Federal Aviation Administration

55054003 EN ROUTE RADAR ASSOCIATE CONTROLLER TRAINING PART C: ADVANCED CONCEPTS

Lesson 11: Beacon Code Assignment

Version: 1.0 2022.08

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LESSON PLAN DATA SHEET

Course Name	En Route Radar Associate Controller Training Part C: Advanced Concepts
Course Number	55054003
Lesson Title	Beacon Code Assignment
Duration	1 hour 15 minutes (Includes lesson and ELT)
Version	1.0 2022.08
Reference(s)	JO 7110.65, Air Traffic Control; TI 6110.101, En Route Automation Modernization RA-Position User Manual; JO 7110.66, National Beacon Code Allocation Plan; TI 6110.108, En Route Automation Modernization Quick Reference Card, 14 CFR Part 91, General Operating and Flight Rules; ERAM EDSM SRS 210.04 V1B1; JO 7400.11, Airspace Designations and Reporting Points; NAS-MD-311, Computer Program Functional Specification Message Entry and Checking
Prerequisites	NONE
Handout(s)	NONE
Exercise / Activity	NONE
Scenario Requirements	NONE
Assessments	⊙ YES - Written
Materials and Equipment	⊙ Pencil and/or pen
Other Pertinent Information	⊙ **Ensure lesson materials are downloaded to the classroom computer** ⊙ Appendix: Equipment Suffixes ⊙ This lesson is based on ERAM EAE410 ⊙ The lesson has been reviewed and reflects current orders and manuals as of April 2022

LESSON ICON LEGEND

	Description
	The Activity icon indicates an exercise, lab, or hands-on activity.
	The Discussion Question icon signals a discussion question to be asked to the students.
	The Handout icon indicates a handout is to be distributed to the students.
	The Instructor Note icon is in hidden text and indicates text that is for the instructor only.
	The Multimedia icon indicates a video or audio clip is in the presentation.
	The Phraseology icon indicates that phraseology is in the content.
	The WBT icon indicates a component of web-based training.
	The Click icon indicates a PPT slide with click-based functionality to present additional information.
	The Definition icon indicates a published definition.

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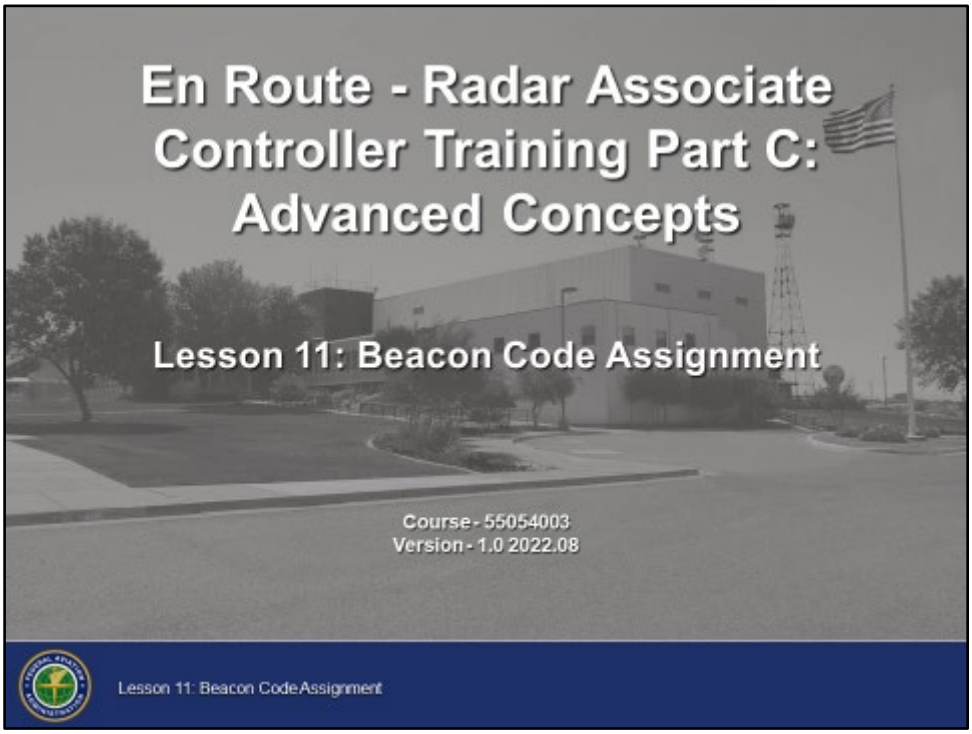
LESSON INTRODUCTION

Overview

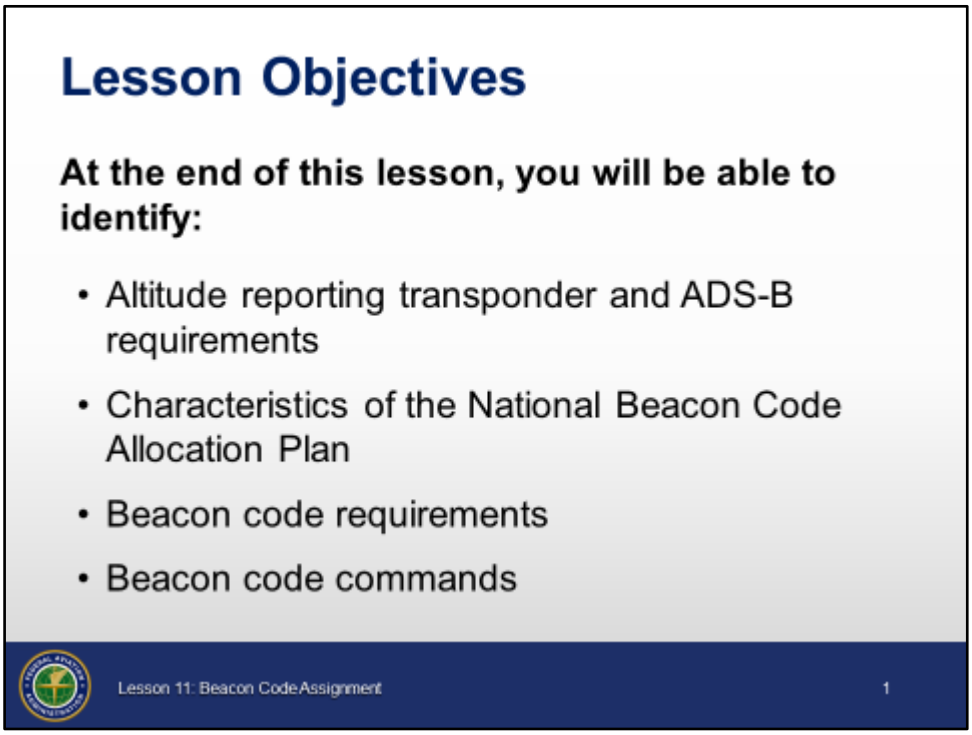


A thorough knowledge of the authorized beacon code assignment criteria and related computer command input requirements will help you to assign beacon codes to aircraft and make computer entries.

