



*NATIONAL CENTER FOR AEROSPACE & TRANSPORTATION TECHNOLOGIES*

# **Dependent Navigation Systems (DNS) Standard**

## **AET - Endorsement**

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# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## I. Safety

## II. Antennas

## III. GPS

## IV. VOR

## V. DME

## VI. ADF

## VII. ILS

There are seventeen (17) *Subject Knowledge, Task Performance and Task Knowledge* activities and functions within the NCATT Dependent Navigation Systems Standard. The Dependent Navigation 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 Dependent Navigation 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](http://www.ncatt.org)) for additional guidance.

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## NCATT Level Definitions

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

## I. Safety

### 1. General / Flight Line / Maintenance & Shop Safety Practices

#### NCATT 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 subject areas within the standard.

## II. Antennas

### 2. General Antenna Theory, Function, Operation and Fault Isolation

#### NCATT 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 navigation systems. The individual will be partially proficient in the tasks of operational checks and fault isolation of navigation 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 terms, components and subjects that address basic theory of operation, operational checks and fault isolation for aircraft antennas used in aircraft navigation systems.

- General
  - Aircraft Application
    - Light Aircraft (12,500 lbs or less max certified take-off weight)
    - Business Jet
    - Air Transport (Air Carrier)
    - Military
  - Antenna Type / Application
    - VOR / ILS (Localizer and Glideslope)
    - DME
    - Marker Beacon
    - GPS
    - ADF (Loop and Sense)
    - Antenna Specification Sheet
- Installation / Operational Checks
  - Mounting Scheme
  - Location / Installation
    - Aircraft Surface Consideration
    - Obstructions (Aircraft Structure)
    - Spacing
    - Doubler(s)

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

- Grounding / Bonding
  - Interior Bonding
  - Exterior Bonding
  - Edge Seal
  - Hardware Seal
  - Resistance Checks
- Tuning / Troubleshooting
  - Voltage Standing Wave Ratio (VSWR) / (SWR)
  - RF Wattmeter
- Cables
  - Coaxial Cable
  - Triaxial Cable
- Connectors
  - BNC
  - TNC
  - C
  - N
  - HN
- Antenna Couplers
  - Duplexer
  - Triplexer
  - Diplexer
- Hardware

\*Note – Also See FAA Advisory Circular (AC) 43.13-1B **CHG 1**

Chapter 12. Aircraft Avionics Systems, Section 2. Ground Operational Checks for Avionics Equipment (Electrical) pg 12-3; paragraph 12-9 Inspection of Avionics Systems; subparagraph 12-9 (b) Inspect Antennas

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## III. Global Positioning Satellite (GPS) System

### 3. General

#### NCATT 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 *Global Positioning Satellite Systems* and be able to recognize and use terminology related to this subject.

As general information, the following terms and subjects are *typically* associated with navigation systems that utilize and/or interface with the GPS Systems.

- Modulation & Frequencies
- Earth Coordinate Systems
- Great Circle Navigation
- GPS Segments
  - Space (Satellites)
  - Control (Ground Stations)
  - User (GPS Receivers)
- Database Updates
- Wide Area Augmentation System (WAAS)
- Local Area Augmentation System (LAAS)
- Receiver Autonomous Integrity Monitoring (RAIM)
- Required Navigation Performance (RNP)
- Actual Navigation Performance (ANP)
- Instrument Flight Rules (IFR)

### 4. Tie-In/Integration

#### NCATT 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 GPS System *Tie-In/Integration*.

As general information, the following terms and components are *typically* associated with tie-in and integration of GPS Systems.

- Aircraft Altimetry System
- Configuration Types
- Autoflight / Autopilot Systems
- Flight Management Systems (FMS)
- Inertia Navigation System (INS) / Inertia Reference System (IRS)
- Instrument Integration
- Remote Annunciation
- Flight Displays

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## 5. GPS Operational Checks / Fault Isolation *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 the tasks of *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 GPS operational checks and fault Isolation activities.

- Operational Checks
  - Database Updates (See paragraph III - GPS General)
  - Satellite Acquisition
  - Annunciations
  - Acquisitions
    - Almanacs
    - Ephemeris
- Isolate Malfunctions
  - BITE
  - Interference

## IV. VHF Omni Directional Range (VOR) System

### 6. General *NCATT 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 *VHF Omni Directional Range (VOR) 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 VOR systems.

- VOR Signal
  - Reference Phase (All Directions in Frequency Modulation)
  - Variable Phase (Narrow Rotating in Amplitude Modulation)
  - Audio Tone – Morse Code
  - Voice - Identification
- Frequency
  - VHF: 108 – 118 MH



# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## 7. Tie-In/Integration NCATT 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 *VOR System Tie-In/Integration*.

