



Unmanned Aircraft System (UAS) Maintenance Standard

NCATT
PO Box 136818
Fort Worth, TX 76136
(817) 984-4738 www.ncatt.org

NCATT Unmanned Aircraft System (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

CONTENTS

SECTION 1 – UAS FUNDAMENTALS

- I. Information Technology (IT) Fundamentals
- II. Ground Control Stations (GCS)
- III. UAS Communication Requirements
- IV. UAS Flight Operation
- V. UAS General Field Maintenance
- VI. UAS Preflight Operational/Function Checks

SECTION 2 – AVIATION/AVIONICS FUNDAMENTALS

- VII. Safety Practices and Hazards Awareness
- VIII. Aircraft Fundamentals
- IX. Electrical Fundamentals for Aircraft Applications

SECTION 3 – GOVERNANCE

- X. Airspace Classification and Use
- XI. U.S. Government, Military, and Commerce Regulation
- XII. Federal Aviation Administration Unmanned Aircraft System Certification: FAA Order 8130.34B

APPENDICES

- Appendix A: FAA Order 8130.34B Summary
- Appendix B: FAA Order 8130.34B Definitions – (8130.34B Appendix F)
- Appendix C: UAS Acronyms & Terms
- Appendix D: Equipment & Tools

There are sixty-six fundamental *Subject Knowledge, Task Performance and Task Knowledge* activities and functions within the NCATT Standard for Unmanned Aircraft System (UAS) Maintenance. The UAS Standard were identified and defined by aerospace industry Subject-Matter-Experts (SMEs) through an NCATT facilitated, industry recognized, occupational analysis workshop. NCATT workshops focus on the “job” an individual performs in relation to an identified topic or career field.

The NCATT UAS Maintenance Standard can be used by aerospace Industry education and training entities to develop lesson plans as part of a complete education and training program focused on UAS Maintenance. It can also be used to develop specialized and/or targeted UAS Maintenance education and training needs.

Individuals can use this document in preparation to challenge the related certification exam(s) by using it as a guide to find relevant materials during the study process.

NCATT Unmanned Aircraft System (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

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.

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

REFERENCES

**The reference listing is for suggested materials and does not encompass all available references for use. Inclusion in this reference list is not indicative of an NCATT endorsement of materials.*

- Austin, R. (2010). *Unmanned Aircraft Systems*. Wiley. ISBN 978-0-470-05819-0
- Dalamagkidis, K., Valavanis, K., & Piegl, L. (2009). *On Integrating Unmanned Aircraft Systems into the National Airspace System* (Vol. 36). Springer. ISBN 978-1-4020-8671-7
- FAA Order 8130.34B – Subject: *Airworthiness Certification of Unmanned Aircraft Systems and Optionally Piloted Aircraft*
- FAA, Title 14, Code of Federal Regulations (CFR), Part 71 – *Designation of Class A, B, C, D, and E Airspace Areas; Air Traffic Service Routes; and Reporting Points*
- FAA, Title 14, Code of Federal Regulations (CFR), Part 91, Appendix G – Subject: *Operations in Reduced Vertical Separation Minimum (RVSM) Airspace*
- FAA, Title 14, Code of Federal Regulations (CFR), Part 91.155 – Subject: *Basic VFR Weather Minimums*
- FAA, Title 14, Code of Federal Regulations (CFR), Part 91.215 – Subject: *Air Traffic Control (ATC) Transponder and Altitude Reporting Equipment and Use*
- FAA, Title 14, Code of Federal Regulations (CFR), Part 91.411 – Subject: *Altimeter System and Altitude Reporting Equipment Tests and Inspections*
- FAA, Title 14, Code of Federal Regulations (CFR), Part 91.413 – Subject: *Air Traffic Control (ATC) Transponder Tests and Inspections*
- FAR Handbook for Aviation Maintenance Technicians
- Hobbs, Alan Ph.D., Herwitz, Stanley R. Ph.D., (2006). *Human Challenges in the Maintenance of Unmanned Aircraft Systems*
- Kochersberger, K., Murtha, J., Techy, T. (2010). *Introduction to Unmanned Aircraft Systems (UAS)*, The Aerospace Resource Center
- NCATT Standard: *Aircraft Electronics Technician*
- NCATT Standard: *Foreign Object Elimination – Elements of Basic Awareness*
- United States Department of Transportation, Federal Aviation Administration. (2008). *Aviation Maintenance Technician Handbook General*. Washington: GPO
- United States, Federal Aviation Administration. (1980). AC20-68B: *Recommended Radiation Safety Precautions for Ground Operations of Airborne Weather Radar*. Washington: GPO
- United States, Federal Aviation Administration. (1976). *AC65-15A Airframe and Powerplant Mechanics Airframe Handbook*. FAA-H-8083-30. Washington: GPO.
- United States, Federal Aviation Administration. (1998). *AC43.13 1B (With Change 1) & 2A* (With Change 2): Acceptable Methods, Techniques, and Practices: Aircraft Inspection, Repair, and Alterations*. Washington: GPO. Reprinted by Jeppesen Sanderson Training Products. *As of 03/03/2008, 2A, Alterations, is revised to 2B.

Additional Generic Recommended References

- Electrical/Electronics Text Books
- Manufacturer's Technical Manuals
- Manufacturer's Avionics Installation Instruction Service Manuals

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

SECTION 1 – UAS FUNDAMENTALS

I. Information Technology (IT) Fundamentals

1. Basic Computer Fundamentals

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Basic Computer Fundamentals”. The following is a non-inclusive list of terms associated with this subject.

- Communications/Network Protocols
- Connection Oriented Communication
- Connectionless Oriented Communication
- International Standards Organization (ISO) Open Systems Interconnect (OSI) Model
- Transmission Control Protocol/Internet Protocol (TCP/IP)
- Department of Defense (DoD) Standards Protocol
- IPV4/IPV6
- Components
- Central Processing Unit (CPU)
- Computer Memory
- Input/Output (I/O) Devices
- Storage Devices
- Peripherals (Printers, FAX, Scanners, etc)
- Network Types
 - Local Area Network (LAN)
 - Metropolitan Area Network (MAN)
 - Wide Area Network (WAN)
- Wireless
- Virtual Private Network (VPN)
- Video Teleconference
- Topologies (Star, Ring, Bus, Hybrid, etc)
- Data Terminal Equipment/Data Communications Equipment (DTE/DCE)
- Modems
- Converters
- Gateway Multiplexing
- Wave Division Multiplexing
- Time Division Multiplexing Switches
- Bridges/Routers
- Encryption/COMSEC Devices (Data and Voice)
- Communication Mediums

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

- Software
- Operating Systems (UNIX, Windows, LINUX, etc.)
- Applications (Word, Excel, Power Point, Share Point, etc.)
- Infectious and Malicious Software

2. Cryptology (Bound & Unbound)

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Cryptology (Bound & Unbound)”. The following is a non-inclusive list of terms associated with this subject.

- Bulk Encryption
- Information Encryption Techniques
- Separation Requirements

3. Network Fault Isolation Techniques

NCATT Level 1a

Outcome: A successful education or training outcome for this task will produce an individual who is extremely limited in the performance task of “Network Fault Isolation Techniques” (i.e., activities or use of the identified equipment or component). For each task, the individual will be able to do simple parts of the task. He or she will need to be told or shown how to do most of the task. In addition, he or she can name parts, tools and simple facts about the task. The following is a non-inclusive list of performance items associated with this task.

- Network Error Detection
- Network Error Correction
- Network Flow Control
- Transmission Impairments

4. Network Management Concepts and Responsibilities

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Network Management Concepts and Responsibilities” used in the operation of unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Strategies,
- Networking Components,
- Configuration

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

- Client/Server Components
- Infrastructure Components

5. Cyber Security

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Cyber Security”. The following is a non-inclusive list of terms associated with this subject.

- Cyber Vulnerabilities
- Vulnerability Preventative Measures
- Identity Management
- Wireless Network Security

6. Communications and Information Professionals

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Communications and Information Professionals”. The following is a non-inclusive list of terms associated with this subject.

- Organizations
- Communications Competencies
- Expeditionary Communications

7. Defense Information Systems Network (DISN)

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Defense Information Systems Network (DISN)”. The following is a non-inclusive list of terms associated with this subject.