This lesson covers: the National Beacon Code Allocation Plan, aircraft transponder and Mode C requirements, aircraft ADS-B Out equipment requirements, phraseology associated with code assignments and for issuing advisories relating to transponder equipment, and command entries associated with beacon code requests and equipment modifiers.

LESSON INTRODUCTION *(CONT'D)*

Lesson Objectives



- At the end of this lesson, you will be able to identify:
  - Altitude reporting transponder and ADS-B requirements
  - Characteristics of the National Beacon Code Allocation Plan
  - Beacon code requirements
  - Beacon code commands

NOTE: There will be a graded end-of-lesson test upon completion of the lesson. The passing score is 70%. If you do not achieve a score of 70%, you will be provided study time and one retake of an alternate end-of-lesson test.

TRANSPONDER AND ADS-B REQUIREMENTS

Transponder and ADS-B Out Requirements

14 CFR 91.215

14 CFR 91.225

14 CFR 91.227

- Some aircraft must be equipped with a transponder and/or Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment
  - Transponder must:
    - Reply to Mode 3/A interrogations with the code specified by ATC
    - Have Mode C altitude reporting capability
    - Be one of the following types:
      - Mode 3/A 4096 code
      - Mode S
  - ADS-B Out equipment must:
    - Broadcast the Mode 3/A transponder code specified by ATC
    - Report pressure altitude
    - Be one of the following types:
      - 1090 ES
      - Universal Access Transceiver (UAT)

Continued on next page

TRANSPONDER AND ADS-B REQUIREMENTS *(CONT'D)*

Transponder and ADS-B Out Requirements (Cont'd)

14 CFR 91.227

- Transponder and ADS-B Out equipment must report pressure altitude information in 100' increments
- Aircraft equipped with both a Mode 3/A or S transponder and ADS-B Out transmitter must derive reported pressure altitude from the same source for each piece of equipment

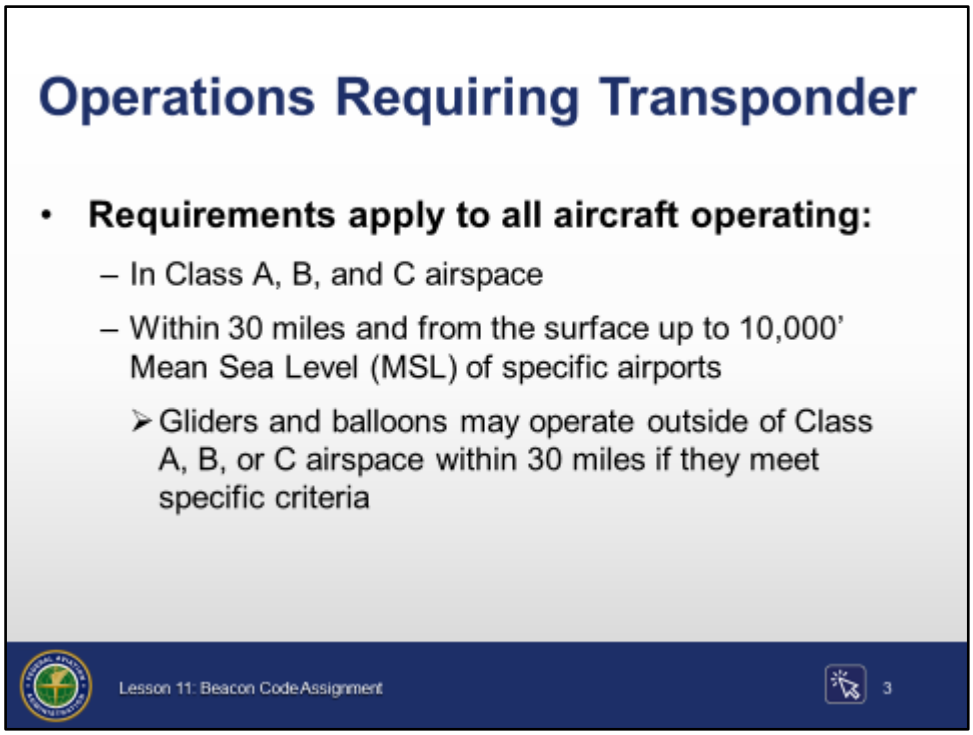
⊙ In addition to beacon and altitude, ADS-B Out equipment must broadcast information including:

- Aircraft's latitude and longitude
- Aircraft's velocity
- The aircraft's call sign that is submitted on the flight plan or the aircraft's registration number, except when the pilot has not filed a flight plan
- If the flight crew has identified an emergency, radio communication failure, or unlawful interference
- The aircraft's IDENT to ATC

NOTE: Aircraft's position and velocity are broadcast at least once per second while airborne or while moving on the airport surface

Operations Requiring Transponder

14 CFR 91.215



⊙ Transponder requirements apply to all aircraft operating:

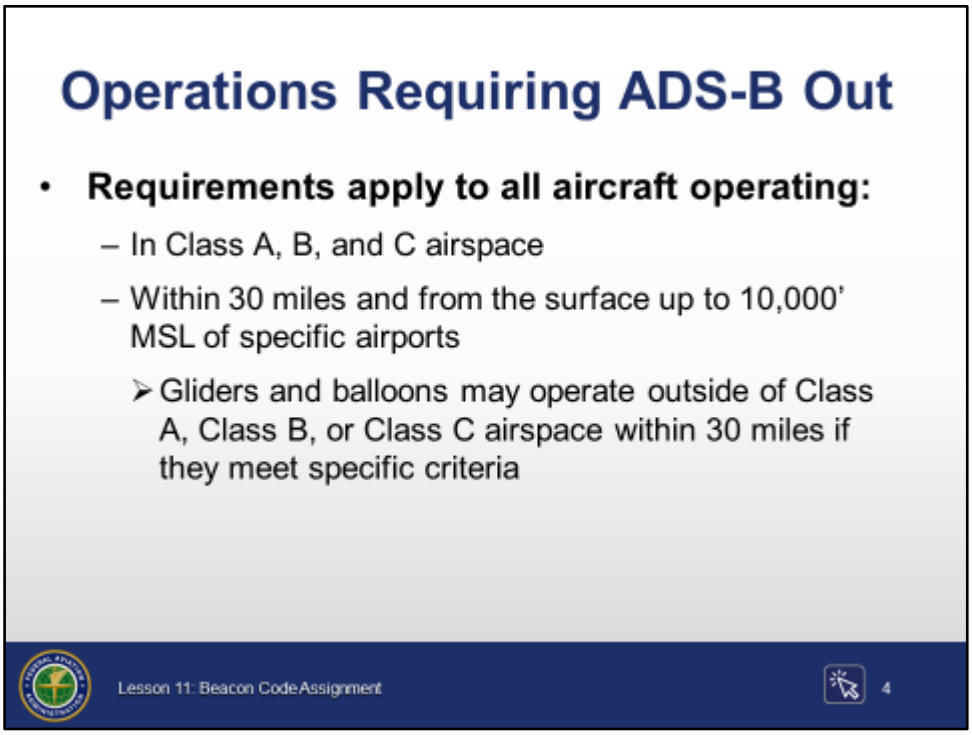
- In Class A, B, and C airspace
- Within 30 miles and from the surface up to 10,000' Mean Sea Level (MSL) of specific airports
  - Gliders and balloons may operate outside of Class A, Class B, or Class C airspace within 30 miles if they meet specific criteria
- Above the ceiling and within the lateral boundaries of Class B or C airspace designated for a specific airport up to and including 10,000' MSL
- In all airspace of the 48 contiguous states and the District of Columbia at and above 10,000' MSL
  - Excluding airspace at and below 2,500' Above Ground Level (AGL)
  - Unless a glider or balloon

TRANSPONDER AND ADS-B REQUIREMENTS *(CONT'D)*

Operations Requiring ADS-B Out

14 CFR 91.225

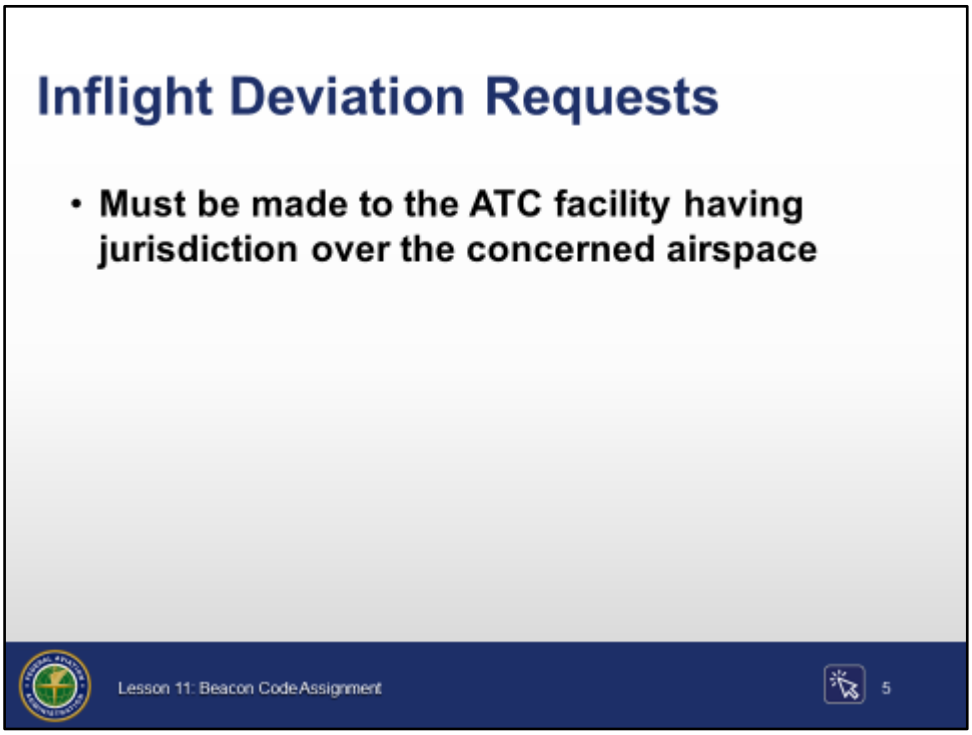
JO 7400.11, sec. 6007



- ADS-B requirements apply to all aircraft operating:
  - In Class A, B, and C airspace
  - Within 30 miles and from the surface up to 10,000' MSL of specific airports
    - Gliders and balloons may operate outside of Class A, Class B, or Class C airspace within 30 miles if they meet specific criteria
  - Above the ceiling and within the lateral boundaries of Class B or C airspace designated for a specific airport up to and including 10,000' MSL
  - Class E airspace within the 48 contiguous states and the District of Columbia at and above 10,000' MSL
    - Excluding airspace at and below 2,500' Above Ground Level (AGL)
    - Unless a glider or balloon
  - In Class E airspace at and above 3,000' MSL over the Gulf of Mexico from the coastline of the United States out to 12 nautical miles

