Corrosion resistance.
  - Fluid resistance.
  - Notch propagation resistance.
  - Smoke emissions resistance.
  - Flame resistance.
  - Heat distortion temperature resistance.
  - Cut-through strength.
  - Dielectric strength.
  - Impact strength.
  - Mechanical strength.
- *Wires Commonly used in Aircraft*—Includes the following standards (military):
  - MIL-W-5086
  - MIL-W-7072
  - MIL-W-7139
  - MIL-W-8777
  - MIL-W-16878
  - MIL-W-22759
  - MIL-W-25038
  - MIL-W-273000
- *Cables Commonly used in Aircraft*—Includes the following standards (military):
  - MIL-C-7078
  - MIL-W-22759
  - MIL-W-8138

22. Aircraft Wiring NCATT Training Standard Level (A)
(b) Coaxial

Objective:

Identify basic facts and terms about use of coaxial aircraft wire.

Content – Coaxial Aircraft Wire:

Explain coaxial aircraft wire and its uses with reference to the following terms:

- *Coaxial Aircraft Wire*—One center wire surrounded by a metallic braided shield.
- *Use of Coaxial Aircraft Wire*—Used for data transmission and RF signal distribution. Coaxial wire is the standard transmission medium for the Ethernet, a computer networking technology for Local Area Networks (LANs).
- For Information on Sleeving Types, AWG standards, Conductors and Plating, Criteria for the Selection of Electrical Wire, Wires Commonly used in Aircraft, and Cables Commonly used in Aircraft—See Aircraft Wiring/ Multiconductor.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

22. Aircraft Wiring NCATT Training Standard Level (A)
(c) Twisted Pair

Objective:

Identify basic facts and terms about use of twisted pair aircraft wire.

Content – Twisted Pair Aircraft Wire:

Explain twisted pair aircraft wire and its uses with reference to the following terms:

- *Twisted Pair Aircraft Wire*—Two or more separately insulated wires twisted together.
- *Uses of Twisted Pair Aircraft Wire*—Used in aircraft onboard communications and circuits. For example, twisted pair aircraft wire is used in lighting circuits for the standby magnetic compass. Twisted pair wire is also a transmission medium for the Ethernet, a computer networking technology for Local Area Networks (LANs).
- For Information on Sleeving Types, AWG standards, Conductors and Plating, Criteria for the Selection of Electrical Wire, Wires Commonly used in Aircraft, and Cables Commonly used in Aircraft—See Aircraft Wiring/ Multiconductor.

22. Aircraft Wiring NCATT Training Standard Level (A)
(d) Single Conductor

Objective:

Identify basic facts and terms about use of single conductor aircraft wire.

Content – Single Conductor Aircraft Wire:

Explain single conductor aircraft wire and its uses with reference to the following terms:

- *Single Conductor Aircraft Wire*—One insulated wire in a jacket. Single conductor aircraft wire is used in aircraft electrical systems. Most aircraft electrical systems are of the single conductor wire-type. Single conductor wire means the structure of the aircraft provides an electrical path for the current to return to the source.
- For Information on Sleeving Types, AWG standards, Conductors and Plating, Criteria for the Selection of Electrical Wire, Wires Commonly used in Aircraft, and Cables Commonly used in Aircraft—See Aircraft Wiring/ Multiconductor.

23. Perform Wire Maintenance Continuity Checks NCATT Training Standard Level (3c)

Objective:

Use multimeter or appropriate tooling to perform continuity checks on wiring or electrical equipment.

Note: Ensure test equipment and tools required are calibrated to perform continuity checks.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Content – Continuity Checks/Tests:

Explain and demonstrate how to measure the continuity of a conductor and a switch using an ohmmeter on a multimeter with reference to the following terms:

- *Continuity Check/Tests*—Facilitates the tracing of circuit paths to ensure current is flowing from one end of the circuit to the other.
- *Continuity Checks/Tests*—Continuity checks distinguish the following:
  - Good fuses from bad fuses.
  - Open or shorted conductors.
  - Operation of switches.
  - Good or faulty lamps.