- Non-secure Internet Protocol Router Network (NIPRNET)
- Secure Networks
- Secret Internet Protocol Router Network (SIPRNET)

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

II. Ground Control Station (GCS)

8. Electrical Power

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about generation, utilization and redundant (back-up) “Electrical Power for Ground Stations” in the operation of an unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Generators
- Ground Power Unit (GPU)
- Uninterrupted Power Source (UPS)

9. LAN – Local Area Network Theory

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about the “Local Area Network Theory” utilized in a ground station in the operation of an unmanned aircraft system. The following is a non-inclusive list of terms associated with this subject.

- Multiplexing / De-multiplexing
- Hubs
- IP Signal Flow / Data Transfer
- Long Haul Communication / WAN
- Processors
- Programming Languages
 - Specific Languages
- Routers
- Sensors
- Telecommunication Switches
 - Asynchronous Transfer Mode (ATM) Switches
 - Keyboard, Video, Mouse (KVM) Switches
 - Ethernet Switch

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

10. Maintain the Maintenance Terminal (Shop Operations as appropriate)

NCATT Level 2b

Outcome: A successful education or training outcome for this task will produce an individual who is *partially proficient* in the performance of “Maintain the Maintenance Terminal”. For each task, the individual *will be able to do most parts of the task and will need help only on the hardest parts*. In addition, he or she *will know* and can determine *step-by-step procedures* for doing the task. The following is a non-inclusive list of performance items associated with this task.

- Types
- Set-up
- Power Up/Down

11. Ground Station Maintenance

NCATT Level 2b

Outcome: A successful education or training outcome for this task/subject will produce an individual who is *partially proficient* in the performance of “Ground Station Maintenance”. For each task, the individual *will be able to do most parts of the task and will need help only on the hardest parts*. In addition, he or she *will know* and can determine *step-by-step procedures* for doing the task. The following is a non-inclusive list of performance items associated with this task.

- Rack Reset (Soft vs. Hard Reboot)
- Software Use/Manipulation
- UA Control
- Data Logger Download (i.e blackbox)
- Software Upload
- PMI (Periodic Maintenance Inspection)
 - Preflight
 - Postflight
 - Scheduled
- Signal Flow

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

III. UAS Communication Requirements

12. Radio Principles /Frequency Band & Range

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Basic Navigation and Communications Theory” used in the operation of unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Low Frequency (LF): 30 – 300 kHz
- Medium Frequency (MF): 300 – 3,000 kHz
- High Frequency (HF): 3 – 30 MHz
- Very High Frequency (VHF): 30 – 300 MHz
 - **VHF Comm 118 – 137 MHz (Aircraft Frequency Range)**
- Ultra High Frequency (UHF): 300 – 3,000 MHz (3GHz)
- Super High Frequency (SHF): 3 – 30 GHz
 - L Band 1 to 2 GHz
 - S Band 2 to 4 GHz
 - C Band 4 to 8 GHz
 - X Band 8 to 12 GHz
 - **Ku Band 12 to 18 GHz**
 - K Band 18 to 26.5 GHz
 - K_a Band 26.5 to 40 GHz
- Extremely High Frequency (EHF) 30 – 300 GHz
 - Q Band 30 to 50 GHz
 - U Band 40 to 60 GHz
 - V Band 50 to 75 GHz
 - D Band 110 to 170 GHz
- Carrier Signals
 - Upper Sideband (USB)
 - Lower Sideband (LSB)
 - High Frequency – Single Sideband (HF-SSB)
- Receiver Sensitivity
- Tuning Circuits
- Amplifiers
- Oscillators
- Modulators and Demodulators
- Filters
- Wave Propagation
 - Ground
 - Sky
 - Space
 - Line of Sight (C band)
 - SATCOM/Ku

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- Federal Regulations (FAA & FCC: General – Related to Airborne Communication)
- Terminology Understanding - Flight Crew / Technician
- Block Diagrams

13. Transmission Lines & Antennas

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Basic Navigation and Communications Theory” used in the operation of unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Transmission Lines
 - Types
 - Velocity Factor
 - Impedance
 - Corrosion
 - Voltage Standing Wave Ratio (VSWR)
 - Installation / Maintenance / Fabrication
 - Spliced
 - Terminated
 - Connectors
 - Separation
- Antennas
 - Aircraft Application
 - Aircraft Classification
 - Military
 - Civil
 - Antenna Type / Application (*Aircraft & Ground Control Unit*)
 - VHF Omnidirectional Range / Instrument Landing System (VOR / ILS)
 - Localizer
 - Glideslope
 - Distance Measuring Equipment (DME)
 - Marker Beacon
 - GPS
 - Automatic Direction Finder (ADF)
 - Loop
 - Sense
 - UHF
 - VHF
 - Fox Mike
 - Ku
 - C Band
 - KA Band
 - X Band
 - Antenna Specification Sheet

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

- Installation / Operational Checks
 - Mounting Scheme
 - Location / Installation
 - Aircraft Surface Consideration
 - Obstructions (Aircraft Structure)
 - Spacing
 - Doubler(s)
- Grounding / Bonding (*Aircraft & Ground Control Unit*)
 - Interior Bonding
 - Exterior Bonding
 - Edge Seal
 - Hardware Seal
 - Resistance Checks
- Tuning / Troubleshooting (*Aircraft & Ground Control Unit*)
 - VSWR / SWR
 - RF Wattmeter
- Cables (*Aircraft & Ground Control Unit*)
 - Coaxial Cable
 - Triaxial Cable
 - Fiber Optics
 - Twisted Pair
- Connectors (*Aircraft & Ground Control Unit*)
 - BNC
 - TNC
 - C
 - N
 - HN
- Antenna Couplers (*Aircraft & Ground Control Unit*)
 - Duplexer
 - Triplexer
 - Diplexer
- Hardware (*Aircraft & Ground Control Unit*)
 - Mounting
 - Gaskets / Seals

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

IV. UAS Flight Operation

14. Unmanned Aircraft Classes / Specifications

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Unmanned Aircraft Classes and Aircraft Specifications”. Although the unmanned aircraft industry currently tends to design, manufacture, and operate independent of regulatory “Standardization”, the following unmanned aircraft *Class* and associated *Specifications* typically are acceptable to industry subject-matter-experts.

- Class 2
 - Maximum Airspeed: Less than 250 Knots
 - Gross Weight: 21 – 1,321 lbs.
 - Operating Altitude (Ceiling): Less than 18,000 Ft
- Class 3
 - Maximum Airspeed: Less than 250 Knots
 - Gross Weight: 12,500 lbs. or less
 - *Operating Altitude (Ceiling): Less than 18,000 Ft
**Some aircraft in this class will exceed 18,000 Ft*
- Class 4
 - Maximum Airspeed: Greater than 250 Knots
 - Gross Weight: 12,500 lbs. or less
 - Operating Altitude (Ceiling): Less than 18,000 Ft
- Class 5
 - Maximum Airspeed: Any
 - Gross Weight: Greater than 12,500 lbs.
 - Operating Altitude (Ceiling): Equal to, or greater than 18,000 Ft

15. Physics of Flight and Aircraft Control

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about the “Physics of Flight and Aircraft Control”. The following is a non-inclusive list of terms associated with this subject.

- Major Operational Stresses
 - Tension
 - Compression
 - Torsion
 - Shear
 - Bending

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

- Forces Acting on Aircraft In Flight
 - Gravity (load and load factor)
 - Lift
 - Thrust
 - Drag
- Theory of Flight
 - Aerodynamics
 - Atmosphere (Gases Compounds)
 - Pressure
 - Density
 - Humidity
 - Bernoulli's Principle
 - Motion
 - Velocity and Acceleration
 - Newton's Laws of Motion
 - Airfoils
 - Upper and Lower Surfaces
 - Relative Wind
 - Camber
 - Angle of Attack
 - Angle of Incidence
 - Dihedral
 - Aircraft Axes
 - Longitudinal
 - Vertical
 - Lateral
 - Stability
 - Static
 - Dynamic
 - Longitudinal Stability
 - Directional Stability
 - Lateral Stability

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

16. Environmental Factors

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Environmental Factors”. The following is a non-inclusive list of terms associated with this subject.