Inflight Deviation Requests

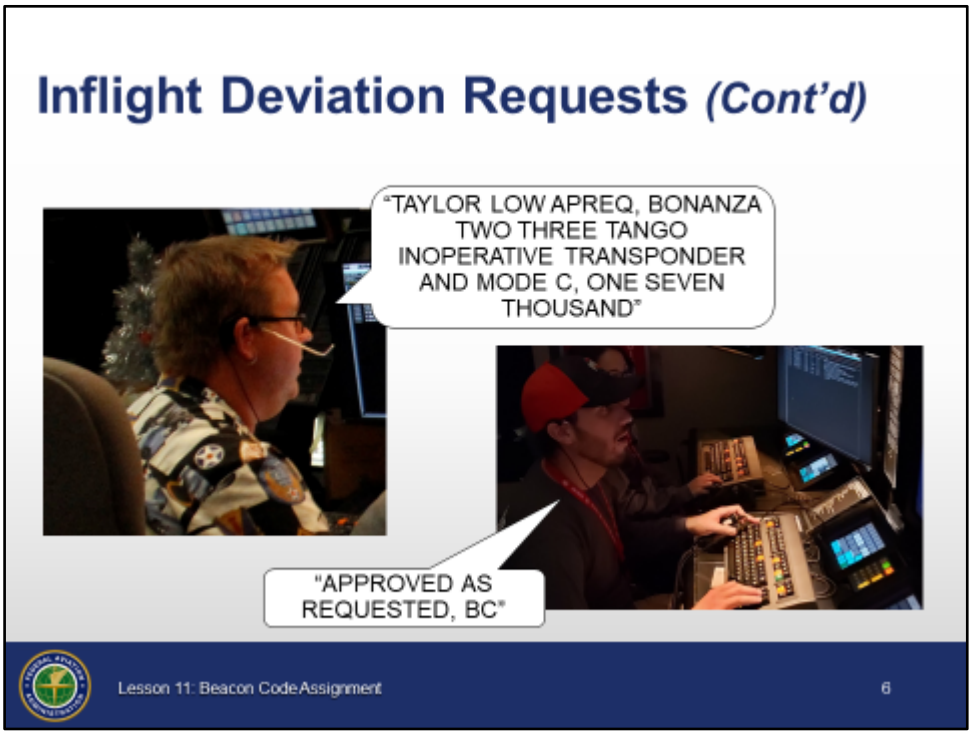
JO 7110.65, par. 5-2-19



- Requests to deviate from the Mode C transponder requirement must be made to the ATC facility having jurisdiction over the concerned airspace
  - For IFR aircraft
    - Without transponder equipment installed:
      - Do not approve, except in an emergency
    - With inoperative transponder:
      - Approve, disapprove, or withdraw previous approval on the basis of traffic and other operational factors
  - For VFR aircraft with an inoperative transponder or Mode C, or not equipped with Mode C, suggest that the aircraft do one of the following:
    - Conduct flight in airspace not affected by 14 CFR Part 91.215
    - File an IFR flight plan
    - Provide a VFR route of flight and maintain radio contact with ATC

Inflight Deviation Requests (Cont'd)

JO 7110.65, par. 5-2-19

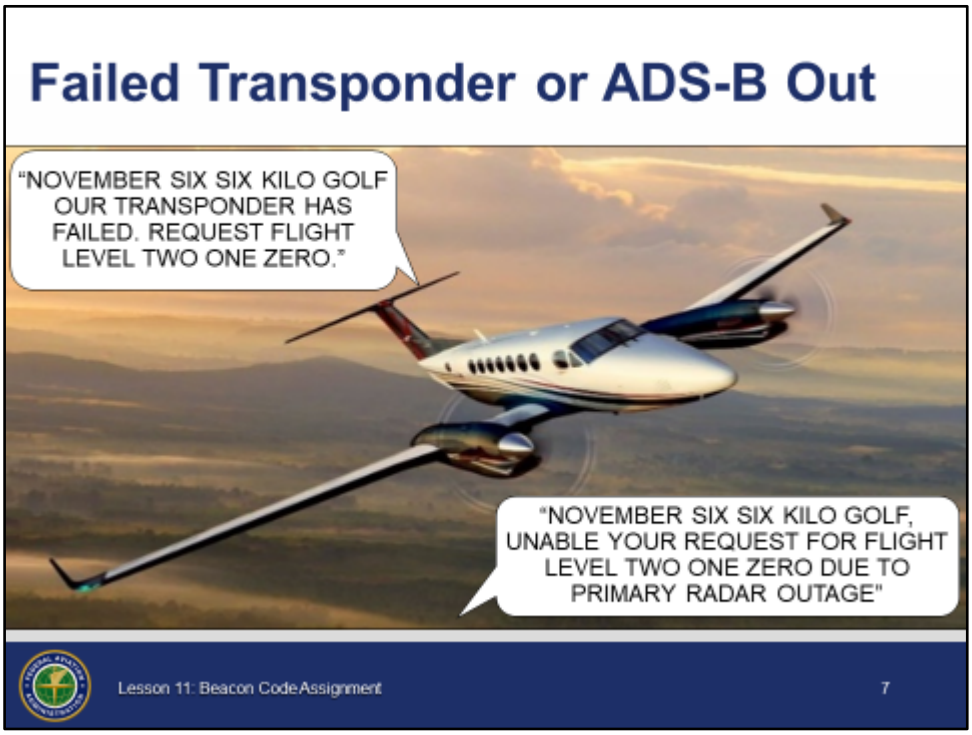


- Approve or disapprove inflight deviation requests within a reasonable period of time or advise when approval or disapproval can be expected
- You may approve an inflight deviation request which includes airspace outside your jurisdiction without the prior approval of the adjacent ATC sector or facility, providing a transponder or Mode C status report is forwarded prior to control transfer
- Do not approve an inflight deviation unless the aircraft has filed an IFR flight plan or a VFR route of flight is provided and radio contact with ATC is maintained