- *Multimeter*—Multi-function meter used to test current values, voltage values, or ohmic values (resistance). With the flip of a switch, a multimeter can be set up as an ammeter, voltmeter, or ohmmeter. Multimeters can also display analog and digital criteria. Use a multimeter whenever possible. Displays are provided in both analog and digital format.
  - *Ammeter*—Electrical testing instrument used to measure DC flowing in an electrical circuit. An ammeter shows the value in amps. The ammeter and voltmeter measure current; they differ in the way each is connected in a circuit.
  - *Voltmeter*—Electrical testing instrument used to measure voltage by connecting resistance in a series with the meter movement. A voltmeter shows the value in volts. A voltmeter provides an effective way to test the continuity of lighting system wire in an aircraft.
  - *Ohmmeter*—Electrical testing instrument used to measure resistance in a circuit or component. An ohmmeter shows the value in ohms. Ohmmeters provide an effective and quick way to test the condition of a switch. The ohmmeter measures current, but it provides its own source of power. Ohmmeters also contain other auxiliary circuits.

24. Use Test Equipment/Special Tools NCATT Training Standard Level (2b)
(a) Analog Multimeters
(b) Digital Multimeters
(c) Oscilloscopes

Objective:

Determine procedures for using test equipment and special tools.

Note: Ensure test equipment and tools required are calibrated.

Content – Analog/Digital Multimeters:

Multimeters are versatile measuring instruments. Explain and demonstrate how to properly connect and measure voltage, current, and resistance in an electrical circuit using a multimeter with reference to the following terms:

- *Multimeter*—See Perform Wire Maintenance Continuity Checks and Basic Circuit Calculations DC/AC Measurements.
  - *Analog Multimeter*—Measured as ohms/volts (Typically 20K ohms or greater). Analog multimeters require 50 micoamps of current to move the point full scale.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Digital Multimeter*—Measured as ohms/volts. Digital multimeters allow for the largest allowable error that can occur under a specific condition. Allowable error is an indication of how close a meter's displayed value is to the actual value of the signal being measured.

Content – Oscilloscopes:

Oscilloscopes are basic instruments for analyzing digital data signals. Explain and demonstrate how to properly connect and use an oscilloscope to display voltage levels and frequency with reference to the following terms:

- *Oscilloscopes*—Electronic test instrument that displays the waveforms of electrical signals. Oscilloscopes measure voltages (AC peak-to-peak values) and time to determine frequencies. An oscilloscope displays phase relationships (comparisons of waveforms in time) to identify equipment malfunctions.
- *RF and Microwave Measurement*—Use the following test equipment:
  - Analog Oscilloscopes—Amplify the signal measured and display the signal at a specific sweep rate.
  - Digital Oscilloscopes—Use high-speed sampling to convert the signal measured into a series of "digital words" that are stored in the memory of the oscilloscope.

Aircraft Fundamentals

25. Aviation Terminology NCATT Training Standard Level (A)

Objective:

Identify basic facts and terms about aircraft design and construction techniques.

Content – Aviation Terminology:

Explain basic aviation facts and terminology with reference to the following terms:

- *Fuselage*—Central area of aircraft aft of the firewall and forward of the empennage. This area contains the cockpit or cabin. Depending on the size of the aircraft, there may be areas for passengers, cargo, and other aircraft components. Two types of fuselages are the following:
  - *Monocoque*—Most common type of fuselage design. Monocoque fuselages have fewer internal parts and more highly stressed skin.
  - *Semimonocoque*—Derives its strength from internal parts such as bulkheads, longerons, keel beams, and drag struts.
- *Wings*—Airfoil framework mainly of spars, ribs, and sometime stringers attached to the fuselage. Wings generate lift in flight, and the wing spars carry the load through the fuselage to the other wing. Wing structures include the following:
  - *Cantilever*—Most common and strongest type of wing design. The wings are attached directly to the fuselage without any external, stress-bearing structures. A single large beam, the main spar, runs through the wing for internal bracing. Wings obtain their entire strength from their internal structural elements.
  - *Semi-cantilever*—Supported by one or two supporting wires or struts extending between each wing and the fuselage for external bracing.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Empennage Components*—Tail assembly of an aircraft. The empennage of an aircraft is normally composed of a vertical tail and a horizontal tail attached to the rear of the fuselage. Tail components include the horizontal and vertical stabilizers/stabilators, elevators, and rudder.
- *Forces of Flight*— Forces of flight that influence an aircraft include the following:
  - Center of Gravity (CG) - The CG is the point at which all of the weight of the aircraft is considered to be concentrated. The CG has a great influence on the stability of the aircraft.
  - *Weight*—Downward force exerted on an object caused by gravity. Gravity acts on everything in the aircraft, the crew, fuel, cargo, and aircraft itself.
  - *Lift*—Upward force created by the effect of airflow as it passes over and under the wings. Lift counteracts the effects of weight. Lift and weight must remain equal for steady horizontal flight.
  - *Drag*—Backward force caused by the disruption of airflow over the wings, fuselage, and any protruding objects. Drag opposes thrust, or forward motion of an aircraft.
  - *Thrust*—Forward force produced by the powerplant. A mass of air is forced behind the aircraft by thrust. Thrust and drag must remain equal for the aircraft to maintain a steady speed.
- *Axis of Flight*—An aircraft must turn one or more of three axes when it changes attitude (meaning the relationship of the three axes and a fixed frame of reference). Axes of flight are the following:
  - *Longitudinal Axis*—Extends lengthwise through the aircraft fuselage from the nose to the tail. The longitudinal axis at which an aircraft's weight is considered to be concentrated is the center of gravity on the aircraft. Motion along this axis is called roll.
  - *Lateral Axis*—Extends crosswise on the aircraft from wing tip to wing tip. Motion along this axis is called pitch.
  - *Vertical Axis*—Extends through the center of the aircraft from the top to the bottom. Motion along this axis is called yaw.
- *Streamlining and Drag Reduction for Airframes and Structures*—Includes the following:
  - *Fairings*—Curved piece of metal that provides aerodynamic smoothness of airflow over angled shapes of wings and fuselage appendages such as wheels, tail cones, and landing gear. Some fairings are removable, and others are attached to the structure of the aircraft by rivets.
  - *Drag Reduction*—Drag can be reduced by reducing the number of exposed parts or streamlining their shape. For example, skin friction can be reduced by eliminating rivet heads and irregularities on the fuselage, as well as using glossy flat finishes to reduce roughness.

26. Basic Aviation/Aircraft Fundamentals and Safety NCATT Training Standard Level (A)

<u>*Objective*</u>:

Identify basic facts and terms about aviation/aircraft fundamentals and safe ground operations.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Content – Basic Aviation/Aircraft Fundamentals and Safety:

Explain basic facts about aviation and aircraft fundamentals of safety with reference to the following terms:

- *Ground Movement of Aircraft*—Ground-handling personnel must be familiar with procedures for handling all aircrafts on the ground, as well as local operating standards governing aircraft ground-handling. Safely moving an aircraft on the ground includes the following:

Note: If specific manufacturer instructions for towing an aircraft are required, consult the manufacturer's towing and maintenance instructions in all instances.

- *Ground-handling Team (TOW Team)*—Includes the following:
  - One person in charge of the team.
  - One qualified person in the cockpit to operate the brakes in case the tow bar fails or becomes unattached to the towing vehicle or another emergency occurs. This person is not in the cockpit to steer the aircraft.
  - One towing vehicle driver responsible for operating the vehicle in a safe manner. The driver should also be able to follow emergency stop directions given by any team member.
  - Two wing-walkers to ensure adequate clearance of the wings from obstructions during aircraft movement.
  - One tail-walker to assist with directing sharp turns and backing the aircraft into position, if necessary.
  - One person in the cockpit to maintain the hydraulic system pressure, when necessary.
- *Towing of Aircraft*—Includes the following:
  - Use the proper tow bar. Some bars are designed and built by the manufacturer to be used with their product.
  - Attach tow bar to the rear or front of the aircraft following the appropriate procedure. Aircraft equipped with tricycle landing gear are generally towed forward. Aircraft equipped with tailwheels are also generally towed forward by attaching the tow bar to the tow rings on the main gear.
  - Make sure the locking scissors are set to full swivel if the aircraft has a steerable nosewheel. The locking scissors device must be reset after the tow bar is removed.
  - Charge the braking system before towing.
  - Ensure all entrance doors on the aircraft are closed, ladders are retracted, and gear locks are installed.
  - Check all tires and landing gear struts for proper inflation. Inflation of struts is not needed if the aircraft is in overhaul or storage mode.
  - Contact the airport control tower on the appropriate frequency prior to movement of an aircraft across runways or taxiways. Wait until the tower personnel give permission to proceed.
  - Keep the towing vehicle at a reasonable speed so the walking team can keep up with the aircraft. Do not stop and start quickly.
  - Keep in radio contact with the person in the aircraft handling the braking. Aircraft brakes must never be applied unless there is an emergency command from one of the tow team members on the ground.
  - Park aircraft in assigned area. If the aircraft is to be parked in a hanger, statically ground the aircraft immediately after parking the aircraft.
  - Place wheel chocks fore and aft of the main landing gear of the aircraft.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