- Avionics
 - Cooling / Venting
 - Heating
 - Isolation
 - Dirty / Corrosive Environments
- Aircraft and Aircraft Components
 - Cleaning
 - Aircraft and Component Exterior cleaning
 - Powerplant cleaning
 - Exterior Finish Maintenance
 - Scheduled cleaning and inspection
 - Non-scheduled cleaning and inspection
 - Cleaning Agents – selection and use
 - Corrosion
 - Environmental Factors
 - Direct Chemical Corrosion
 - Electrochemical (Galvanic)Corrosion
 - Oxidation
 - Concentration Cell Corrosion
 - Filiform Corrosion
 - Intergranular Corrosion
 - Exfoliation Corrosion
 - Stress Corrosion
 - Fretting Corrosion
 - Corrosive Agents
 - Organic Growths (Water / Fuel Cell)
 - Inspection for wear/tear damage due to environmental (operational) conditions

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

17. Avionics Components / Functions

NCATT Level C

Outcome: A successful education or training outcome for this subject will produce an individual who can analyze facts and principles and draw conclusions about the “Avionics Components and Functions” that are used in an unmanned aircraft system. The following is a non-inclusive list of terms associated with this subject.

- Flight Control Computers (Autopilot / Flight Management System (FMS) integrated or stand-alone)
 - Autopilot Functions and / or Modes of Operation:
 - Air Speed Mode
 - Altitude Hold
 - Altitude Pre Select
 - Approach Mode
 - Area Navigation (RNAV)
 - Attitude Hold
 - Auto Land
 - Auto Recovery Systems
 - Autopilot Authority
 - Autopilot Disconnect
 - Back Course Intercept
 - Control Wheel Steering (CWS)
 - Coupled Autopilots
 - Course Intercept
 - Deadman Recovery System
 - Enroute Modes
 - Fail Operational/Fail Passive
 - Flight Level Change
 - Glide slope Capture
 - Go Around Function
 - Heading & Navigation Systems
 - Heading Select
 - Indicated Airspeed (IAS)/Mach
 - Lateral Navigation (LNAV)
 - Lateral-Precision with Vertical Guidance (LPV)
 - Radar Altimeter / Trip Points
 - Terrain Following Mode
 - Vertical Navigation
 - Vertical Speed Mode
 - Flight Management System
 - Install / Update Databases
 - Navigation Sensors
 - Powerplant Sensors

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

- Fuel Sensors
- Airframe Sensors
- Flight Management System Integration
 - Nav Radio Tuning
 - Flight / Nav Guidance
 - Global Positioning System (GPS)
 - Long Range Surveillance (LRS)
 - Inertial Navigation System (INS)
 - Lost Link & Flight Recovery
- Digital Data Bus Theory
 - Data Information
 - Address Information
 - Control Information
 - ARINC 429 Specification (Digital Data Transfer)
- Air Data Bus System
 - Air Data Bus Sensors
 - Air Data Bus

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

V. UAS General Field Maintenance

18. UAS Assembly and Disassembly

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about routine field maintenance including routine troubleshooting theory and troubleshooting operations. The individual will also be able to identify basic facts and terms related to “UAS Assembly and Disassembly”. The following is a non-inclusive list of terms associated with this subject.

- Transportation to Launch / Operational area
- Unpacking aircraft/components and Ground Control Unit
- Ensuring aircraft and Ground Control Unit is assembled (and disassembled) in accordance with the approved / accepted data
- Inspect, service and perform minor repairs to aircraft primary structure and aircraft components in accordance with approved / accepted data
- Perform aircraft rigging checks and adjustments
- Inspect and perform minor repairs and replacement (as required) of fluid lines and fittings
- Inspect, service and maintain aircraft landing gear systems (including retractable gear and skid systems), wheels, brakes, and tires
- Inspection, installation, and removal of engine and accessories
- Inspection and troubleshooting of aircraft engine and engine instrumentation and ignition systems
- Securing the aircraft after assemble
- Pre-Flight Inspection / Aircraft and Ground Control Unit
- Fault Isolation / Aircraft and Ground Control Unit
- Systems Check / Aircraft and Ground Control Unit
- Troubleshooting systems using approved procedure
 - Logic Troubleshooting Technique
 - Logic Troubleshooting Flowchart
- Ground Handling
 - Tow/Taxi
 - Fueling Methods
 - Assemble of Ground Control Unit
 - Bringing Ground Control Unit on-line

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

19. Electrostatic Sensitive Device (ESD): Electrostatic-Discharge-Sensitive Equipment and/or Parts

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about handling “Electrostatic Sensitive Device (ESD): Electrostatic-Discharge-Sensitive Equipment and/or Parts”. The following is a non-inclusive list of terms associated with this subject.

- Identification
 - ESD Markings
 - ESD Warning Labels
- Handling
 - Wrist Straps
 - Ground Jacks
 - Static Dissipative Bench and Floor Mats
 - Grounded Test Equipment
 - Electrical Connector Covers or Shorting Clips
 - Printed-circuit board connections shorted
 - Protective “semi-conductive plastic bag” package
- Transportation
 - Shipping Labels
 - Anti-Static Packaging

20. Foreign Object Elimination / Foreign Object Damage (FOE / FOD)

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Foreign Object Elimination (FOE / FOD)”. The following is a list of terms subjects associated with this subject.

- Basic Terms & Definitions
- Principles of Housekeeping
- Tool Accountability
- Hardware Accountability
- Lost Item Control
- Physical Entry & Personnel Control
- Reporting & Investigating
- Parts Protections
- Hazardous Materials
- Wildlife / Environment as FOD
- FOD Effects

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

21. Payload Integration

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Payload Integration” in the safe operation of an unmanned aircraft. The following is a non-inclusive list of terms associated with this subject.

- Payload Maintenance Integration Considerations
- Payload Integration (Weight & Balance)
- Intelligence Surveillance Reconnaissance (ISR)

22. Launch Recovery Systems

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who knows the basic principles of each major component, or sub-component (part or process) in this section, and can identify relationships of basic facts and state general principles about “Launch Recovery Systems”. The following is a non-inclusive list of terms associated with this subject.

- Manual
- Assisted
- Autonomous

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

VI. UAS Preflight Operational/Function Checks

23. UAS Operational Checks

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who knows the basic principles of each major component, or sub-component (part or process) in this section, and can identify relationships of basic facts and state general principles about “UAS Operational Checks”. The following is a non-inclusive list of terms associated with this subject.

- Link Checks
- Ground Functional Checks
- Engine Runs
- Flight Controls
- Line Checks
- Gear Checks

24. Ground Station Operational Check

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about the proper establishment and utilization of a “Ground Station Operational Check” as associated with the operation of unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Signal Flow
- Fiber Optics
- Auxiliary Equipment Rack
- Ground Station Configuration
- Video Dissemination
- Power Requirements
- Pilot Sensor Operator (PSO) Workstation
- Software Configuration Management
- Data Logger (i.e. blackbox)

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

SECTION 2 – AVIATION/AVIONICS FUNDAMENTALS

VII. Safety Practices and Hazards Awareness

25. Hazards / Safety Practices (General)

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Hazards and Safety Practices”, related to the maintenance and operation of unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Flight Line / Shop / Hangar Safety Practices
 - Signage for dangerous equipment or hazardous conditions
 - Safety lanes/walkways/fire lanes
 - Noise protection
 - Eye/sight protection
 - Aircraft movement awareness
 - Propeller/jet exhaust/jet inlet awareness
 - Helicopter main and tail rotor awareness
 - Aircraft security and tiedown
 - Aircraft fueling /defueling hazards
- Personal Protective Equipment (PPE)
- Protection of Personnel from physical contact injury from antennas
- Ground Operation of Airborne Weather Radar
- Fire Safety Practices
 - Classification of Fires
 - Fire Extinguishers
 - Type
 - Identification of Type
 - Extinguisher Operation
 - Extinguisher Inspection
- Compressed Gases
- Hazardous Materials (also see Hazardous Materials Handling this section)
- Material Safety Data Sheet (MSDS)
- RF Energy
- Microwave
- Electromagnetic Interface (EMI)
- High Intensity Radiated (electromagnetic) Field (HIRF)
- Laser(s)
- Noise
- Electrical Power
 - Circuit protection devices
 - Elimination/termination of circuit power
- Electrical shock rescue

