Federal Aviation Administration

Initial En Route Qualification Training

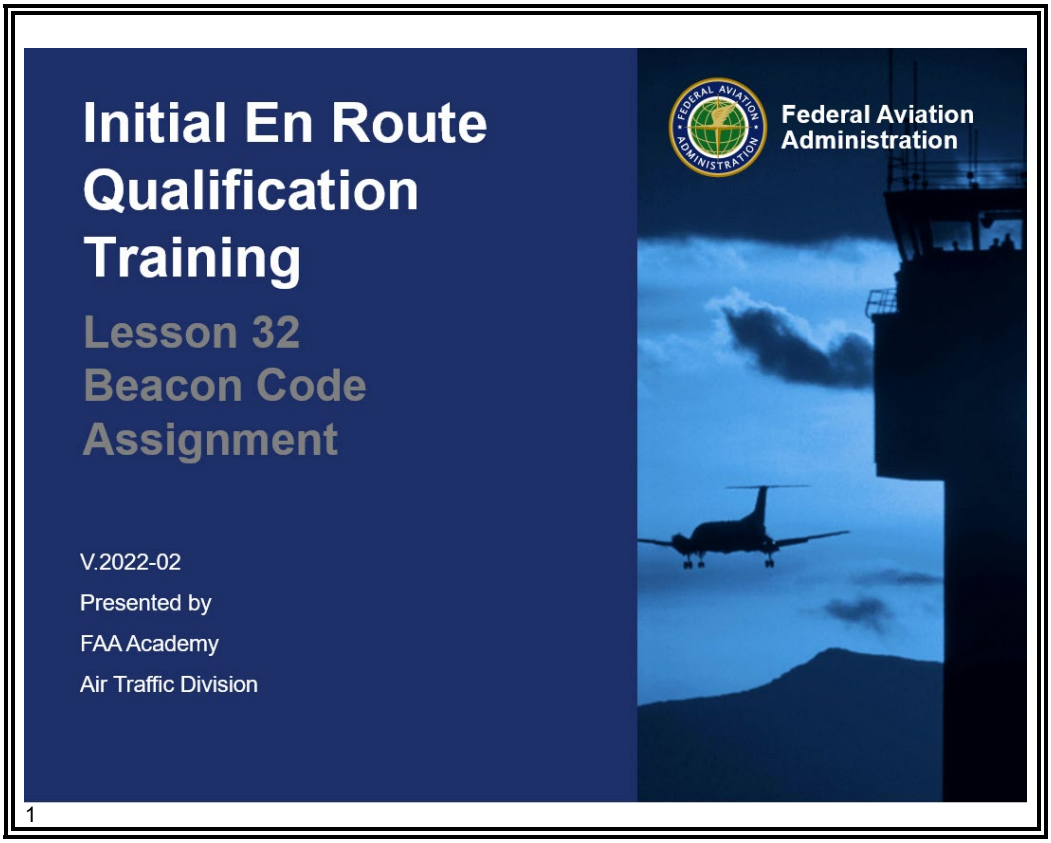
Lesson 32
Beacon Code Assignment Procedures

Course 50148001

LESSON PLAN DATA SHEET

COURSE NAME:	INITIAL EN ROUTE QUALIFICATION TRAINING
COURSE NUMBER:	50148001
LESSON TITLE:	BEACON CODE ASSIGNMENT
DURATION:	1+45 HOURS
DATE REVISED:	2022-02
VERSION:	V.2022-02
REFERENCE(S):	FAA ORDERS JO 7110.65, AIR TRAFFIC CONTROL, JO 7110.66, NATIONAL BEACON CODE ALLOCATION PLAN; N7110.422; ETM 12-0-1, FUNDAMENTALS OF PRIMARY AND SECONDARY SURVEILLANCE RADAR; AND FAR, PART 91.215, ATC TRANSPONDER AND ALTITUDE REPORTING EQUIPMENT AND USE
HANDOUT(S):	NONE
EXERCISE(S)/ ACTIVITY(S):	NONE
END-OF-LESSON TEST:	YES
PERFORMANCE TEST:	NONE
MATERIALS:	NONE
OTHER PERTINENT INFORMATION:	APPENDIX INCLUDES FAR, PART 91.215, ATC TRANSPONDER AND ALTITUDE REPORTING EQUIPMENT AND USE