TRANSPONDER AND ADS-B REQUIREMENTS *(CONT'D)*

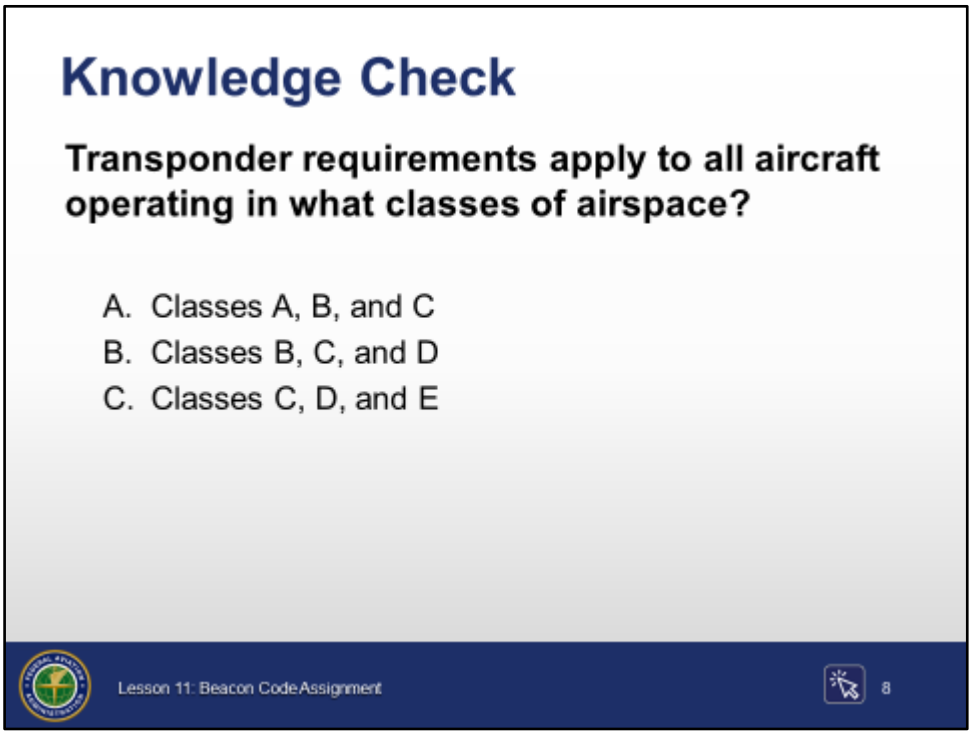
Failed Transponder or ADS-B Out

JO 7110.65, par. 5-2-14



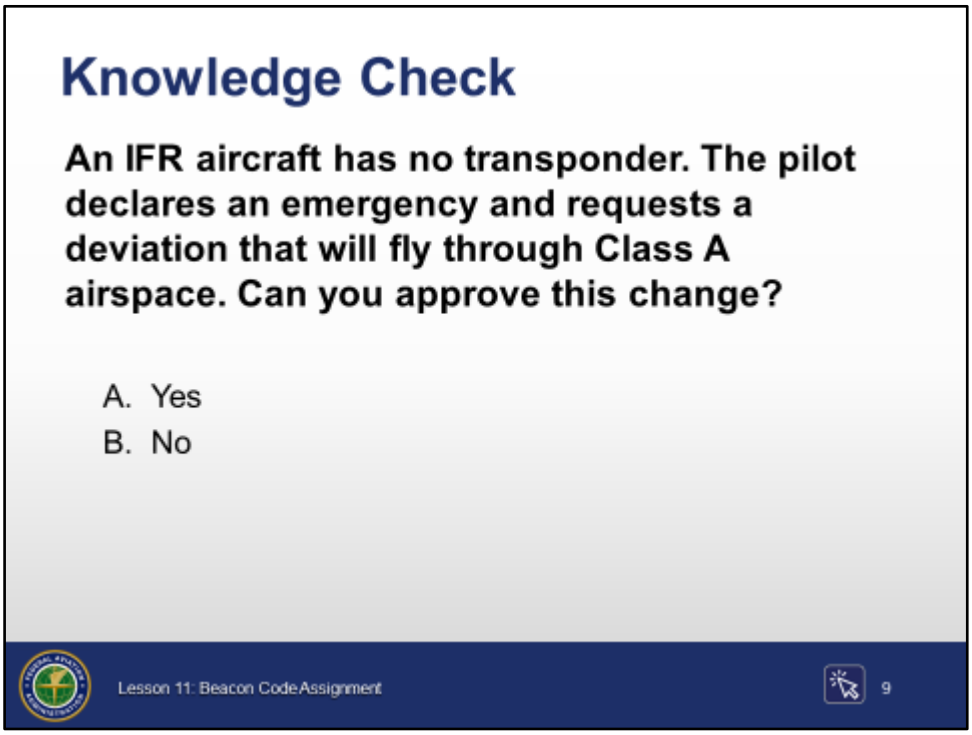
- Disapprove a request or withdraw a previously issued approval to operate with a failed transponder or ADS−B Out on the basis of traffic conditions or other operational factors

Knowledge Check



Question: Transponder requirements apply to all aircraft operating in what classes of airspace?

Knowledge Check



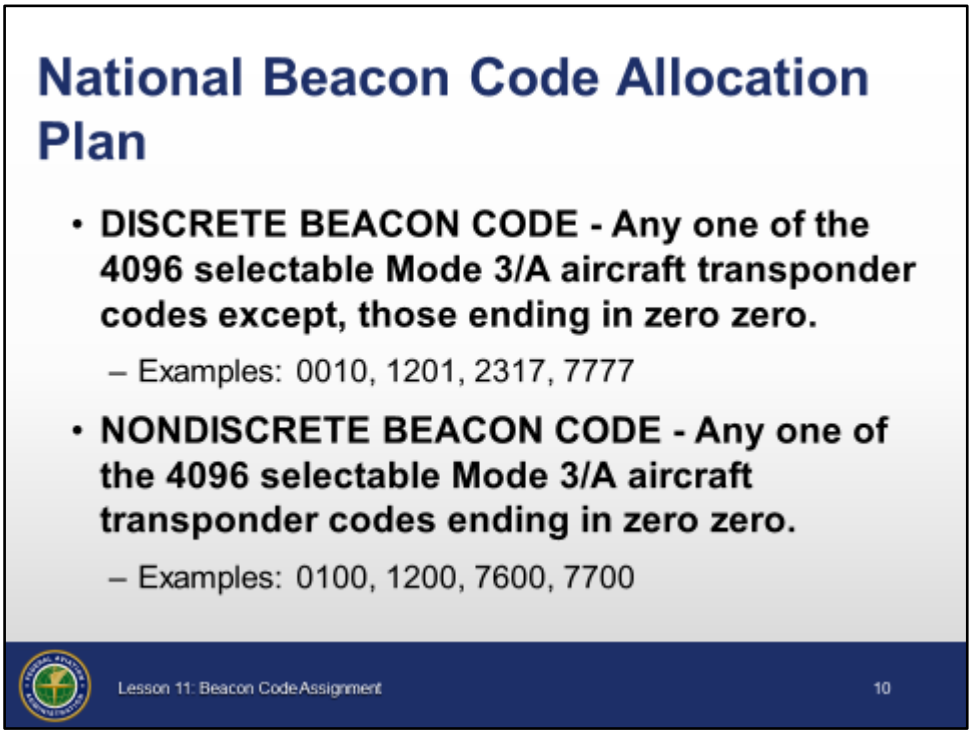
Question: An IFR aircraft has no transponder. The pilot declares an emergency and requests a deviation that will fly through Class A airspace. Can you approve this change?