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

- First Aid for Electrical Shock
- First Aid and Cardiopulmonary Resuscitation (CPR)
- Steps to take in case of need for First Aid

26. Hazardous Materials Handling (General)

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Hazardous Materials Handling (General)”, related to the maintenance and operation of unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Department of Transportation (DOT) Awareness Training for “Hazmat Employee”
- Hazardous Material Safety Data Sheet
- Hazardous Materials Labels
 - Safety Diamond
 - Tags
 - Operating Instructions
 - Types of Hazardous Materials / Fluids
 - Hazardous Materials Handling Procedures
 - Hazardous Material Storage & Labeling
 - Hazardous Material Disposal

27. Hazardous Materials (Crash & Recovery)

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Hazardous Materials (Crash & Recovery)”, related to the maintenance and operation of unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Hazardous materials that may be carried onboard the aircraft, including liquid materials (e.g. fuel, oil, etc.)
- Chemically volatile payloads
- Military weapons payloads
- High voltage sources that may continue to have electrical power potential
- Battery and electrolyte damage and spillage
- Ballistic parachute recovery systems that have not been made safe and secured

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

28. Human Factors

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Human Factors”, related to the maintenance and operation of unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- General statements of human factor/human error issues
 - Removal of on-board pilot may transfer risk of human error from pilots to ground-based maintenance personnel
 - Across a range of industries, deficient maintenance is recognized as one of the most common causes of system failure
 - Each disturbance of an otherwise functioning system for maintenance introduces the risk of maintenance-induced failure
 - Maintenance is one of the most critical and time consuming activities conducted in aviation
 - Current operational experience is demonstrating that human error presents a hazard to the operation of unmanned aircraft systems
- General statements of UAS maintenance difficulties that may relate to human factor / human error issues
 - No pilot log book entries capturing onboard sensory data
 - Maintenance personnel may become relaxed or complacent about maintenance tasks - because there is no human on board
 - UAS maintainers and operators may have a “model aircraft culture” that generally tends to operate without the discipline of conventional aviation industry practices and expectations
 - UAS maintainers (in general) need to be much more “computer-literate” than their conventional aircraft counterpart
 - Some UAS operations utilize a single person as the system ground based control center operator/maintainer, launch and recovery operator/maintainer, and aircraft maintainer; which requires a very broad scope of skill and knowledge

Repeated packing, transporting, assembly and disassembly of an UAS; often under poor environmental conditions and performance pressure, introduces human performance related vulnerabilities.

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

VIII. Aircraft Fundamentals

29. Fabrication Materials

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who knows the basic principles of each major component, or sub-component (part or process) in this section, and can identify relationships of basic facts and state general principles about unmanned aircraft “Fabrication Materials”. The following is a non-inclusive list of terms associated with this subject.

- Nonmetallic Structural Materials
 - Wood
 - Plastics
 - Fabric
- Laminated Materials (Advanced Composites)
 - Glass Fiber
 - Ceramic Fiber
 - Kevlar
 - Carbon / Graphite Fiber
 - Honeycomb Core
 - Wood Core
 - Metal Core
- Nonferrous Metals
- Ferrous Metals

30. Aircraft Components

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who knows the basic principles of each major component, or sub-component (part or process) in this section, and can identify relationships of basic facts and state general principles about unmanned “Aircraft Components”. The following is a non-inclusive list of terms associated with this subject.

- Fixed Wing Aircraft Components
 - Cockpit (Manned and Pilot Optional)
 - Fuselage
 - Empennage
 - Wing Structure
 - Main Spar
 - Leading Edge
 - Trailing Edge
 - Chord Line
 - Nacelles or Pods
 - Powerplant Mounts

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- Payload Mounts
- Access and Inspection Panels / Doors
- Fixed Wing Flight Controls
 - Primary Flight Controls
 - Elevator
 - Aileron
 - Rudder
 - Secondary Flight Controls
 - Auxiliary Flight controls
- Rotary Wing (Helicopter) Components
 - Fuselage (Cabin Area)
 - Main Rotor(s)
 - Tail Rotor (Rotary Rudder / Anti-Torque Rotor)
 - Tail Boom (Tail Cone)
- Flight Controls Rotary Wing
 - Collective
 - Cyclic
 - Directional Control (Rotary Rudder)
- Landing Gear
 - Fixed Gear
 - Retractable Gear
 - Skids

31. Flight Control Surfaces & Actuators

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who knows the basic principles of each major component, or sub-component (part or process) in this section, and can identify relationships of basic facts and state general principles about unmanned aircraft “Flight Control Surfaces and Actuators”. The following is a non-inclusive list of terms associated with this subject.

- Electrical Servos
- Auto Pilot
- Verify Gain Calibration
- Balancing
- Rigging

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

32. Propulsion Systems NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who knows the basic principles of each major component, or sub-component (part or process) in this section, and can identify relationships of basic facts and state general principles about unmanned aircraft “Propulsion Systems”. The following is a non-inclusive list of terms associated with this subject.

- Powerplants
 - Reciprocating
 - Theory of 2-cycle and 4-cycle engine operation
 - Troubleshooting 2-cycle and 4-cycle engines
 - Service, inspection and maintenance of engines
 - Inspection, checking, troubleshooting, service and repair of engine-cooling systems
 - Inspection, checking, servicing and troubleshooting electrical or mechanical engine instrumentation
 - Removal and replacement of engine accessories (e.g., spark plugs, exhaust systems, wiring, carburetor / fuel control unit, etc.)
 - Service of oil and fluids
 - Engine run-up practices and procedures
 - Theory – Compression combustion (diesel) engine operation
 - Turbine Engine - Turbo Props /Turbo Fan
 - Theory of turbine engine operation
 - Types and characteristics of turbine engine compressors
 - Types and characteristics of turbine engine combustion chambers
 - Inspection and service of compressor and turbine blades
 - Theory and characteristics of fan or by-pass turbine engines
 - Inspection and troubleshooting of unducted fan engines
 - Inspection and service of turbine engine accessory and fan gear-boxes
 - Inspect, check, service, troubleshoot, and repair of turbine engine fuel, lubrication, ignition, and starting systems
 - Inspection, checking, servicing, and troubleshooting electrical or mechanical engine instrumentation
 - Battery
 - Solar
 - Chemical
- Propellers
 - Theory, inspection, and maintenance of fixed pitch and ground adjustable propellers
 - Service, inspection, and maintenance of variable pitch propellers
 - Service, inspection, and maintenance of feathering or folding propellers

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

- Rotor System
 - Types
 - Rigid / Semirigid
 - Full Articulated
 - Aeroelastic
 - Control & Feedback
 - Actuators
 - Sensors
 - Service, Inspection, & Maintenance
 - Blade Tracking
 - Balance

33. Fuel Systems

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who knows the basic principles of each major component, or sub-component (part or process) in this section, and can identify relationships of basic facts and state general principles about unmanned aircraft “Fuel Systems”. The following is a non-inclusive list of terms associated with this subject.

- Fuel Mixtures
- Fuel Distribution
- Fuel Types
- Contamination
- Fuel Indicating Systems
 - Flow
 - Pressure
 - Quantity

34. Electrical Systems

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who knows the basic principles of each major component, or sub-component (part or process) in this section, and can identify relationships of basic facts and state general principles about unmanned aircraft “Electrical Systems”. The following is a non-inclusive list of terms associated with this subject.