  - Set internal or external control locks (gust locks or blocks) to protect the aircraft while parked.
- *Remove Before Flight (RBF) Streamer*— Components that jut-out from the aircraft such as intake/exhaust covers, plugs, landing gear pins, locks, or pitot tubes must have a RBF streamer attached to it. The streamers, attached by safetying pins, are usually red and have "Remove Before Flight" in large white printed letters printed on the front. This streamer warns personnel of any dangers around the aircraft. Injuries from these type components are one of the most commonly reported Workers' Compensation claims. The "Remove Before Flight" lettering on the RBF is to remind the ground crew to remove the streamers before flight so the aircraft can fly safely. Failure to remove the streamers can cause aircraft systems to become inoperative before and during flight.
- *Safety Precautions*—Includes the following:
  - Once the tow bar is attached, persons in the aircraft must not attempt to steer the aircraft.
  - No one is permitted to walk or ride under the aircraft; ride between the towing vehicle and the nose of the aircraft; or ride on the outside of the towing vehicle or the aircraft while the aircraft is moving. Also, no one is permitted to board or leave the aircraft or towing vehicle while the vehicles are moving.
  - Aircraft engines are not operated during towing. If the engines must be in operation, special precautions must be taken.
  - Throughout towing operations, chocks must be immediately available.
- *Taxing of Aircraft*—Only rated Pilots and qualified A & P Technicians are allowed to start, run up, or taxi aircraft. These operations must be in accordance with applicable local regulations
- *Storage of Aircraft*—Storage facilities provide a protective environment for equipment, parts inventories, and supportive materials, such as de/anti-icing materials and sand. Follow the manufacturer's instructions for storage and removal from storage of an aircraft.
- *Aircraft Pre- and Post-flight Inspection*—Includes the following:
  - *Preflight*—Suggested preflight functions and checks that avionics/ electronics technician should perform prior to an aircraft's first flight following repair, service or installation of avionics/electronics equipment, and subsequent to completion of all required documentation and record keeping requirements.
    - Internal includes the following:
      1) Ensure the aircraft's on-board battery provides power to each avionics/electronics unit.
      2) Ensure the aircraft's external power supply provides power to each avionics/electronics unit independent of the aircraft's battery.
      3) Ensure the avionics/electronic circuit protection devices function properly and are set in the correct operational position.
      4) Visually inspect for security of avionics/electronics components (look under and behind the instrument panel).
    - External includes the following:
      1) Walk around the aircraft and look for any discrepancies (damage to the aircraft) that may have existed prior to (should have been noted at the time the aircraft entered the avionics shop) or subsequent to the performance of avionics/electronics work.
      2) Check for missing panels and close out fairings.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

3) Visually inspect all antennas for the following:
    - Security.
    - Missing fasteners.
    - Skin cracks.
    - Deteriorated and damaged seals.
    - Inadvertently painted antennas.
- *Postflight*—Suggested postflight functions and checks that an avionics/electronics technician should perform after an aircraft's first flight following repair, service, or installation of avionics/electronics equipment.
    - Repeat visual inspections performed during preflight inspections both internally and externally to ensure that all components are secure.
    - Perform postflight documentation requirements.

Note: All activities are conducted in accordance with the specific airframe and avionics/electronics equipment operating instructions.

27. Basic Troubleshooting Theory NCATT Training Standard Level (A)

Objective:

Identify basic facts and terms about troubleshooting theory.

Content – Basic Troubleshooting Theory:

Explain and demonstrate how to troubleshoot and isolate various faults using operational knowledge, published information, and test equipment.