INTRODUCTION

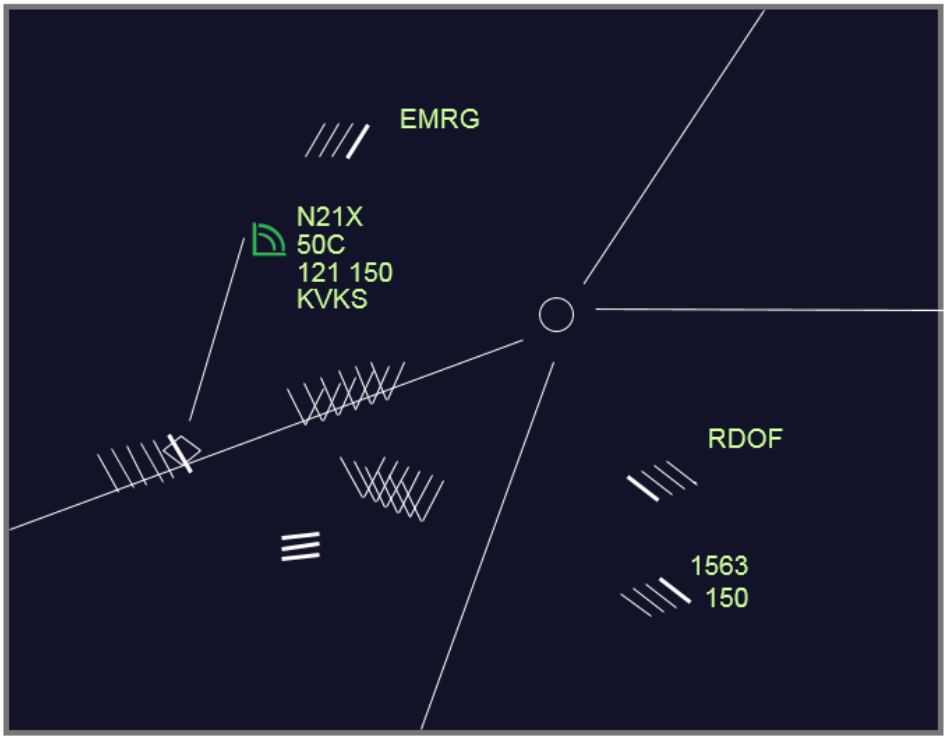


A thorough knowledge of the authorized beacon code assignment criteria as well as related computer message input requirements is essential to assign codes using correct procedures.

Knowing the phraseology for assigning codes and issuing advisories relating to beacon code equipment is necessary to communicate with pilots.

INTRODUCTION *(Continued)*

BEACON CODE ASSIGNMENT



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During World War II, the British developed a top-secret transceiver that responded to a radar-interrogating signal by sending back a coded transmission. A code would allow the land-based radar station to distinguish British from German aircraft on their radar screen. The British code-named the system PARROT. The United States Army Air Forces version of the system was called IFF, for Identification Friend or Foe.

The PARROT system was designed to prevent a clever German ruse. The Germans were joining in the stream of British night bombers returning to England. They were waiting until the bombers were most vulnerable, just prior to landing, and then shooting them down. PARROT allowed detection of these German aircraft, since their primary return would **not** have a distinctive code.

Only 10 codes were available, and they were changed daily. The aircraft would be directed to “squawk your parrot,” meaning to turn on the set for identification; or to “strangle your parrot” as a directive for turning the set to standby. The term “squawk” remains in use today, a reminder of those early days of aircraft identification.

INTRODUCTION *(Continued)*

Purpose

This lesson covers the National Beacon Code Allocation Plan (NBCAP) as well as FAR, Part 91.215, 91.225 and 91.227, which explains aircraft transponder, Mode C, and ADS-B requirements.

Lesson Objectives

LESSON OBJECTIVES

- On an End-of-Lesson Test and in accordance with FAA Orders JO 7110.65 and JO 7110.66 and FAR, Part 91.215, 91.225, and 91.227, you will identify:
  - ATC transponder and altitude reporting equipment requirements and use
  - Beacon code assignment requirements and procedures

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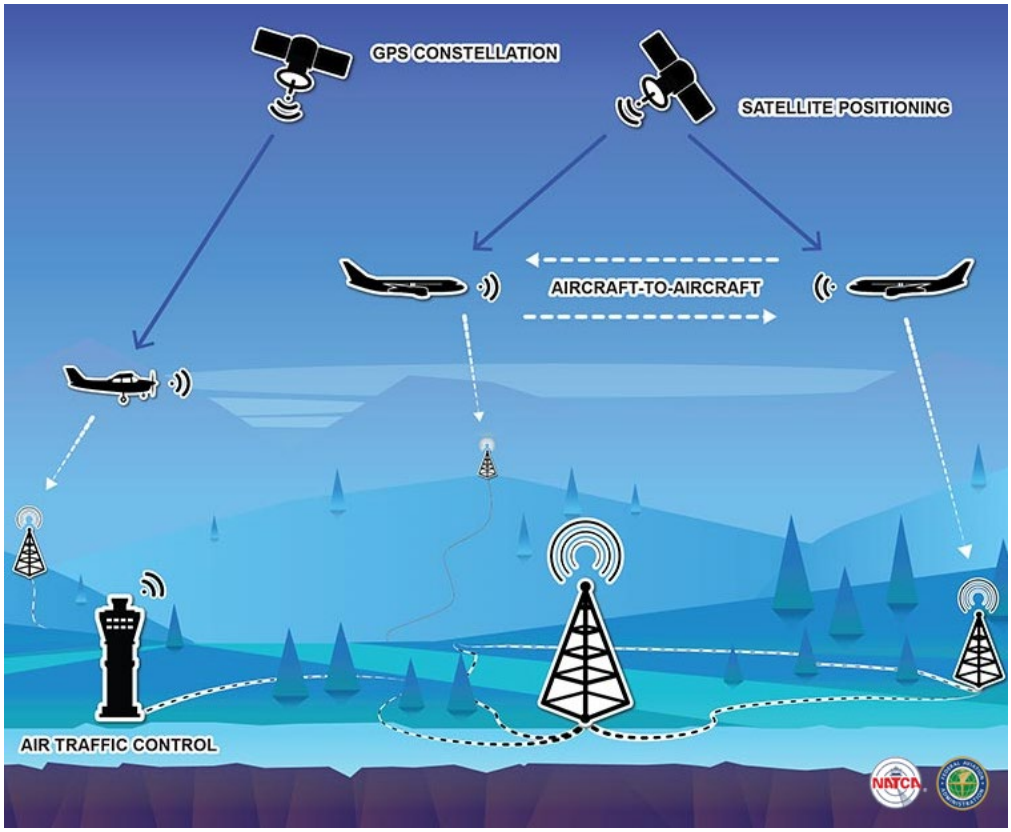
AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B)