- Wiring Considerations
 - Heat
 - Wear
 - Connectors
- Wiring Diagrams
- Circuit Protection
- Distribution

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- Generators
- Voltage Regulators
- Constant Speed Drive (CSD)
- Batteries
- Back-Up System
- Temp/Cooling
- Electrical Load Analysis
- Bonding (Electrical grounds that utilize short metal braid or strip [Jumper Wires]with electrical terminal ends)
 - Purpose
 - Low-resistance path for electrical current flow across structural components (collective integral electric unit)
 - Low-resistance path for electrical current flow for electrical equipment (elimination of ground wires)
 - Reduction or elimination of radio interference
 - Reduction or elimination of static electrical charges between aircraft structural components
 - Mounting considerations
 - Moveable aircraft component operational interference (aircraft component and/or jumper damage)
 - Electrical contact at mounting points (clean contact points)
 - Dissimilar metal corrosion at mounting points
 - Protection of mounting location from electrolytic corrosion
 - Current carrying capacity when used to carry a “ground load” for an electrical unit
- Shielding (Protection from electromagnetic fields)
 - Reduces or eliminates electromagnetic interference (EMI)from adjacent units (High-energy radiated [electromagnetic] fields – HERF)
 - Prevents primary conductor or electrical unit to generate its own interference

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

IX. Electrical Fundamentals for Aircraft Applications

35. Direct Current (DC) Basic Terms

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who *can identify basic facts and terminology* related to “Basic Direct Electrical Current (DC)”. The following is a non-inclusive list of terms associated with this subject.

- Ampere
- Capacitor
- Coulomb
- Direct Current
- EMF
- Henry
- Insulator
- Magnetic permeability
- Metric prefixes
- Ohm
- Resistance
- Static electricity
- Watts
- Battery
- Conductor
- Current
- Electron
- Farad
- Inductor
- Left-hand Rule
- Magnetism
- Neutron
- Proton
- Scientific notation
- Volt

36. Alternating Current (AC) Basic Terms

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Alternating Electrical Current (AC)”. The following is a non-inclusive list of terms associated with this subject.

- Alternating current
- Capacitive reactance
- Effective
- Impedance
- Phase
- Power factor
- Resistance
- Sine wave
- Wye wound
- Apparent power
- Delta wound
- Frequency
- Inductive reactance
- Polyphase
- Rectifier
- Root Mean Square (RMS)
- True power

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

37. Basic Circuit Theory of Operation

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Circuit Theory of Operation”. The following is a non-inclusive list of terms associated with this subject.

- Amps
- Bridge circuits
- Complex circuits
- Joules
- Kirchhoff’s Law
- Ohm’s Law
- Parallel circuits
- Power
- Resistance
- Resistors in parallel circuits
- Resistors in series circuits
- Series circuits
- Voltage drop
- Volts
- Watts

38. Basic Circuit Troubleshooting

NCATT Level 2b

Outcome: A successful education or training outcome for this task will produce an individual who is *partially proficient* in the performance task of “Basic Circuit Troubleshooting”. The individual *will be able to do most parts of the task and will need help only on the hardest parts*. In addition, he or she *will know the task procedures, and can determine the step-by-step procedures* for doing the task. The following is a non-inclusive list of performance items associated with this task.

- Troubleshooting Theory
- Bridge circuits
- Complex circuit voltage drop
- Kirchhoff’s Law
- Parallel circuit
- Resistors in parallel circuit
- Resistors in series circuit
- Series circuit

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

39. Basic Circuit Calculations

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Basic Circuit Calculations”. The following is a non-inclusive list of terms associated with this subject.

- AC
 - Apparent power
 - Capacitance
 - Capacitive reactance
 - Effective (working) voltage
 - Frequency
 - Impedance
 - Inductance
 - Inductive reactance
 - Peak voltage
 - Period
 - Phase angle
 - Power factor
 - Resonance
 - True power
- DC
 - Amps
 - Ohms
 - Volts
 - Watts

40. DC / AC Basic Circuit Measurements

NCATT Level 2b

Outcome: A successful education or training outcome for this task will produce an individual who is *partially proficient* in the performance task of “DC / AC Basic Circuit Measurements”. The individual *will be able to do most parts of the task and will need help only on the hardest parts*. In addition, he or she *will know the task procedures, and can determine the step-by-step procedures* for doing the task. The following is a non-inclusive list of performance items associated with this task.

- Ammeters
- Ohmmeters
- Oscilloscopes
- Voltmeters

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

41. Resistor / Color Codes

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who *can identify basic facts and terminology* about “Resistor / Color Codes”, related to determining the value of a carbon resistor by its color code.

- Use of color codes to identify resistor / resistance values
- Calculate resistance values based on color codes

42. Resistor / Fault Isolation

NCATT Level 2b

Outcome: A successful education or training outcome for this task will produce an individual who is *partially proficient* in the performance task of “Resistor / Fault Isolation”. The individual *will be able to do most parts of the task and will need help only on the hardest parts*. In addition, he or she *will know the task procedures, and can determine the step-by-step procedures* for doing the task. The following is a non-inclusive list of performance items associated with this task.

- Improperly installed Resistors
- Open Resistors
- Resistors of incorrect value
- Shorted Resistors

43. Inductors

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Inductors”. The following is a non-inclusive list of terms associated with this subject.

- Theory of Operation
 - Calculation of inductive reactance
 - Correct operation of Inductors (coils)
 - Use of multiple Inductors
- Isolate Faulty Inductors
 - Improperly installed Inductors
 - Open Inductors
 - Shorted Inductors

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

44. Capacitor / Theory of Operation

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Capacitor Theory of Operation”. The following is a non-inclusive list of terms associated with this subject.

- Calculation of capacitive reactance
- Correct operation of Capacitors
- Dielectric
- Electrolytic
- Farad
- Fixed Capacitors
- Time constants
- Use of multiple Capacitors
- Variable Capacitors

45. Capacitor / Fault Isolation

NCATT Level 2b

Outcome: A successful education or training outcome for this task will produce an individual who is *partially proficient* in the performance task of “Capacitor / Fault Isolation”. The individual *will be able to do most parts of the task and will need help only on the hardest parts*. In addition, he or she *will know the task procedures, and can determine the step-by-step procedures* for doing the task. The following is a non-inclusive list of performance items associated with this task.

- Improperly installed Capacitors
- Open Capacitors
- Shorted Capacitors

46. Transformer / Theory of Operation

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Transformer Theory of Operation”. The following is a non-inclusive list of terms associated with this subject.

- Counter Electro Magnetic Field (EMF)
- Eddy currents
- Hysteresis
- Primary winding

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- Secondary winding
- Step-down
- Step-up

47. Transformer / Fault Isolation

NCATT Level 2b

Outcome: A successful education or training outcome for this task will produce an individual who is *partially proficient* in the performance task of “Transformer / Fault Isolation”. The individual *will be able to do most parts of the task and will need help only on the hardest parts*. In addition, he or she *will know the task procedures, and can determine the step-by-step procedures* for doing the task. The following is a non-inclusive list of performance items associated with this task.

- Improperly installed Transformers
- Open or shorted Primary Coil
- Primary and secondary resistance testing
- Secondary Coil

48. Analog Circuits, Devices & Switches

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Analog Circuits, Devices & Switches”. The following is a non-inclusive list of terms associated with this subject.

- Derating factors
- Double Pull Double Throw (DPDT)
- Double Pull Single Throw (DPST)
- Micro Switch
- Normally closed
- Normally open
- Proximity switches
- Push button Switch
- Relays
- Rocker
- Rotary
- Solenoids
- SPDT
- Switches
- Toggle

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

49. Power Supply Circuit / Rectifiers

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Power Supply Circuit / Rectifiers”. The following is a non-inclusive list of terms associated with this subject.

- Diode
- Forward bias
- Full-wave Rectifier
- Germanium
- Half-wave Rectifier
- Reverse bias
- Ripple amplitude
- Silicon
- Solid-state
- Three phase Rectifier
- Types of components used
- Use of power supply circuits

50. Power Supply Circuit / Filters

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who *can identify basic facts and terminology* related to “Power Supply Circuits and Filters”. The following is a non-inclusive list of terms associated with this subject.

- Active filters
- Passive filters

51. Frequency Sensitive Filter - Theory of Operation

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who *can identify basic facts and terminology* related to “Frequency Sensitive Filters”. The following is a non-inclusive list of terms associated with this subject.

- Band-pass
- Band-reject
- Cutoff frequency
- Demodulation
- Detection
- Filtering

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- High-pass
- Tuning circuit
- Use of crystals

52. Wave Generation Circuits

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who *can identify basic facts and terminology* related to “Wave Generation Circuits”. The following is a non-inclusive list of terms associated with this subject.