- *Use of Basic Troubleshooting Tools*—Includes the following:
    - *Multimeter*—Most versatile electrical measuring instrument used by aircraft technicians. Multimeters measure voltage, current, and resistance in an electrical circuit. Each multimeter has a voltmeter, ammeter, and ohmmeter which are used to analyze values in electrical circuits. See Perform Wire Maintenance Continuity Checks and Use Test Equipment/Special Tools.
        - Use a voltmeter to find a circuit problem with power on the circuit. When checking for zero output voltage, a good starting point is to check the input with a voltmeter.
        - Use an ammeter to find a circuit problem with power on the circuit. Milliammeters and microammeters measure very small rates of current flow.
        - Use an ohmmeter to find a circuit problem when power is removed from the circuit. Ohmmeters measures resistance.
    - *Oscilloscope*—Measures and displays voltage (AC peak-to-peak values) in waveforms (output) of a wave generating circuit. See Use Test Equipment/Special Tools.
    - *Continuity Check/Test*—Checks for the existence of a complete electrical system between two points. Most of the time, a voltmeter or ohmmeter is used to test the continuity of a circuit. Tests should be made at each terminal of the circuit to isolate the problem.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Note: It is a good idea to keep up with the latest manufacturer's service bulletins and letters and Airworthiness Directives (AD). Manufacture's service information is optional. Airworthiness Directives are mandatory.

- *Steps in the Troubleshooting Process*—Includes the following:

    1. Isolate the problem.—Is the equipment being operated properly? Is the problem ongoing? Is the problem intermittent? What are the circumstances? Is the software loaded properly? Is the problem worse during taxi and takeoff or landing? Does the problem exist while cruising? What was the weather like?
    2. Check for the obvious.—Are there any loose connections? Loose wires? Broken wires? Bent wires? Frayed wires? Inoperative indicator lights? Bad bondings? Broken or cracked parts? Anything punctured? Is the component over heating? Do some components need adjusting?
    3. Use troubleshooting charts.—Solve the malfunction problem, if possible, by locating the possible cause, following the isolation procedure, and making the correction (s) as shown on a troubleshooting chart.
    4. Check manufacturer information.—Find information on components or systems in manufacturer's installation and operations manuals or on their Website.
    5. Perform operational checks on components or systems.—Locate the fault through checks using a multimeter, oscilloscope, or other appropriate testing instruments or methods.

28. Identify Flight Controls NCATT Training Standard Level (A)

<u>*Objective*</u>:

Identify basic facts and terms about identification of flight controls.

<u>*Content – Identify Flight Controls:*</u>

Explain basic facts about the theory of flight and flight controls with reference to the following terms:

- *Theory of Flight*—Includes the following:
    - *Bernoulli's Principal*—"As the velocity of a fluid (air) increases, its internal pressure decreases." Air flowing over the curved top surface of a wing reaches the trailing edge of a wing at the same time as air flowing along the flat bottom of a wing. Air flowing over the top of the wing has to travel faster, meaning the air pressure is lower over the top of the wing than under the flat bottom of the wing. The main source of lift on an aircraft is this difference in air pressure. A wing follows Bernoulli's Principal in its design.
    - *Newton's Laws of Motion*—The Three Laws of Motion that explain the effect of force on matter are listed below:
        - *Newton's First Law of Motion*—Referred to as the law of inertia. A body at rest tends to remain at rest, and a body in motion tends to stay in motion unless acted upon by an outside force.
        - *Newton's Second Law of Motion*—Referred to as the law of force. The acceleration produced in a mass by the addition of a given force is directly proportional to the force and inversely proportional to the mass.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

        - *Newton's Third Law of Motion*—Referred to as the law of action and reaction. For every action, there is an equal and opposite reaction.
    - *Airfoil*—Any surface on an aircraft that converts movement of air to an aerodynamic force when they interact. The following components are examples of airfoils:
        - *Wings*—Camber, the curvature of an aircraft wing above and below the chord line surface, produces lift.
        - *Propeller Blades*—The shape and position of the blades when a propeller rotates pulls the aircraft forward. The propeller blades cause a higher pressure to be built up behind the propellers than in front of the propellers.
- *Flight Controls*—The primary group of flight control surfaces consist of the following:
    - *Ailerons*—Controls roll on the longitudinal axis. Ailerons are located on the trailing edge of each wing. Turning the control wheel left or right, or movement of the stick left or right controls the ailerons.
    - *Elevator*—Controls pitch on the lateral axis. An elevator is hinged (moveable) to the trailing edge of the fixed horizontal stabilizer on the tail. A stabilator combines the horizontal stabilizer and elevator into one unit. Forward or aft movement of the stick controls the elevator.
    - *Rudder*—Controls yaw. A rudder is vertically hinged, moveable, and operated by foot-petals in the cockpit or cabin. The rudder is mounted on the trailing edge of the vertical fin of the tail.
- *Flight Controls*—The secondary or auxiliary group of flight control surfaces include the following:
    - *Flaps*—Provide increased lift, drag, and wing area for take off and landing. Flaps are inboard of the ailerons on the trailing edge of the wings, and they are hinged to bend or split. For example, when the flaps are lowered in flight, lift increases, drag increases, and stall speed decreases.
    - *Trim Tabs/Controls*—Work with the flight controls to reduce workload on the pilot. For example, elevator trim tabs free the pilot from having to constantly adjusting the pitch controls. Trim tabs also help to reduce drag to increase fuel efficiency.