NATIONAL BEACON CODE ALLOCATION PLAN

National Beacon Code Allocation Plan

JO 7110.66, pars. 6, 11

JO 7110.65, PCG



DISCRETE BEACON CODE - Any one of the 4096 selectable Mode 3/A aircraft transponder codes, except those ending in zero zero.

Examples: 0010, 1201, 2317, 7777

- Beacon codes are octal and use only digits 0-7.

NONDISCRETE BEACON CODE - Any one of the 4096 selectable Mode 3/A aircraft transponder codes ending in zero zero.

Examples: 0100, 1200, 7600, 7700

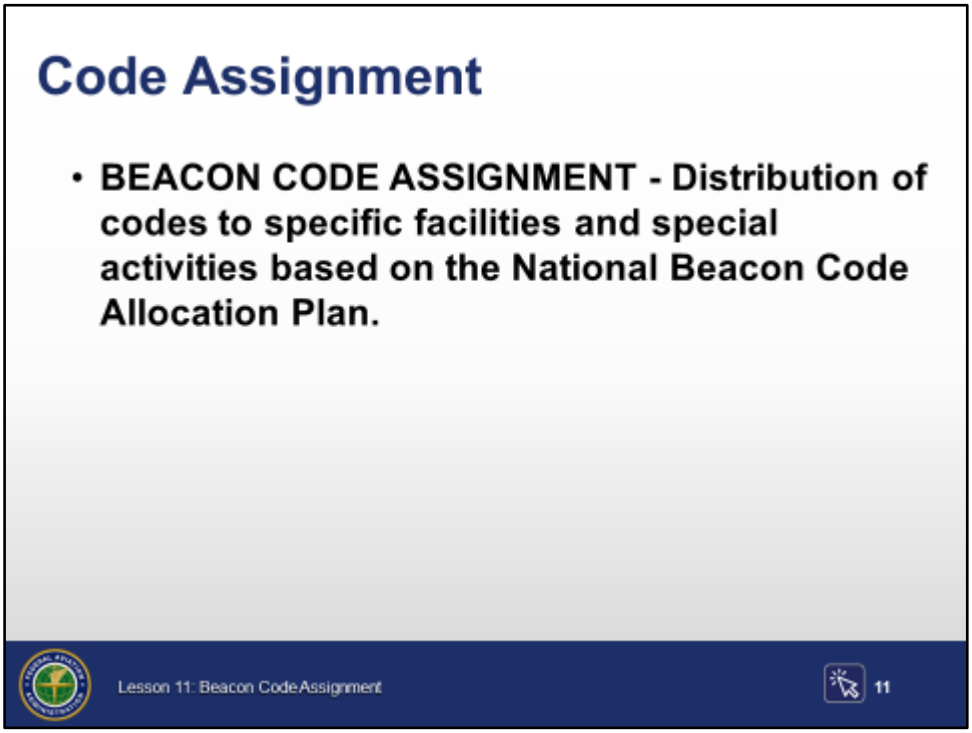
- The National Beacon Code Allocation Plan should allocate ARTCCs enough discrete beacon codes to allow all aircraft to proceed from departure to destination using the same discrete code
  - Minimizes code changes

NATIONAL BEACON CODE ALLOCATION PLAN
(CONT'D)

Code Assignment

JO 7110.65, par. 5-2-1

JO 7110.66, par. 11



BEACON CODE ASSIGNMENT - Distribution of codes to specific facilities and special activities based on the National Beacon Code Allocation Plan.

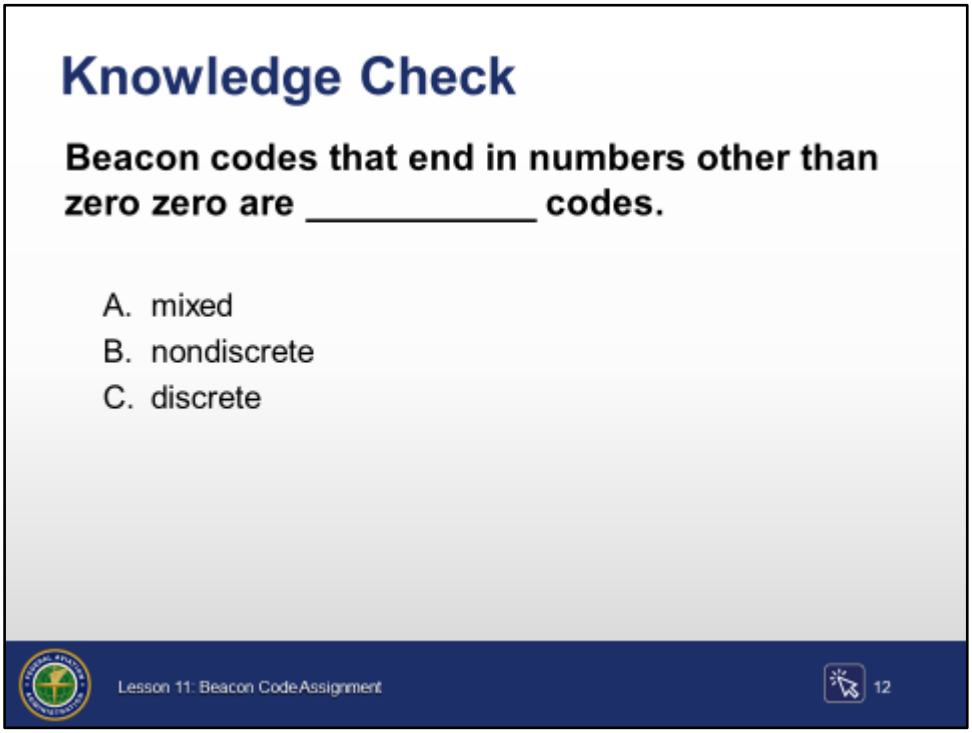
EXTERNAL CODES - Codes reserved for computer assignment to a flight plan with one or more route segments that are not contained within a single domestic ARTCC's airspace.

