



Radio Communication Systems (RCS) Standard

AET - Endorsement

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NCATT Radio Communication Systems Standard Subject, Performance and Task Knowledge Requirements

- I. Safety
- II. Radio Transmitters / Receivers
- III. Communication Systems
- IV. Satellite Communication (SATCOM)

There are four (4) *Subject Knowledge, Task Performance and Task Knowledge* activities and functions within the NCATT Radio Communication Systems Standard. The Radio Communication Systems Standard was identified and defined by aerospace industry Subject-Matter-Experts (SMEs) through an NCATT facilitated occupational analysis workshop. NCATT workshops focus on the “job” an individual performs in relation to an identified topic or career field.

The NCATT Radio Communication Systems 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 avionic / electronics systems. The Standard can also be used to develop specialized and/or targeted education and training needs.

The depth, complexity and detail of task performance, task knowledge and subject knowledge, required for *NCATT Accredited* programs, can be determined by referring to the NCATT Level Definitions provided below.

Educational entities that wish to align their programs with the NCATT Standards (and required teaching levels) should refer to the NCATT webpage (www.ncatt.org) for additional guidance.

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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 Radio Communication Systems Standard Subject, Performance and Task Knowledge Requirements

I. Safety

1. Radio Communication System Safety

Level B

Outcome: A successful education or training outcome for this task/subject will produce an individual who knows and can identify the relationship of basic facts and state *general principles* about *safety* and safety issues as applied to general safety practices, flight line operations and maintenance / shop activities. The individual will be able to recognize and use terminology that may be applicable to safety issues specific to this Standard, and related to specific subjects areas within the Standard. The following is a minimum list of safety related areas that must be addressed in this section of the Radio Communication System Standard.

- Protection of Personnel from physical contact injury from antennas
- Radio Frequency Radiation (RFR) Hazards
- Electromagnetic Field (EMF) Hazards
- Ground Operation of Airborne Weather Radar

II. Radio Transmitters / Receivers (inclusive of Transceivers)

2. General

Level B

Outcome: A successful education or training outcome for this task/subject will produce an individual who knows and can identify the relationship of basic facts and state *general principles* about *Radio Transmitters and Receivers* and be able to recognize and use terminology related to this subject.

As general information, the following terms and components are *typically* associated with radio transmitters and receivers (inclusive of transceivers).

- History (Airborne Communications)
- Radio Communication Principles
 - Frequency Band & Range
 - 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
 - Extremely High Frequency (EHF) 30 – 300 GHz
 - Carrier Signals
 - USB (Upper Sideband)
 - LSB (Lower Sideband)
 - HF-SSB (High Frequency Single-Sideband)

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- Receiver Sensitivity
- Tuning Circuits
- Amplifiers
- Oscillators
- Modulators and Demodulators
- Filters
- Wave Propagation
 - Ground
 - Sky
 - Space
- Federal Regulations (FAA & FCC: General – Related to Airborne Communication)
- Terminology Understanding - Flight Crew / Technician
- Block Diagrams

3. Tie-In/Integration

Level A

Outcome: A successful education or training outcome for this task/subject will produce an individual who can identify basic facts and terms about Radio Transmitter and Receiver *Tie-In and Integration*.

As general information, the following is a *typical* list of aircraft systems that utilize or tie-into aircraft radio transmitters and receivers (inclusive of transceivers).

- Power Input
- Audio Panel
- Headphones
- Control Panel
- Flight Management System Auto Tuning

4. Operational Checks / Fault Isolation

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 the tasks of *Radio Transmitter and Receiver Operational Checks and 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, they will know the procedures for the task, and can determine step-by-step procedures for doing the task.

As general information, the following is a *typical* list of transmitter, receiver (inclusive of transceivers) operational checks and fault isolation activities.