29. Safety (Operational Risk Management/Fall Protection) NCATT Training Standard Level (A)

Objective:

Identify basic facts and terms about operational risk management/fall protection.

Content – Safety: Operational Risk Management/Fall Protection:

The General Duty Clause requires employers to furnish to each of their employees a place of employment which is free from recognized hazards that are likely to cause death or serious physical harm to their employees. The General Duty Clause requires employers to comply with occupational safety and health standards promulgated under this act.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

Identifying good safety practices and deciding how best to protect workers is the first step in reducing or eliminating safety hazards. The use of safe work practices and training enables employees to do their job properly. Explain causes of accidents and proper techniques to use when lifting or moving objects and preventing falls.

- *Causes of Accidents (as related to the human element)*—Unsafe acts and unsafe conditions cause many accidents. Here are some reasons for accidents in the workplace:
  - *Human Factors*—Most of our errors are in thinking rather than lack of knowledge. The number one causal factor in the technical/maintenance area is 80% human error. Think about actions that may lead to error in the workplace.
    - Did you use safe equipment for short duration job? Was the ladder stable?
    - Did you use the guardrails when you went up and down the stairs by the aircraft? Did you see an opportunity for improvement?
    - Did you report a hazard to your supervisor before doing the work? Did you just step around a potential hazard, or go under/over it?
    - Do you need some strength and fitness training? Strength and fitness training can reduce workplace accidents.
  - *Dirty Dozen in the Workplace*—Includes the following:
    - Lack of communication.
    - Lack of teamwork.
    - Norms.
    - Pressure.
    - Complacency.
    - Lack of knowledge.
    - Lack of awareness.
    - Lack of resources.
    - Distraction.
    - Lack of assertiveness.
    - Fatigue.
    - Stress.
- *Proper Techniques for Avoiding Falls*—Before beginning a fall protection program, potential fall hazards in the workplace must be identified. Any time a worker is at a height of four feet or more, the worker is at risk and needs to be protected. Employees and employers need to be aware of the following ways to prevent falls:
  - Read your company's written fall prevention plan.
  - Attend and participate in fall prevention training. Get specialized training before working on scaffolds, lifts, or ladders.
  - Use the appropriate fall protection equipment, if required for the job. Inspect fall protection equipment and devices before each use.
  - Make sure that floor holes, open shafts, riser penetrations, and skylights are protected by sturdy guardrails or covers.
  - Keep your feet firmly on the platform of a boom lift and tie-off at all times.
  - Choose the correct ladder for the task. Read the instructions and check to make sure the ladder is in good condition. Check for stable footing and the proper angle. Never stand on the top rung of a ladder.
  - Contact your supervisor if you see fall hazards or have any questions.
  - Practice good housekeeping. Keep cords, welding leads, and air hoses out of walkways.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.

- *Proper Techniques for Lifting or Moving Objects*—Back disorders can develop gradually as a result of microtrauma brought about by repetitive activity over time; back disorders can be the product of a single traumatic event. Employees and employers need to be aware of the following ways to prevent back injuries:
  - Read your company's written plan for lifting a load.
  - Attend and participate in back injury prevention training.
  - Before lifting a load, check for potential hazards on the load such as slippery areas or sharp corners.
  - When getting ready to lift a load, keep your feet comfortably apart, about shoulder width. Secure your footing.
  - Get close to the load. Do not reach while lifting.
  - Turn your feet; never twist your back when you lift a load.
  - Bend at your knees, not your waist to lift the load. Use your legs to help distribute the weight of a load when lifting.
  - Keep your back straight and get a firm grip on the load.
  - Keep the load close to your body.
  - Use the same procedures to place the load after lifting.

Copyright © 2008 by the National Center for Aircraft Technician Training. All rights reserved.
Individuals may download, print, and make copies of this document
for their own personal use. Commercial use prohibited.