As general information, the following terms and components are *typically* associated with tie-in and integration of VOR Systems.

- Navigation / Flight Systems
  - Autoflight / Autopilot Systems
  - Flight Management System (FMS)
  - Instrument Landing System (ILS)
- Electronic Flight Instruments (EFIS)
  - Horizontal Situation Indicator (HSI)
  - Course Deviation Indicator (CDI)
  - Radio Magnetic Indicator (RMI)
- Audio Identification

## 8. Operational Checks and Fault Isolation 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 the tasks of *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 task.

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

- VOR Check (14 CFR Part 91.171; Equipment Check for IFR Operations)
  - Approved Procedure
  - VOR Test Facility (VOT)
    - FAA Test Signal
    - Repair Station Test Signal
  - Airport VOR Checkpoint - FAA Designated Surface Point
  - Airborne VOR Checkpoint – FAA Designated
  - Two VOR Check – VOR Airway
- VOR Indicator – Ops Checks / Faults /Marking /Indications
  - VOR Test Set Operation
  - VOR Course Bends and Scallops
  - VOR Propeller or Rotor Modulation
  - VOR Course Width
  - Flag Operation / Sensitivity Check
  - To / From Indication

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## V. Distance Measurement Equipment (DME) System

### 9. General

#### NCATT 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 *Distance Measurement Equipment (DME) 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 DME systems.

- Modulation & Frequencies
- Radar Mile
- Slant Range
- Channeling
- Pairing
- Time To Station (TTS)
- Random Spacing ("Jitter")
- Squitter

### 10. Tie-In/Integration

#### NCATT 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 *DME System Tie-In/Integration*.

As general information, the following terms and components are *typically* associated with tie-in and integration of DME Systems.

- Inertia Navigation System (INS) / Inertia Reference System (IRS)
- Suppressor Link / Suppression Line
- Autoflight / Autopilot System
- Flight Management Systems (FMS)
- Audio Identification
- Military
  - Tactical Air Navigation (TACAN) System
  - VOR / TACAN (Vortac) System

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## 11. Operational Checks and Fault Isolation

### 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 the tasks of *DME Operational Checks, 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 task.

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

- Fail Flags
- Proper channeling by VOR receiver

## VI. Automatic Direction Finder (ADF) System

### 12. General

#### NCATT 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 *Automatic Direction Finder (ADF) 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 ADF systems.

- Modulation & Frequencies
- Beat Frequency Oscillator (BFO)
- Limitations
  - Night Effect
  - Coastal Effect
  - Attitude Error
  - Quadrantal Error
- Broadcast Station (transmitter location)

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## 13. Tie-In/Integration NCATT 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 *ADF System Tie-In/Integration*.

As general information, the following terms and components are *typically* associated with tie-in and integration of ADF Systems.

- Remote ADF Indicator
- Radio Magnetic Indicator (RMI)
- Horizontal Situation Indicator (HSI)
  - Bearing Pointer
- Electronic Flight Instrument (EFIS)
  - Bearing Pointer

## 14. ADF Operational Checks and Fault Isolation - 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 the tasks of *ADF 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 task.

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

- Use of ILS Compass Locator
- Use of NDB Station
- Use of local AM Radio Station
- Audio Quality Checks
- In-flight Interference / P-static
  - Grounding / Bonding
  - Wicks

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## VII. Instrument Landing System (ILS)

### 15. General

#### NCATT 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 *Instrument Landing System (ILS)* and be able to recognize and use terminology related to this subject.

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

- ILS Components (Transmitter / Receiver)
  - Localizer
  - Glideslope
  - Marker Beacon
- Modulation & Frequencies
  - Paired Frequency Relationships
- Airport Lighting
  - Approach Lights
  - Runway Edge Lights
  - Touchdown Zone Lights
  - Lighted Centerline
  - Roll Bars
- ILS Categories
  - Category I
  - Category II
  - Category IIIa
  - Category IIIb
  - Category IIIc

### 16. Tie-In/Integration

#### NCATT 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 *Instrument Landing System Tie-In/Integration*.

As general information, the following terms and components are *typically* associated with tie-in and integration of ILS Systems.

- Autoflight / Autopilot Systems
- Flight Management Systems
- Radar Altimeter
- Audio System
  - Marker Beacon
  - ILS Audio
- Flight Displays

# NCATT Dependent Navigation Systems Standard Subject, Performance and Task Knowledge Requirements

## 17. Operational Checks and Fault Isolation

### 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 the tasks of *ILS Operational Checks, 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 task.

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

- Prop or Rotor Modulation
- ILS Components
  - Nav Receivers
  - Nav Indicators
    - HSI
    - RMI
- Multi-Mode Receivers (MMR) w/GPS ILS
- Test Equipment (Unique)
- BITE