ADS-B



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Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance system in which an aircraft to be detected is fitted with a data link transmitter. The aircraft periodically broadcasts its Global Positioning System (GPS) − derived position, call sign, velocity, and other information over the data link. The information is received by a radio station for processing and display at an air traffic control facility.

ADS-B FAILURES

ADS-B Failures
7110.65 5-2-25, 5-2-26

⊙ Inform an aircraft when the ADS-B transmitter appears to be inoperative or malfunctioning. Notify the OS/CIC of the aircraft call sign and location of aircraft.

✈ **Phraseology**

"(Aircraft ID) YOUR ADS-B TRANSMITTER APPEARS TO BE INOPERATIVE / MALFUNCTIONING."

⊙ Call Sign Miss-Match (CSMM). A CSMM alert will occur when the ADS-B broadcast call sign does not match the flight plan call sign.

✈ **Phraseology**

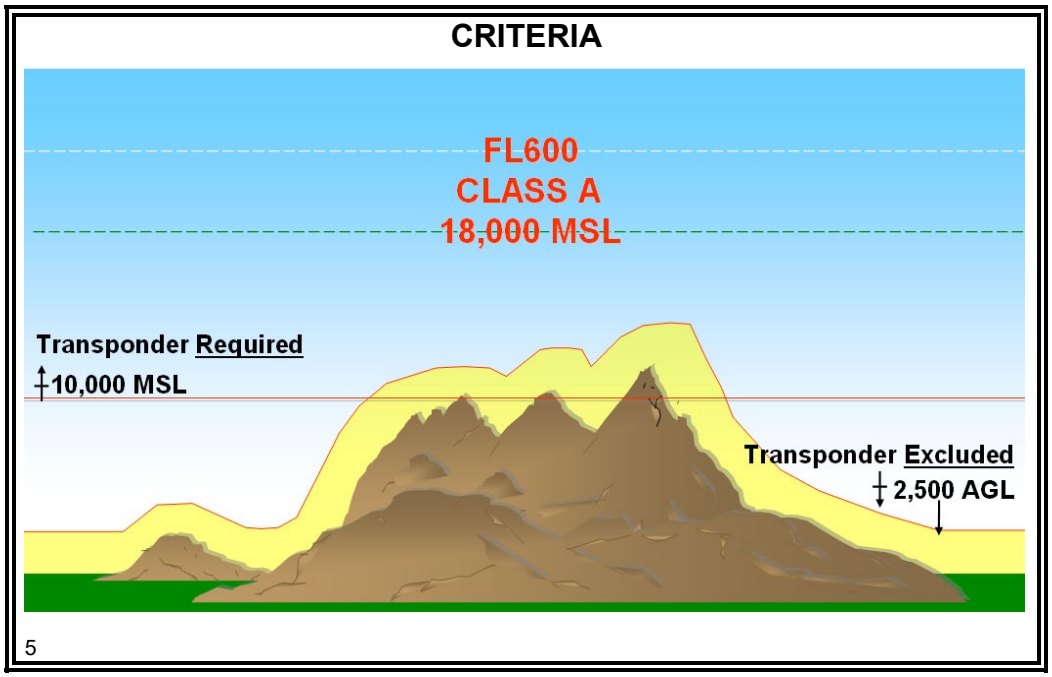
"(Aircraft ID) YOUR ADS-B CALL SIGN DOES NOT MATCH YOUR FLIGHT PLAN CALL SIGN."

⊙ Duplicate ICAO Address. If the broadcast ICAO address is shared with one or more flights in the same ADS-B Service Area (regardless of altitude), and radar reinforcement is not available, target resolution may be lost on one or both targets. Notify the OS/CIC of the aircraft call sign and locations of aircraft.

NOTE: Duplicate ICAO Address Alerts appear as "Duplicate 24-bit Address" on ERAM systems.

ATC TRANSPONDER AND ALTITUDE REPORTING EQUIPMENT/USE

Criteria
FAR, Part 91.215, 91.225, 91.227



- Aircraft **must** be equipped with an operable transponder with altitude reporting capability and appropriate ADS-B equipment:
  - At and above 10,000 feet MSL and below floor of Class A airspace, excluding at and below 2,500 feet Above Ground Level (AGL)
  - In Class A, B, and C airspace

NOTE: Other criteria are covered in later stages of training.

Failures

- If the Mode C, transponder, or ADS-B fails between 10,000 MSL and 18,000 MSL,
  - You **must** advise a manager and verbally coordinate with the next controller to forward a transponder/Mode C status report prior to control transfer.
- If the Mode C, transponder, or ADS-B fails at or above 18,000 MSL
  - You must advise a manager and coordinate with the next controller to obtain approval for the aircraft to enter that sector.