- Oscillators
 - Crystal-controlled Oscillator
 - LC tank
 - Oscillator
 - Regenerative feedback path
- Waveshaping Circuits
 - Astable Multivibrator
 - Bistable Multivibrator
 - Crystal-controlled Oscillator
 - LC tank
 - Monostable Multivibrator
 - Oscillator

53. Limiter Circuits

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Limiter Circuits”. The following is a non-inclusive list of terms associated with this subject.

- Diodes
 - Forward bias
 - Proper use and installation
 - Reverse bias
 - Schematic diagram symbol
- Zener Diodes
 - Proper use and installation
 - Schematic diagram symbol
- Transistors
 - Base current
 - Bipolar
 - Collector Base Junction
 - Collector current
 - Emitter Base Junction
 - Emitter current

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

- NPN
- PNP
- Polarity of connections
- Proper use and installation
- Schematic diagram symbol

54. Digital Numbering Systems

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Digital Numbering Systems”. The following is a non-inclusive list of terms associated with this subject.

- Binary
 - Conversion from/to digital and hexadecimal
 - Digital signal
 - One
 - Zero
- Octal
 - Conversion from/to binary and decimal
 - Octal notation
 - Triad
- Hexadecimal
 - Base 16
 - Decimal to hex conversion
 - Hex to decimal conversion

55. Digital Logic Functions

NCATT Level B

Outcome: A successful education or training outcome for this subject will produce an individual who *knows and can identify the relationship of basic facts and state general principles* about “Digital Logic Functions”. The following is a non-inclusive list of terms associated with this subject.

- Main Logic Gates
 - AND
 - Display of digital data
 - Exclusive OR
 - INVERT
 - Logic gates
 - NAND
 - NOR
 - OR
 - Positive and negative logic

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- Proper use and installation
- Truth tables
- Flip-Flops
 - Advantages of flip-flops
 - Asynchronous flip-flop
 - Clock pulse
 - Data-type latch
 - JK flip-flop
 - Latches
 - RS latch
- Counters
 - Adder and subtractor circuits
 - Asynchronous
 - Counter triggering method
 - Frequency division characteristics
 - Full-adder
 - Half-adder
 - Subtractor
 - Synchronous
- Adders
 - Adder
 - Full-adder
 - Half-adder

56. Types of Aircraft Wiring / Cabling

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who *can identify basic facts and terminology* related to aircraft wiring. The following is a non-inclusive list of terms associated with this subject.

- Coaxial Cable
- Databus (Multiplex) Cables
- Multiconductor
- Single Conductor
- Twisted Pair
- Fiber Optics

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

57. Perform Wire Maintenance

NCATT Level 3c

Outcome: A successful education or training outcome for this task will produce an individual who is *competent* in the performance task of “Performance of Wire Maintenance”. The individual *will be able to do all parts of the task and will need only a spot check of completed work*. In addition, he or she *will know the operating principles* used with this standard, and *can identify why and when the task must be done and why each step is needed*. The following is a non-inclusive list of performance items associated with this task.

- Lacing / Tying Wire Bundles
- Cutting Wire / Cables
- Splicing
- Connecting Terminals
- Assemble Solderless Connectors
 - Crimped Connection
 - Coaxial Connector
- Connecting Terminals to Terminal Blocks
 - Multi-pin Connector
- Bonding and Grounding
- Conduit
- Continuity Checks
- Wiring Inspections

58. Use Test Equipment / Special Tools

NCATT Level 2b

Outcome: A successful education or training outcome for this task/subject will produce an individual who is *partially proficient* in the performance task of “Use of Test Equipment / Special Tools”. The individual *will be able to do most parts of the task and will need help only on the hardest parts*. In addition, he or she *will know the task procedures*, and *can determine the step-by-step procedures* for doing the task. The following is a non-inclusive list of performance items associated with this task.

- Analog Multimeter
- Digital Multimeter
- Continuity Tester
- Oscilloscope
- Signal / Function Generator

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

SECTION 3 – GOVERNANCE

X. Airspace Classification and Use

59. Airspace Classification

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Airspace Classifications”. The following is a non-inclusive list of terms associated with this subject.

- National Airspace System (NAS) – Federal Aviation Administration (FAA) controls flights within the NAS
 - NAS is all airspace not within a Restricted Airspace Area
 - FAA Airspace Classification:
 - Class A
 - Class B
 - Class C
 - Class D
 - Class E
 - Class G
 - Special Use Airspace / Special Area of Operation (SAO)
- Restricted Airspace - FAA does not control flights within Restricted Airspace
 - Military use Airspace
 - Airspace that is in a sensitive area (e.g., national security perspective)

60. Permitted National Airspace System (NAS) Use

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about the operational use and restrictions of unmanned aircraft within the “National Airspace System”. The following is a non-inclusive list of terms associated with this subject.

- Non-FAA Certificated Unmanned Aircraft (UA) may operate in the NAS if they weigh less than 25 kg, or 55 lbs. (Hobby / Recreational Aircraft): All other UA are classified as either Civil or Government (Public) aircraft
- Government Operators may operate Non-FAA Certificated unmanned aircraft within the NAS after the government agency has obtained a Certificate of Authorization (COA) from the FAA – Restrictions for the operation of the unmanned aircraft will be developed by the FAA and the operator
- Civil UA must obtain an FAA issued “Experimental Airworthiness Certificate” to operate within the NAS

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- Operating limitations on the Experimental Airworthiness Certificate will typically specify:
 - No change to the UA configuration from the configuration as Certificated
 - UA operations must remain outside of Class B, C and D airspace
 - Large UA must utilize an onboard transponder and “squawk” a code which the air traffic controlling agency can recognize
 - Cannot be operated at night or instrument conditions (flight through clouds is prohibited)
 - Operation near Victor Airways, airports and congested areas is typically not allowed
 - The UA must maintain two-way radio communications with the ground control station
 - If the communication link is broken:
 - Have a back-up communication system in place
 - Be capable of flying “home” to improve radio reception
 - Be capable of “safely crashing” in the event that attempts to communicate fail

61. Restricted Airspace Operational Use

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about the operational use and restrictions of unmanned aircraft systems within “Restricted Airspace”. The following is a non-inclusive list of terms associated with this subject.

- Unmanned aircraft can operate in restricted airspace without a COA or Experimental Airworthiness Certificate.
- The unmanned operating agency must meet the Restricted Airspace controlling agency’s safety and spectrum management requirements

62. Flight Monitoring Systems

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Flight Monitoring Systems”. The following is a non-inclusive list of terms associated with this subject.

- Surveillance
 - Frequency Spectrum
 - Sense & Avoid
 - Transponders
 - Automatic Dependent Surveillance – Broadcast (ADS-B)
 - 91.225
 - Traffic Alert and Collision Avoidance System (TCAS)
 - Reduced Vertical Separation Minimums (RVSM)
 - 91.706

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

XI. U.S. Government, Military and Commerce Regulation

63. Export Compliance and Regulation

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about unmanned aircraft “Export Compliance and Basic Regulatory Requirements” for exportation of unmanned aircraft. The following is a non-inclusive list of terms associated with this subject.

- Licenses
- Standards
- Economic Sanctions
- Defense Contract Management Agency (DCMA)
- International Traffic in Arms Regulations (ITAR)

64. Military Security

NCATT Level A

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about “Military Security” issues that relate to unmanned aircraft systems. The following is a non-inclusive list of terms associated with this subject.

- Criteria
- Levels of Clearances

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

XII. Federal Aviation Administration Unmanned Aircraft System Certification: Reference - FAA Order 8130.34B, dtd 11/28/2011 *Appendix A of the NCATT UAS Maintenance Standard includes a summary of FAA Order 8130.34B. Use this summary in conjunction with any FAA changes or up- dates to the order to ensure knowledge of the subject.*

65. Requirements for Certification of UAS / Optionally Piloted Aircraft (OPA) Systems *NCATT Level A*

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about the “Requirements for UAS / OPA Systems”. The following is a non-inclusive list of terms and FAA requirements associated with this subject.

- Proof of Ownership
- Registration Numbers (“N” Numbers)
- Airworthiness Certificate

66. Certificated UAS / OPA Systems Inspection, Maintenance and Record Documentation Requirements *NCATT Level A*

Outcome: A successful education or training outcome for this subject will produce an individual who can identify basic facts and terms about the “Maintenance, Inspection and Documentation Requirements” for FAA Certificated UAS / OPA systems. The following is a non-inclusive list of terms associated with this subject.