- In-flight Interference / Radio Frequency Interference (RFI)
 - Precipitation Static (P-static)
 - Grounding
 - Bonding
 - Antenna Location (See Paragraph II – Antenna)

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- Operational Function Test
 - Transmit indicator lights
 - Transmitted signal received on portable radio
 - Radio-frequency wattmeter
 - Circuit Breaker / Circuit Protection Device
 - Squelch Test
 - Electronic interference from aircraft systems
 - Microphone
- Testing
 - TDR
 - Voltmeter
 - Wattmeter
- Ramp Testers
- Power Measurement Devices

III. Communication Systems

5. Transmission Lines

Level B

Outcome: A successful education or training outcome for this task/subject will produce an individual who knows and can identify the relationship of basic facts and state *general principles* about *Communication Systems Transmission Lines* and be able to recognize and use terminology related to this subject.

As general information, the following terms and components are *typically* associated with communication systems transmission lines.

- Types
- Velocity Factor
- Impedance
- Corrosion
- VSWR
- Installation / Maintenance / Fabrication
 - Spliced
 - Terminated
 - Connectors
 - Separation

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6. Antennas – Theory, Installation, Operational Checks and Fault Isolation *Level 2b*

Outcome: A successful education or training outcome for this task/subject will produce an individual who knows basic *antenna* theory of operation and can identify antennas used with aviation radio communication systems. The individual will be partially proficient in the tasks of operational checks and fault isolation of communication system antennas. They will know the procedures for operational checks and fault isolation and can determine the step-by-step procedures for doing the task. The individual will be able to do most parts of the task and will need help only on the hardest parts.

As general information, the following is a *typical* list of communication system antenna operational checks and fault isolation activities.

- General
 - Aircraft Application
 - Voice and/or Data Consideration
 - Light Aircraft (12,500 lbs or less max certified take-off weight)
 - Business Jet
 - Air Transport (Air Carrier)
 - Military
 - Antenna Type
 - Trailing Wire / Long Wire
 - Short Wire
 - V
 - Shunt
 - Whip
 - Blade Type
 - Antenna Specification Sheet
- Installation / Operational Checks
 - Mounting Scheme
 - Separate antenna for each comm radio
 - Top or Bottom Mount
 - Location
 - Aircraft Surface Consideration
 - Obstructions (Aircraft Structure)
 - Spacing
 - Doubler(s)
 - Tuning / Troubleshooting
 - Voltage Standing Wave Ratio (VSWR) / (SWR)
 - RF Wattmeter
 - Grounding / Bonding
 - Interior Bonding
 - Exterior Bonding
 - Edge Seal
 - Hardware Seal
 - Resistance Checks

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- Cables
 - Coaxial Cable
 - Triaxial Cable
- Connections
 - BNC
 - TNC
 - C
 - N
 - HN
- Antenna Couplers
 - Duplexer
- Hardware
 - Mounting
 - Gaskets / Seals

IV. Satellite Communications (SATCOM)

7. International Maritime Satellite (Inmarsat) System

Level B

Outcome: A successful education or training outcome for this task/subject will produce an individual who knows and can identify the relationship of basic facts and state *general principles* about *Inmarsat* and be able to recognize and use terminology related to this subject.

As general information, the following terms and components are *typically* associated with Inmarsat systems.

- Service Provided (typical)
 - Two-Way Voice / High-volume data transfer / Video-conferencing E-mail / ATC
- Components
 - Space Segment (Inmarsat Aero)
 - Four Geo-Stationary (GEO) Satellites (with back-ups) - 22,000 mile orbit
 - Pacific Ocean Region (POR)
 - Indian Ocean Region (IOR)
 - Atlantic Ocean Region West (AOR-W)
 - Atlantic Ocean Region East (AOR-E)
 - Ground Earth Station (GES)
 - Terrestrial Public & Private Telecommunications Networks
 - Terrestrial Public & Private Data Networks
 - Aircraft Earth Station (AES)
 - User Interface
 - Telephone
 - Fax
 - Data
 - Satcom Avionics
 - Satellite Data Unit (SDU)