ATC TRANSPONDER AND ALTITUDE REPORTING EQUIPMENT/USE *(Continued)*

Knowledge Check

KNOWLEDGE CHECK

QUESTION: What equipment is required for all aircraft operating at or above 10,000 feet or within Class B airspace?

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BEACON CODE ASSIGNMENT

Mode Definition
JO 7110.65, Pilot/Controller Glossary

📖 A **mode** is the letter or number assigned to a specific pulse spacing of radio signals transmitted or received by ground interrogator or airborne transponder components of the Air Traffic Control Radar Beacon System (ATCRBS).

Radar Beacon Modes
ETM 12-0-1, p. 41; JO 7110.65, Pilot/Controller Glossary

⊙ The radar beacon modes and their applications are:

- Mode 3/A - Military and ATC common use
  - Used by ATC for target tracking and identification
- Mode C – Civil use (ATC – altitude reporting)
- Mode S – Traffic Alert and Collision Avoidance System (TCAS)

NOTE: Although there are other modes, they are **not** utilized by ATC at this time.

Criteria
JO 7110.65, par. 5-2-1

⊙ Assign beacon codes to Mode 3/A-equipped aircraft only.

NOTE: Beacon codes are four digits and consist of only digits 0 through 7.

Discrete Codes Definition
JO 7110.66, par. 5

📖 **Discrete codes** are beacon codes which do **not** end in the numerals “00” (e.g., 0101, 5520, and 6421).

BEACON CODE ASSIGNMENT *(Continued)*

Discrete Code Environment
JO 7110.65, pars. 5-2-1, 5-2-2

⊙ Give first preference to use of discrete codes.

- Issue discrete computer-assigned codes
  - Codes may be modified as required

✈ **Phraseology**

"SQUAWK (code)."

- Make handoffs on the computer-assigned code

Nondiscrete Codes Definition
JO 7110.66, par. 5

📖 **Nondiscrete codes** are beacon codes which end in the numerals "00" (e.g., 0100, 1200).

NBCAP Airspace Definition
JO 7110.65, Pilot/Controller Glossary

📖 **NBCAP Airspace** is the airspace over United States territory located within the North American continent between Canada and Mexico, including adjacent territorial waters outward to abut boundaries of Oceanic Control Areas (CTAs)/Flight Information Regions (FIRs).

NBCAP Concept
JO 7110.66, par. 6

⊙ Each ARTCC computer is allocated discrete codes.

⊙ Primary goals of the NBCAP are to:

- Minimize code changes
- Retain same code from departure to destination

BEACON CODE ASSIGNMENT *(Continued)*

Code Change
JO 7110.65,
pars. 5-2-5, 5-2-9

⊙ Do **not** request a code change until the aircraft is in your area of responsibility unless:

- Specified in a Letter of Agreement
- Coordinated at the time of handoff
- VFR aircraft requests radar services
  - Coordinate as soon as possible after the aircraft is identified and prior to issuing a control instruction or providing a service other than a safety alert/traffic advisory.

NOTE: This prevents inaccurate radar tracking.

Knowledge Check

KNOWLEDGE CHECK

QUESTION: What advantage does a discrete beacon code assignment provide the controller?

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KNOWLEDGE CHECK

QUESTION: What type of beacon code is preferred, discrete or nondiscrete?

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Continued on next page

BEACON CODE ASSIGNMENT *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: Beacon codes that end in other than 00 are _____.

A. discrete

B. nondiscrete

C. mixed

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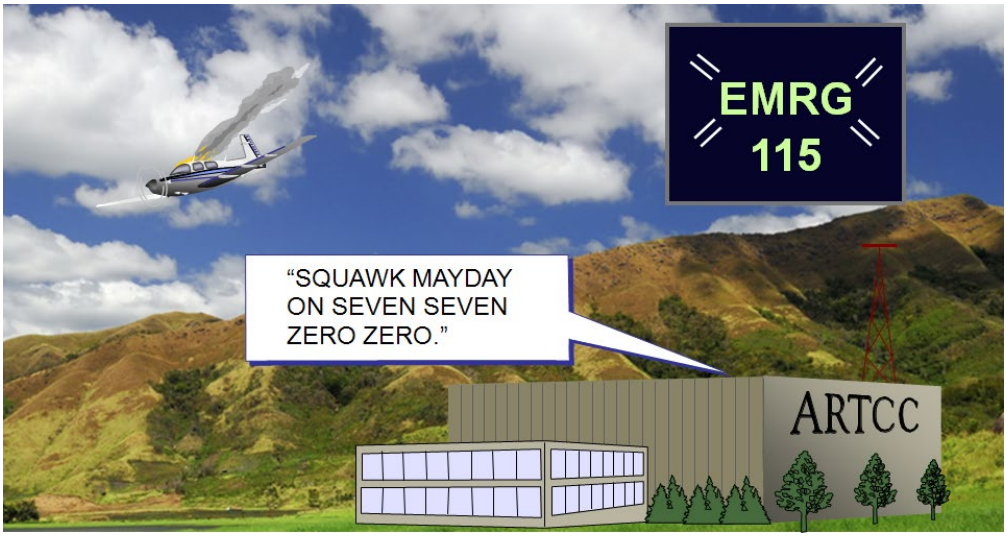
EMERGENCIES AND RADIO FAILURE

Emergency Code 7700
JO 7110.65, par. 5-2-7

EMERGENCY CODE 7700



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⊙ Assign code 7700 if a pilot declares an emergency and is **not** radar-identified.