- Requirements for Record Keeping
- Persons Authorized
- Terminology
- Frequency of Maintenance and Inspections

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

APPENDIX A: FAA ORDER 8130.34B SUMMARY

Use this summary in conjunction with any FAA changes or up-dates to the order to ensure knowledge of the subject.

FAA Requirements for Certification of UAS / OPA Systems

FAA Order 8130.34B, identifies, defines and explains the regulatory requirements and processes used to certify an unmanned aircraft system. A summary follows:

- FAA Certification for UA or OPA is for *Special Airworthiness Certificates* in the *Experimental Category*. The FAA may also issue *Special Flight Permits* for production flight testing new aircraft.
- The Experimental Airworthiness Certificate may be issued in one of the following categories:
 - Research and development (R&D)
 - Crew training
 - Market survey
- An Experimental Airworthiness Certificate for R&D, crew training, or market surveys is effective for 1 year or less after the date of issuance
- U.S. aircraft registration (FAA registration) is a prerequisite for issuance of an Experimental Airworthiness Certificate
- Proof of ownership of the UA or OPA must be provided to the FAA Aircraft Registration Branch (AFS-750) at the time of registration
- The size, shape and other requirements for displaying the registration number are provided in Title 14, CFR, Part 45: Subject – *Identification and Registration Marking*
- The Experimental Airworthiness Certificate will contain and impose “Operating Limitations”
 - Changes in the UA mission may require reissuance of the Airworthiness Certificate
 - Physical changes in the unmanned aircraft may require reissuance of the Airworthiness Certificate
- FAA may prescribe additional operating limitations deemed necessary for the special purpose involved as authorized by Title 14, CFR, Part 91.319 – Subject: Aircraft having experimental certificates: Operating limitations, sub paragraph (i)
- The Experimental Airworthiness Certificate must be surrendered to the FAA when:
 - The aircraft owner/operator sells or leases a U.S. owned UA or OPA to a purchaser in the U.S. The registration may be transferred or the aircraft deregistered. In either case the certificate must be surrendered to the FAA
 - The aircraft owner/operator sells or leases a U.S. owned UA or OPA to a purchaser in another country, the aircraft is deregistered and the certificate is no longer effective. The certificate must be surrendered to the FAA
- The applicant for an Experimental Airworthiness Certificate, UA or OPA must provide a “Program Letter” to the FAA, (AIR-200). The letter will follow an FAA provided template and must contain the following information:
 - Aircraft specifications (identification/description)
 - Purpose of the Experimental Certificate (category)
 - Area of operation that flights are to be conducted

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- Duration of the Program
- Containment (ability to contain the aircraft with the boundaries of the proposed flight area)
- Lost Link (sequence that will be followed that will result in safely returning the aircraft to a predefined lost-link waypoint, or any other procedure that is safe and predictable)
- Flight recovery (if command and control link is unrecoverable, an independent means to safely terminate the flight)
- The applicant must provide the FAA, (AIR-200) with a “Safety Checklist” that is used by the applicant in providing all the required information during the FAA Safety Evaluation. FAA Order 8130.34B, Appendix D provides the template for this information.
- FAA will review the applicant’s records and certification documentation requirements for the subject aircraft and all supporting systems and equipment (e.g. ground stations, launch and recovery systems, and backup generators). Records and document review will include:
 - The maintenance program for the aircraft and supporting systems
 - Maintenance and Inspections records for the aircraft and supporting systems
 - Established system configuration corresponds to the submitted documents
 - Weight and balance data for accuracy and currency
 - Compliance with all relevant airworthiness directives (ADs)
- The FAA will inspect the aircraft and support systems to determine:
 - Aircraft nationality and registrations marks are in accordance with Title 14, CFR, Part 45 – Subject: *Identification and Registration Marking*
 - Proper operation of the flight control system
 - Powerplant/Propeller(s) and associated instruments are operating in accordance with the manufacturer’s instructions
 - Pitot-static and transponder inspections have been certified in accordance with Title 14, CFR, Part 91.411 – Subject: *Altimeter Systems and Altitude Reporting Equipment Test and Inspections*, and Part 91.413, *Air Traffic Control (ATC) Transponder Tests and Inspections*
 - All elements of the control station operation for normal preflight operational transmit and receive link checks of the control station to the unmanned aircraft
- The FAA will assign a “Flight Test Area” in accordance with Title 14, CFR, Part 91.305 – Subject: *Flight Test Areas*. All UAS flight testing operations must be limited to the assigned flight test area
- FAA Order 8130-34B, Appendix A, - Sample Operating Limitations for Unmanned Aircraft Systems: Experimental Certificate or Special Flight Permit contains the following conditions and limitations of all unmanned aircraft system flight operations for the certificated aircraft while operating in the National Airspace System (NAS):
 - General Information
 - Program Letter
 - Initial Flight Testing
 - Authorized Flight Operations Area
 - Unmanned Aircraft Pilots and Observers
 - Equipage
 - Air Traffic Control Provisions
 - Communications
 - Flight Prohibitions

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- Flight Termination and Lost Link Procedures
- Inspections and Maintenance
- Information Reporting
- Revisions and Other Provisions
- UAS Modifications

FAA Certificated UAS / OPA Systems Inspection, Maintenance and Record Documentation Requirements

- The UAS must not be operated unless it is inspected and maintained in accordance with the applicant's FAA accepted inspection and maintenance procedures, or later accepted FAA revision.
- The applicant must establish and maintain aircraft maintenance records
- No person may operate the subject UAS unless within the preceding 12 calendar months the UAS has had a condition inspection performed according to the FAA-accepted, applicant's Inspection and Maintenance Program
 - The condition inspection must have found the UAS to be in a condition for safe operation
 - The inspection will be recorded in the UAS maintenance records
 - Only those individuals trained and authorized by the applicant and acceptable to the FAA may perform the inspections and maintenance required by the UAS operating limitations
- Inspections and maintenance of the UAS must be recorded in the UAS maintenance records
- Inspection entries must contain the following, or similarly worded, statement: *"I certify that this UAS was inspected on (date), in accordance with the scope and detail of the (applicant name) Inspection and Maintenance Program, and was found to be in a condition for safe operation"*
- Maintenance record entries must include a description of the work performed, the date of completion for the work, the UAS's total time-in-service, and the name and signature of the person performing the work
- UAS instruments and equipment required to be installed must be inspected and maintained in accordance with the requirements of the applicant's Inspection and Maintenance Program. Any maintenance or inspection of this equipment must be recorded in the UAS maintenance records
- No person may operate the subject UAS unless the altimeter system and transponder have been tested within the preceding 24 calendar months in accordance with Part 91.411, Altimeter system and altitude reporting equipment tests and inspections, and Part 91.413, ATC transponder tests and inspections. These inspections will be recorded in the UAS maintenance records

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

APPENDIX B: DEFINITIONS (FAA ORDER 8130.34B, APPENDIX F)