INTERNAL CODES - Codes reserved for computer assignment to a flight plan where all route segments are contained within a single domestic ARTCC's airspace.

⊙ Discrete beacon codes are assigned by the automation system to a flight plan for external and internal flights

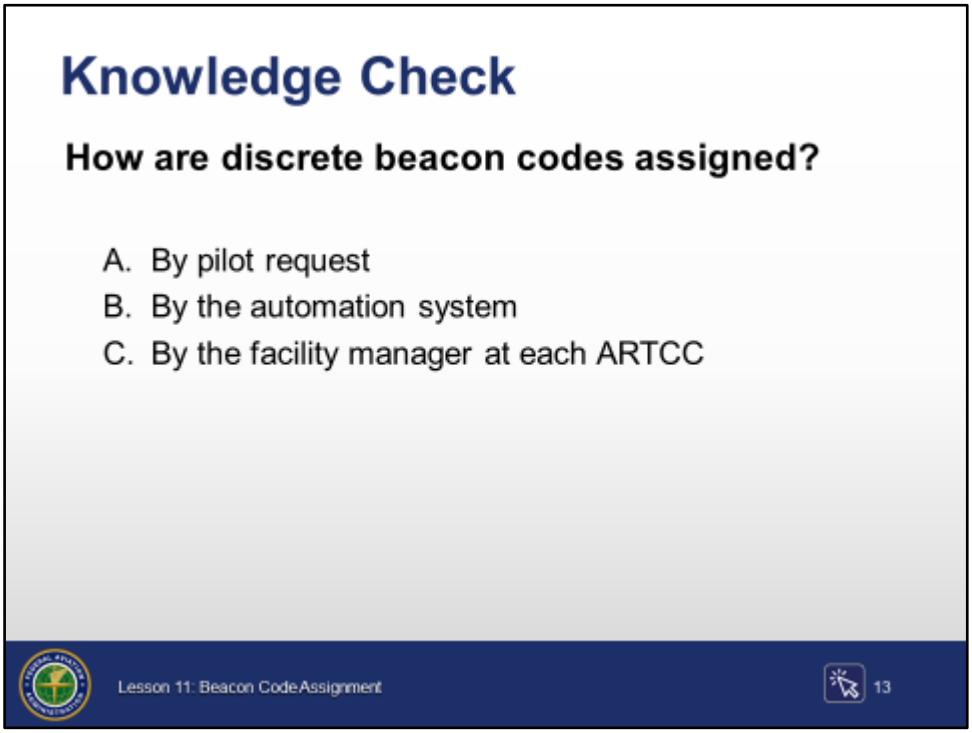
NOTE: It is best to allow the computer to assign the beacon code, except when required by facility directive or LOA, or when an aircraft is experiencing a stuck transponder digit.

Knowledge Check



Question: Beacon codes that end in numbers other than zero zero are _____ codes.

Knowledge Check

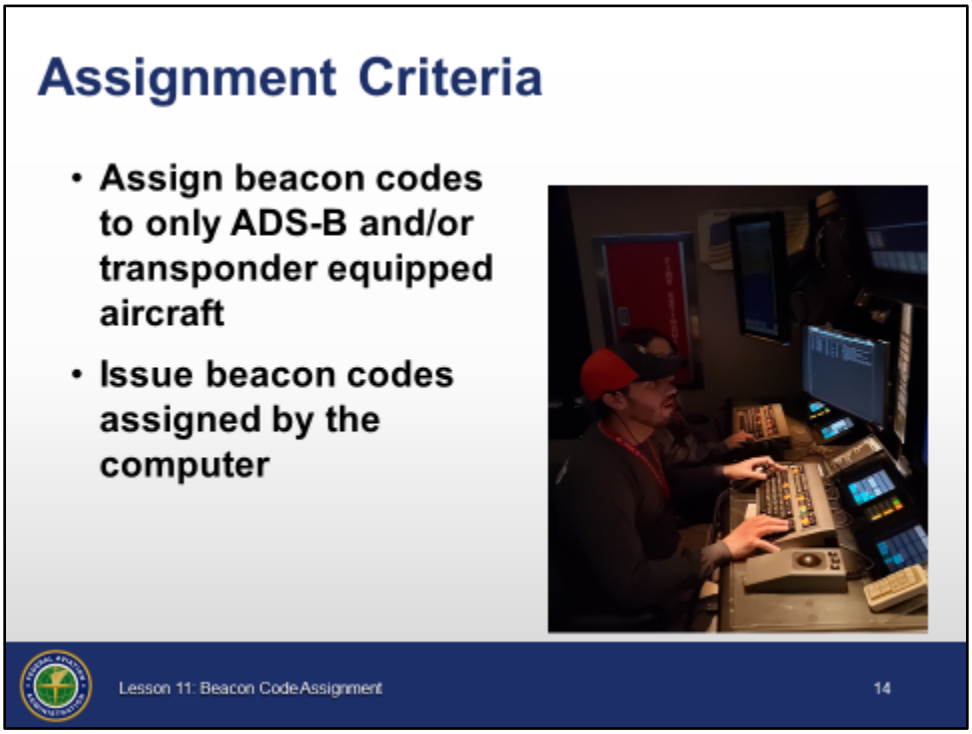


Question: How are discrete beacon codes assigned?