- "EMRG" blinks in the data block

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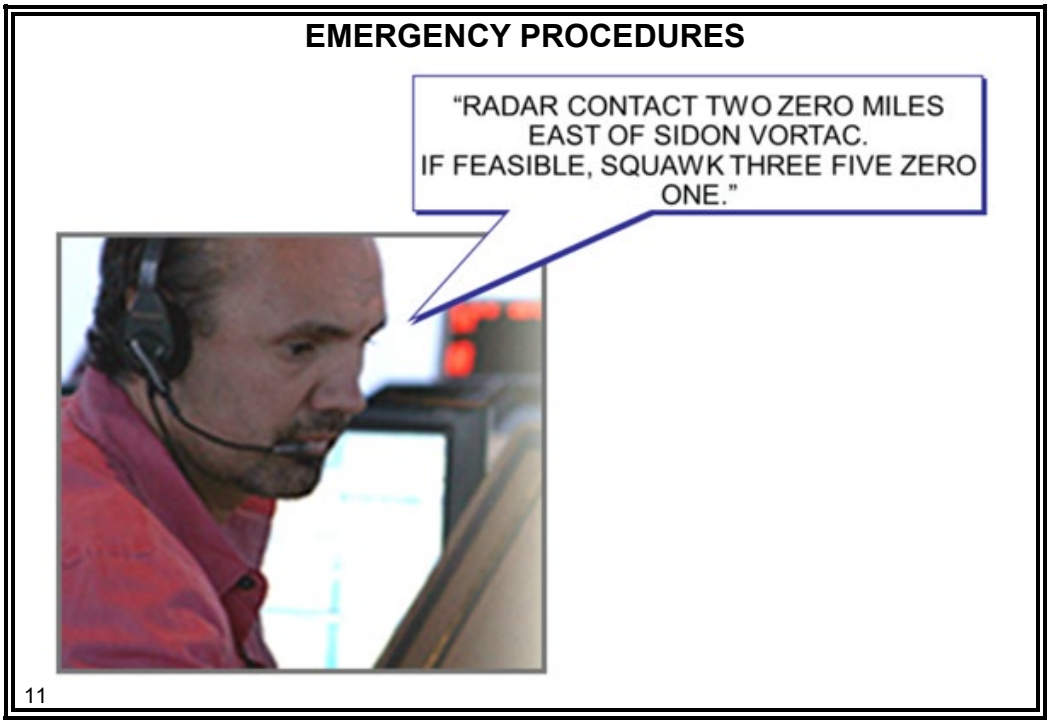
EMERGENCIES AND RADIO FAILURE *(Continued)*

Emergency Code 7700 (Cont'd)
JO 7110.65, par. 5-2-7

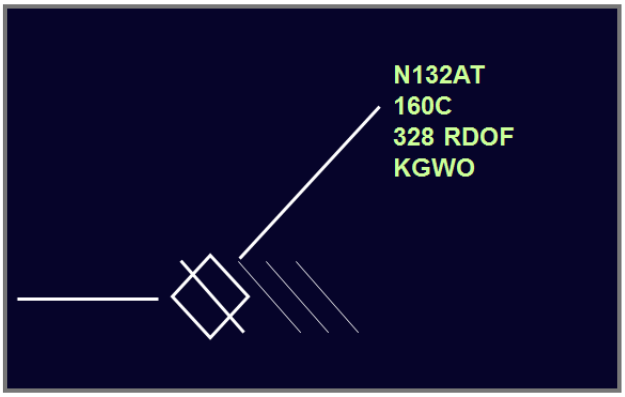


- After radio and radar contact are established, you may request aircraft to change from code 7700 to the appropriate discrete or function code.
  - Code change will signify to other radar facilities that the emergency aircraft is identified and under ATC control.
  - Exception
    - Do **not** request code change from single-piloted helicopters and single-piloted turbojet aircraft.

EMERGENCIES AND RADIO FAILURE *(Continued)*

Radio Failure Code 7600
JO 7110.65, pars. 5-2-8, 10-4-4

RADIO FAILURE CODE 7600



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- Expect pilot to squawk 7600.
  - "RDOF" blinks in the data block
- Controllers **shall** apply lost communications procedures.
  - Use all appropriate means to reestablish communications, such as:
    - Emergency frequencies
    - Voice capability equipped NAVAIDs
    - Flight Service Stations (FSSs)
    - Aeronautical Radio, Incorporated (ARINC)
  - Use transponder or turns to verify receipt of transmissions
    - Accomplished by radar controller

UAS LOST LINK

Unmanned Aircraft Systems (UAS) Lost Link
JO 7110.65, par. 5-2-9

- Code 7400 may be displayed by unmanned aircraft systems (UAS) when the control link between the aircraft and pilot is lost.
- Controllers working airspace with UAS aircraft that observe a 7400 display should:
  - Determine the lost link procedure outlined in a Certificate of Waiver or Authorization (COA)
  - Coordinate as required to allow the lost link procedure to be executed
  - Advise Operations Supervisor
- If you observe or are advised by the UAS pilot that the UAS aircraft is deviating from the programmed Lost Link procedure, or encountering some other anomaly, treat the situation in accordance with FAA Order 7110.65, Chapter 10, par. 10-1-1c (Emergencies.)
- Some UA aircraft (Global Hawk) may not be programmed in NAS Automation to squawk 7400, and will squawk 7600 in the case of a lost link. In these cases, the above procedures will apply.