- **Airworthy.** An unmanned aircraft system (UAS) is airworthy if the aircraft and all of the other associated support equipment of the UAS are in condition for safe operation. Special emphasis must be placed on the integrity of the data link. If any element of the systems is not in condition for safe operation, then the UA would not be considered airworthy.
- **Direct Control.** The capability of a remote pilot to manipulate the flight control surfaces of the aircraft in a direct fashion using, for example, a radio control box with joystick or a ground control station using conventional type aircraft controls (such as a yoke/stick, rudder pedals, power levers, and other ancillary controls). This infers a one-to-one correspondence between control input and flight control surface deflection.
- **Certificate of Waiver or Authorization (COA):** The authority needed to operate a UAS in the National Airspace System (NAS) as a public aircraft. COAs are issued by the FAA Air Traffic Organization.
- **Exemption.** Relief from the requirements of a current regulation as provided for in 14 CFR part 11, General Rulemaking Procedures.
- **Indirect Control.** The capability of a remote pilot to affect the trajectory of the aircraft through computer input to an onboard flight control system. An example of an indirect control would be the entry of a navigational fix or waypoint on a remote system that, in turn, uploads this information to an onboard autopilot. The autopilot then computes the flight control inputs to achieve a flight path to the uploaded waypoint. The onboard system controls the flight control surfaces.
- **Optionally Piloted Aircraft (OPA).** An aircraft that is integrated with UAS technology and still retains the capability of being flown by an onboard pilot using conventional control methods.
- **Safety Evaluation.** A comprehensive review of an applicant's UAS or OPA and all associated elements defined in paragraph f and j of this appendix. The applicant is expected to provide any and all information necessary to allow the FAA to objectively determine if the UAS or OPA can be safely operated in the NAS. The form of this review is a presentation by the applicant to the FAA. The safety evaluation is a formal review of the information contained in the safety checklist and is performed at the discretion of the FAA.
- **Support Equipment.** All associated equipment, whether ground based or airborne, used to enable safe operation of the unmanned aircraft. This includes all elements of the control station, data links, telemetry, navigation, communications equipment, as well as equipment that may be used to launch and recover the aircraft.
- **Unmanned Aircraft (UA).** A device used or intended to be used for flight in the air that has no onboard pilot. This includes all classes of airplanes, helicopters, airships, and translational lift aircraft that have no onboard pilot. Unmanned aircraft include only those aircraft controllable in three dimensions and, therefore, exclude traditional balloons and unpowered gliders.
- **Unmanned Aircraft System (UAS).** An unmanned aircraft and its associated elements related to safe operation, which may include control stations, data links, support equipment, payloads, flight termination systems, and launch/recovery equipment.

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

APPENDIX C: UAS ACRONYMS & TERMS

- **ADF** – Automatic Distance Finder
- **ADS-B** – Automatic Dependent Surveillance – Broadcast
- **AMT** – Aviation Maintenance Technician (Airframe & Powerplant Rated Mechanic, A&P)
- **ASAP** – Aviation Safety Action Program
- **ASRS** – Aviation Safety Reporting System
- **ASTM** – American Society for Testing And Materials International
- **ATA** – Air Transport Association
- **ATM** – Asynchronous Transfer Mode
- **COA** – Certificate of Authorization (for non-certificated or waived certificate in Restricted Airspace)
- **COA** – Certificate of Airworthiness (issued by the FAA)
- **COTS** – Commercial “Off-The-Shelf”
- **CWS** – Control Wheel Steering
- **DCMA** – Defense Contract Management Agency
- **DISN** – Defense Information Systems Network
- **DME** – Distance Measuring Equipment
- **DOT** – Department of Transportation
- **DPDT** – Double Pull Double Throw **DPST** – Double Pull Single Throw
- **EASA** – European Aviation Safety Agency
- **EMF** – Electro Magnetic Field
- **EMI** – Electro Magnetic Interference or Electromagnetic Interface
- **EPA** – Environmental Protection Administration
- **ESD** – Electrostatic Sensitive Device
- **FAA** – Federal Aviation Administration
- **FOD** – Foreign Object Damage
- **FOE** – Foreign Object Elimination
- **FIM** – Fault Isolation Manual
- **FMS** – Flight Management System
- **GCS** – Ground Control Station
- **GPS** – Global Positioning System
- **GPU** – Group Power Units
- **HF-SSB** – High Frequency – Single Sideband
- **HIRF** – High Intensity Radiated (electromagnetic) Field
- **IAS** – Indicated Air Speed
- **ICAO** – International Civil Aviation Organization
- **INS** – Inertial Navigation System
- **ISR** – Intelligence Surveillance Reconnaissance
- **ITAR** – International Traffic in Arms Regulations
- **Ku** – Kurt’s Underband Frequency Band 12-18 GHz
- **KVM** – Keyboard, Video, Mouse

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard

Subject, Performance, and Task Knowledge Requirements

- **LAN** – Local Area Network
- **LNAV** – Lateral Navigation
- **LOL** – Loss of Link
- **LPV** – Lateral-Precision with Vertical Guidance
- **LRS** – Long Range Surveillance
- **LRU** – Line Replaceable Unit
- **LSB** – Lower Sideband
- **MAN** – Metropolitan Area Network
- **MOS** – Military Occupation Specialty
- **MTOW** – Maximum Take-Off Weight
- **NAS** – National Airspace System
- **NCATT** – National Center for Aerospace, Transportation and Technologies
- **NDI** – Non Destructive Inspection/Training
- **NIPRNET** – Non-secure Internet Protocol Router Network
- **NTSB** – National Transportation Safety Board
- **OPA** – Optionally Piloted Aircraft
- **OS** – Operator Station
- **OHSA** – Occupational Health and Safety Administration
- **PPO** – Pilot Payload Operator
- **PSO** – Pilot Sensor Operator
- **RC** – Radio Controlled
- **RNAV** – Area Navigation
- **RVSM** – Reduced Vertical Separation Minimums
- **SIPRNET** – Secret Internet Protocol Router Network
- **SHEL** – Software, Hardware, Environment, Liveware
- **SSR** – Secondary Surveillance Radar
- **TCAS** – Traffic Alert and Collision Avoidance System
- **TCP/IP** – Transmission Control Protocol / Internet Protocol
- **UAV** – Unmanned Aerial Vehicle
- **USB** – Upper Sideband
- **VOR/ILS** – VHF Omnidirectional Range / Instrument Landing System
- **VSWR** – Voltage Standing Wave Ratio
- **WAN** – Wide Area Network

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

APPENDIX D: EQUIPMENT & TOOLS

Common Hand Tools

- 25' Tape Measure
- 6" Scale in 10ths and Fractions (1/16" - 1/32")
- Adjustable Wrench (12")
- Adjustable Wrench, 4 inch
- Allen Wrenches (individual)
- Assorted Slot and Phillips Screwdriver
- Aviation Sheetmetal Snips (Straight, Right and Left)
- Aviation Spark Plug Socket, 7/8" Deep Well, 1/2" Dr with 3/8" Adapter
- Center Punch
- Cold Chisel, 3/4"
- Combination Pliers – 6 ½ inch
- Combination Square
- Combination Wrench Set, 3/16 inch – 7/8 inch
- Diagonal Cutters – 8 inch
- Diagonal Cutters (Flush Cut) – 4- 4 ½ inch
- Engineer's 6 inch Scale
- Extensions, 3/8" Dr, 3" and 6"
- File -10" Round Double Cut Bastard with Handle
- File -6" Round Double Cut Bastard with Handle
- File- 8" Half Round (Double Cut) Bastard with Handle
- File -8" Mill (Single Cut) with Handle
- Flashlight (2 Cell), Explosion Proof
- Gauge, Feeler .015 To .025
- Hacksaw W/3 Blades 24 Pitch, 3 Blades 32 Pitch
- Hammer Machinist, 12 Oz.
- Ignition Wrench Set, 5/32" - 7/16"
- Inspection Mirror
- Long Reach Phillips Screwdriver – #2, 12 inch
- Magnifying Glass
- Mallet, Plastic Or Rawhide
- Multi-Meter
- Needle File Set
- Needle Nose Pliers – 5 ¾ inch
- Pencil Compass
- Pin Punch, 3/32 and 1/8 inch
- Pliers, Duckbill
- Pliers, Side Cutting
- Putty Knife
- Ratchet and Socket Set, 3/8 inch Dr, 3/16 inch – ½ inch
- Scissors
- Screwdriver Set, Phillips, #1-4", #2-1", and #2-6"
- Screwdriver Set, Slot 1", 4", and 8"
- Scribes
- Snap Ring Pliers Kit
- Socket Set, 1/4" Dr 3/16" – 3/4"
- Speed Handle, 3/8" Dr
- Tape Measure
- Tweezers
- Universal, 3/8" Dr

Specialized Tools

- Pocket Transit (Check Dish Angle)
- Specific Tools Used Based on Manufacturer's Instructions

NCATT Unmanned Aircraft Systems (UAS) Maintenance Standard Subject, Performance, and Task Knowledge Requirements

Avionics Test Equipment

- Analog Multimeter
- Continuity Tester
- Digital Data Bus Reader
- Digital Multimeter
- Oscilloscope

Common Personal Protective Equipment

- Muff Hearing Protectors
- Safety Goggles (Clear)