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- Radio Frequency Unit
- High Power Amp
- Antenna Sub Systems
 - Diplexer / Low Noise Amp
 - Beam Steering Unit
 - Antenna
- Frequency Bands
 - Aircraft Earth Station (AES): L - band
 - Space-To-AES (Down-links): 1525.0 – 1559.0 MHz
 - AES-To-Space (Up-links): 1626.5 – 1660.5 MHz
- Ground Earth Station (GES): C- band
 - Space-To-Earth (Down-links): 4 GHz
 - Earth-To-Space (Up-links): 6 GHz Note: Aircraft Avionics system (must conform to Inmarsat Standards and ARINC 741)
- Aircraft Antenna Systems
 - Low Gain
 - Intermediate Gain
 - High Gain
 - Conformal (High Gain)
- Service Providers – Inmarsat Aero Services
 - Swift64
 - SwiftBroadband

8. Iridium Satellite System

Level B

Outcome: A successful education or training outcome for this task/subject will produce an individual who knows and can identify the relationship of basic facts and state *general principles* about *Iridium Satellite Systems* and be able to recognize and use terminology related to this subject.

As general information, the following terms and components are *typically* associated with Iridium Satellite Systems.

- Service Provided (typical)
 - Voice / Data transfer
- Components
 - Space Segment
 - Sixty-Six (66) Low-Earth Orbiting (LEO) Satellites (multiple in-orbit back-ups)
 - Each satellite orbits the earth in 100 minutes (10 minutes horizon to horizon)
 - Each satellite can support 1100 phone calls
 - Ground Stations Segment
 - Subscriber Products (phones and terminals)
 - Aircraft Segment
 - Iridium Satellite Phone
- Frequency Bands
 - Ground Based Users: L-band 1616 – 1626.5 MHz
 - Terrestrial Gateways: 29.1 – 29.3 GHz (Up-links)

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- Inter-satellite links: 22.55 – 23.55 GHz
- Terrestrial Gateways: 19.1 – 19.6 GHz (Down-links)
- Aircraft Antenna Systems
 - Omnidirectional (not aimed or steered)
 - Small Lightweight
- Service Providers – Iridium Communications LLC. Inc.

9. Satellite Radio – Continental United States

Level B

Outcome: A successful education or training outcome for this task/subject will produce an individual who knows and can identify the relationship of basic facts and state *general principles* about *Satellite Radio* and be able to recognize and use terminology related to this subject.

As general information, the following terms and components are *typically* associated with Satellite Radio.

- Service Provided (typical)
 - 100+ Channels / Music / News / Sports / Satellite TV / Internet
- XM
 - Two Geostationary Satellites – Receiver / Transmitter (Equator Orbit)
 - XM Earth Transmitters (content to satellites)
 - Receivers - XM customer's receiver and XM Repeater Stations (repeaters located across U.S.)
 - The XM customer receiver accepts signals from either geostationary satellite or the XM repeater stations simultaneously.
- Sirius
 - Four Satellites
 - Three Satellites in Unique Elliptical Orbits (figure eights) with 16 hour duration over U.S. each orbit.
 - One Geostationary Satellite (leased)
 - Sirius Earth Transmitters (content to geostationary satellite)
 - Content transmitted to orbiting satellites from geostationary satellite
 - Receivers – Sirius customer's receiver and Sirius Repeater Stations (repeaters located across U.S.)
 - The Sirius customer receiver accepts signals from either one of the orbiting satellites or the repeater network

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Suggested Resources:

PRINCIPLES OF AVIONICS-FOURTH EDITION AUTHOR: DR. ALBERT HELFRICK ISBN
9781885544261

AIRCRAFT ELECTRICITY/ELECTRONICS (GLENCOE'S AVIATION TECHNOLOGY SERIES)
AUTHOR: THOMAS K. EISMIN, RALPH D. BENT, AND JAMES L. MCKINLEY ISBN 0-02-801859-1

AVIONICS TRAINING - SYSTEMS, INSTALLATION AND TROUBLESHOOTING AUTHOR: LEN
BUCKWALTER ISBN 1-885544-21-9

ANTENNA ENGINEERING HANDBOOK AUTHOR: JOHN L. VOLAKIS CAT. NO. AEN-01

ADDITIONAL AVIONICS TITLES CAN BE FOUND AT <http://www.avionics.com/www/titles.htm>