Knowledge Check

KNOWLEDGE CHECK

QUESTION: The code used to indicate an emergency is _____.

A. 1277

B. 7600

C. 7700

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KNOWLEDGE CHECK

QUESTION: What two types of aircraft continue on the emergency code even after radio and radar contact have been established?

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Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: The code used to indicate a radio failure is ____.

A. 7700

B. 7600

C. 3100

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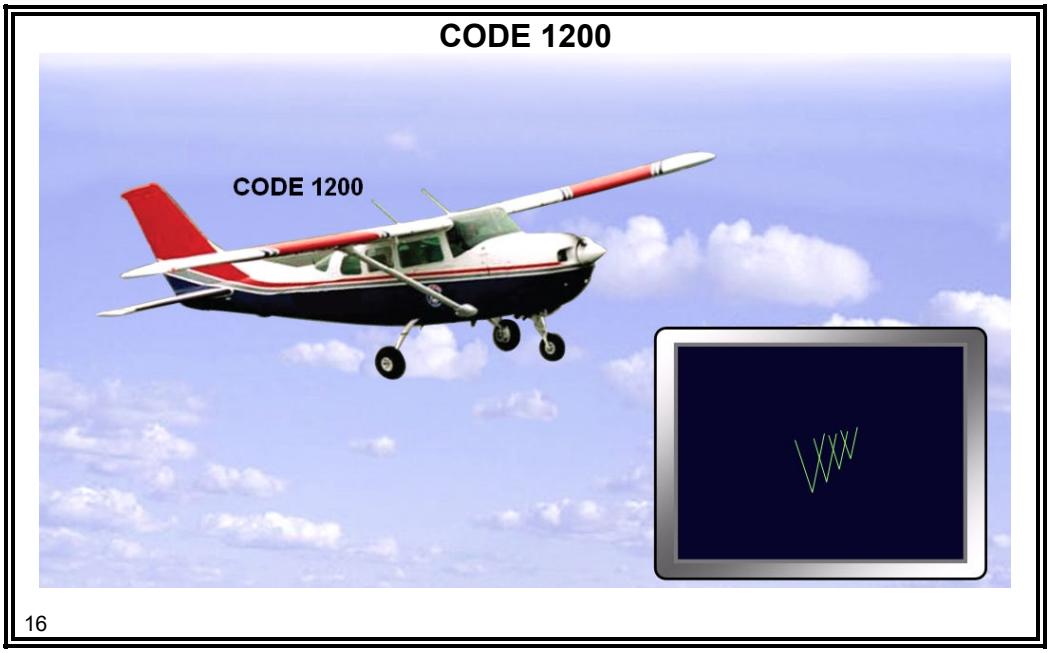
VFR CODE ASSIGNMENT

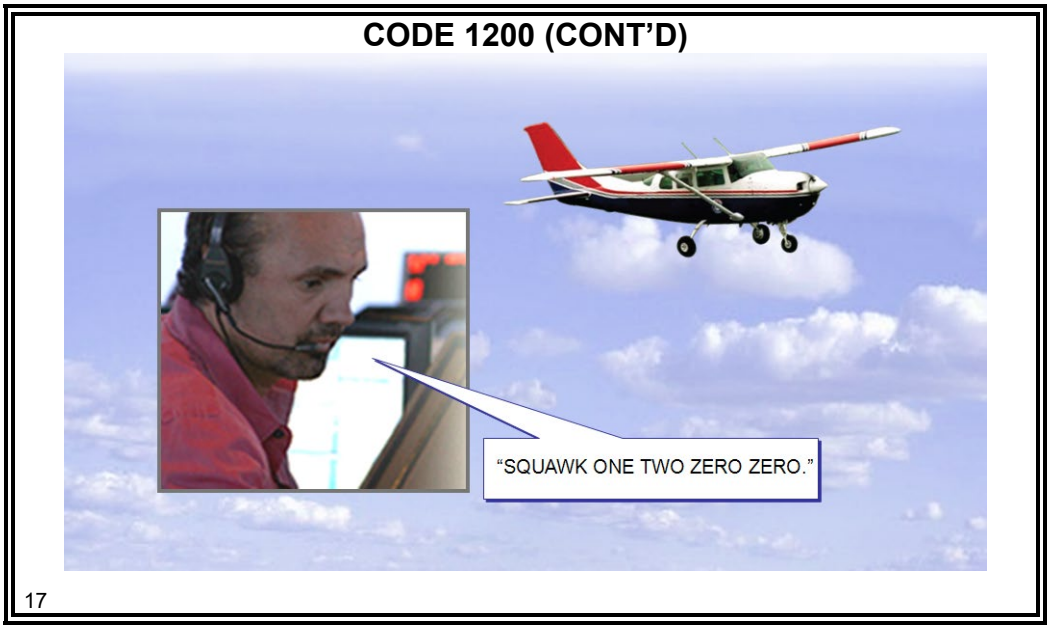
Code 1200
JO 7110.65,
par. 5-2-9



⊙ Issue code 1200 to VFR aircraft when:

- IFR aircraft cancels IFR flight plan and does **not** request radar advisories
- Radar services are being terminated

✈ **Phraseology**



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VFR CODE ASSIGNMENT *(Continued)*

Code 1200 (Cont'd)
JO 7110.65, par. 5-2-10

- When an aircraft changes from VFR to IFR, Mode C aircraft must be assigned a beacon code to allow MSAW alarms.
- Issue computer-assigned codes to VFR aircraft receiving radar advisories.
- VFR aircraft **not** in contact with ATC facilities may squawk:
  - 1202 for Glider operations
  - 1255 while en route to/from/within designated fire fighting area
  - 1277 on Search and Rescue (SAR) missions for United States Air Force (USAF) or United States Coast Guard (USCG) while en route to/from/within designated search areas

NOTE: All 1200 series codes, discrete and nondiscrete, display as VFR aircraft on terminal radar equipment.

BEACON CODE MONITORING

Monitoring Procedures
JO 7110.65, par. 5-2-14

⊙ The radar team **shall** continuously monitor Mode 3/A radar beacon codes assigned for use by aircraft within your area of responsibility, including:

- Code 1200 - VFR aircraft
  - Unless your area of responsibility includes **only** Class A airspace
- Code 1202 - Glider operations
- Code 1255 - Firefighting aircraft
- Code 1277 - Search and Rescue aircraft
- Code 4000 - Fast maneuvering military aircraft
  - At positions of operation that contain a Restricted or Warning Area or VR Route within or immediately adjacent to their area of jurisdiction

NOTE: Codes 1200, 1202, 1255, 1277, and 4000 should be entered into the sector code list by the radar controller.

NOTE: If an assigned beacon code disappears and re-identification is **not** possible, notify your supervisor.

Knowledge Check

KNOWLEDGE CHECK

QUESTION: An aircraft is VFR at 12,500 feet and **not** working an ATC facility. What nondiscrete beacon code should the aircraft squawk?

A. 1000

B. 1200

C. 1400

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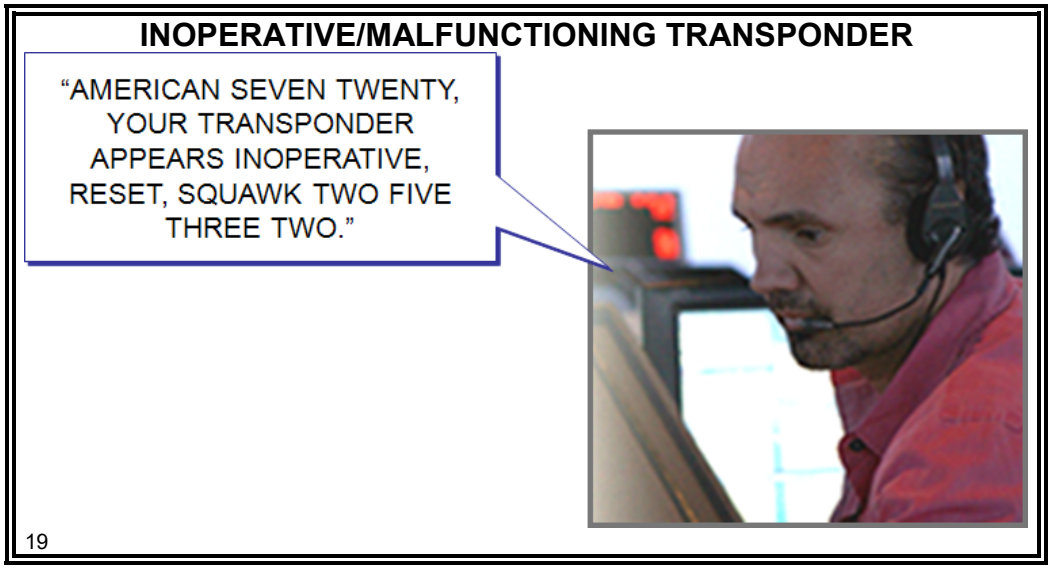
UNUSUAL SITUATIONS

Failure to Display Assigned Beacon Code/ Inoperative/ Malfunction-ing Transponder
JO 7110.65, par. 5-2-15



- Inform aircraft when:
  - Assigned beacon code is **not** being displayed
  - Transponder appears to be inoperative/malfunctioning
- Coordinate with next facility.

AUTOMATIC ALTITUDE REPORTING

Procedure
JO 7110.65,
par. 5-2-21

⊙ Inform an aircraft when you want it to turn on/off the automatic altitude reporting of its transponder.

- **Not** all aircraft have the capability to disengage the altitude squawk independently from the beacon code squawk.

NOTE: Inaccurate or inoperative Mode C may require coordination and/or an equipment suffix update.

Knowledge Check

KNOWLEDGE CHECK

QUESTION: Is it possible for an aircraft to retain the same beacon code from takeoff to touchdown?

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KNOWLEDGE CHECK

QUESTION: Identify what beacon code is used for the following situations:

- IFR aircraft that cancels IFR flight plan and does not request radar advisories
- Radio failure
- SAR aircraft
- Emergency aircraft

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AUTOMATIC ALTITUDE REPORTING *(Continued)*

Knowledge Check (Cont'd)

KNOWLEDGE CHECK

QUESTION: Inaccurate or inoperative Mode C may require _____ and/or _____?

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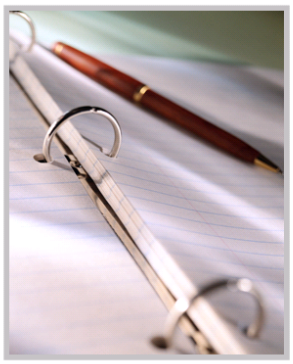
IN CONCLUSION

Lesson Review

LESSON REVIEW

The following topics were covered in this lesson:

- ATC transponder and altitude reporting equipment/use
- National Beacon Code Allocation Plan (NBCAP)
- Beacon Code assignment
- Emergencies and radio failure
- VFR code assignment
- Beacon code monitoring
- Unusual situations
- Automatic altitude reporting



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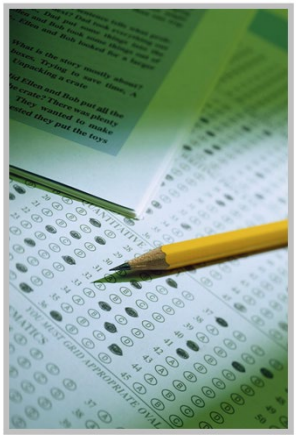
End-of-Lesson Test

END-OF-LESSON TEST

Beacon Code Assignment



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APPENDIX: §FAR, PART 91.215

ATC TRANSPONDER AND ALTITUDE REPORTING EQUIPMENT AND USE

(a) *All airspace: U.S.-registered civil aircraft.* **[**For operations not conducted under part 121, 127 or 135 of this chapter, ATC transponder equipment installed must meet the performance and environmental requirements of any class of TSO-C74b (Mode A) or any class of TSO-C74c (Mode A with altitude reporting capability) as appropriate, or the appropriate class of TSO-C112 (Mode S).**]**

(b) All airspace. Unless otherwise authorized or directed by ATC, no person may operate an aircraft in the airspace described in paragraphs (b)(1) through (b)(5) of this section, unless that aircraft is equipped with an operable coded radar beacon transponder having either Mode 3/A 4096 code capability, replying to Mode 3/A interrogations with the code specified by ATC, or a Mode S capability, replying to Mode 3/A interrogations with the code specified by ATC and intermode and Mode S interrogations in accordance with the applicable provisions specified in TSO C-112, and that aircraft is equipped with automatic pressure altitude reporting equipment having a Mode C capability that automatically replies to Mode C interrogations by transmitting pressure altitude information in 100-foot increments. This requirement applies—

(1) All aircraft. In Class A, Class B, and Class C airspace areas;

(2) All aircraft. In all airspace within 30 nautical miles of an airport listed in appendix D, section 1 of this part from the surface upward to 10,000 feet MSL;

(3) Notwithstanding paragraph (b)(2) of this section, any aircraft which was not originally certificated with an engine-driven electrical system or which has not subsequently been certified with such a system installed, balloon or glider may conduct operations in the air-space within 30 nautical miles of an airport listed in appendix D, section 1 of this part provided such operations are conducted—

(i) Outside any Class A, Class B, or Class C airspace area; and

(ii) Below the altitude of the ceiling of a Class B or Class C airspace area designated for an airport or 10,000 feet MSL, whichever is lower; and

(4) All aircraft in all airspace above the ceiling and within the lateral boundaries of a Class B or Class C airspace area designated for an airport upward to 10,000 feet MSL; and

(5) All aircraft except any aircraft which was not originally certificated with an engine-driven electrical system or which has not subsequently been certified with such a system installed, balloon, or glider—

(i) In all airspace of the 48 contiguous states and the District of Columbia at and above 10,000 feet MSL, excluding the airspace at and below 2,500 feet above the surface; and

(ii) In the airspace from the surface to 10,000 feet MSL within a 10-nautical-mile radius of any airport listed in appendix D, section 2 of this part, excluding the airspace below 1,200 feet outside of the lateral boundaries of the surface area of the airspace designated for that airport.

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APPENDIX: §FAR, PART 91.215 *(Continued)*

(c) *Transponder-on operation.* While in the airspace as specified in paragraph (b) of this section or in all controlled airspace, each person operating an aircraft equipped with an operable ATC transponder maintained in accordance with §91.413 of this part shall operate the transponder, including Mode C equipment if installed, and shall reply on the appropriate code or as assigned by ATC.

(d) ATC authorized deviations. Requests for ATC authorized deviations must be made to the ATC facility having jurisdiction over the concerned airspace within the time periods specified as follows:

(1) For operation of an aircraft with an operating transponder but without operating automatic pressure altitude reporting equipment having a Mode C capability, the request may be made at any time.

(2) For operation of an aircraft with an inoperative transponder to the airport of ultimate destination, including any intermediate stops, or to proceed to a place where suitable repairs can be made or both, the request may be made at any time.

(3) For operation of an aircraft that is not equipped with a transponder, the request must be made at least one hour before the proposed operation.