BEACON CODE REQUIREMENTS

Assignment Criteria

JO 7110.65, par. 5-2-1



⊙ Assign beacon codes to only ADS-B and/or transponder-equipped aircraft

- Mode 3/A is the common mode for air traffic control

NOTE: Assigned beacon code is one of the required message elements of an aircraft's ADS-B broadcast.

⊙ Issue beacon codes assigned by the computer

- Facilities may not process alerts properly on non-system generated beacon codes
- Computer-assigned codes may be modified as required

NOTE: The computer will assign only discrete beacon codes unless all the discrete codes allocated to a facility are in use.

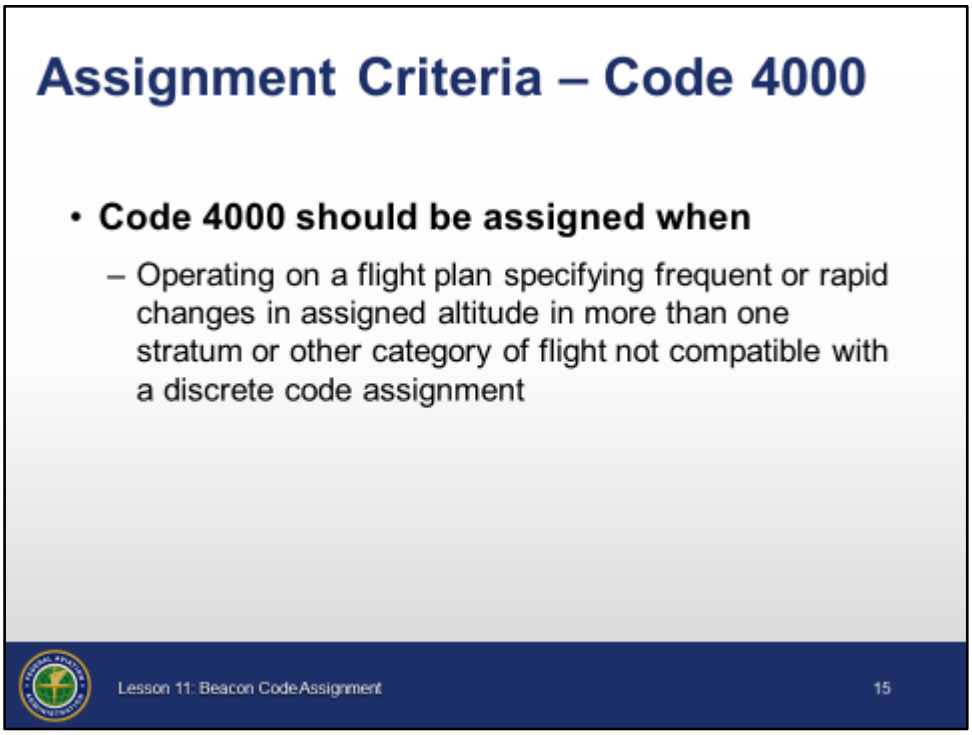
SQUAWK THREE/ALFA (code)

SQUAWK (code)

BEACON CODE REQUIREMENTS *(CONT'D)*

Assignment Criteria - Code 4000

JO 7110.65, par. 5-2-1



⊙ Code 4000 should be assigned when:

- Operating on a flight plan specifying frequent or rapid changes in assigned altitude in more than one stratum or other category of flight not compatible with a discrete code assignment

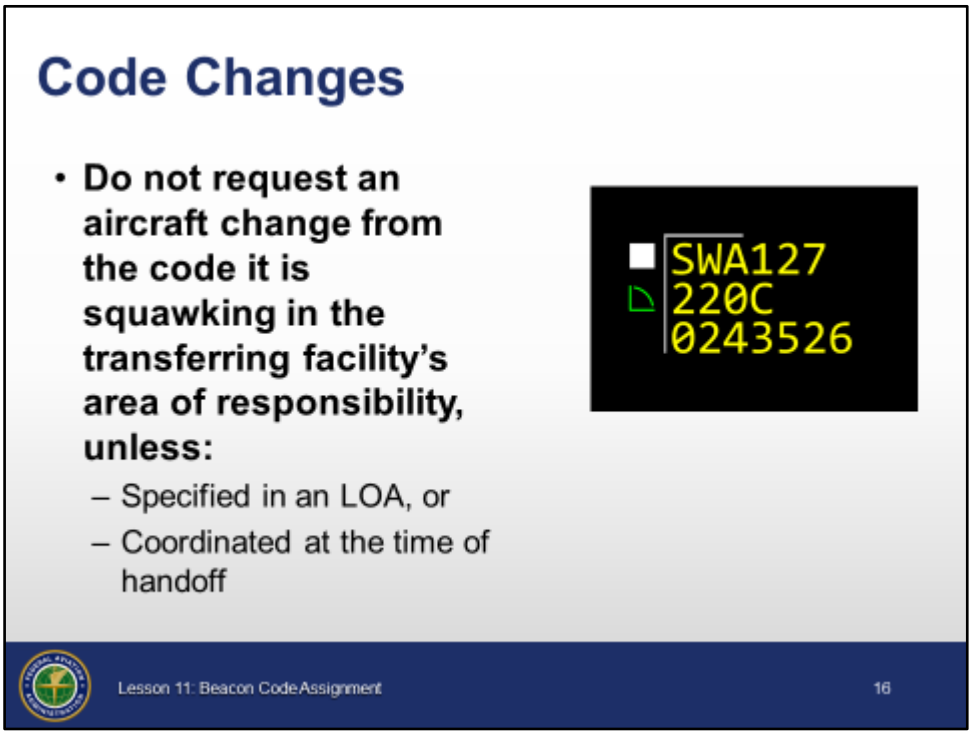
NOTE: Categories of flight that can be assigned Code 4000 include certain flight test aircraft, MTR missions, aerial refueling operations requiring descent involving more than one stratum, ALTRVs where continuous monitoring of ATC frequencies is not required and frequent altitude changes are approved, and other flights requiring special handling by ATC.

Military aircraft operating in restricted/warning areas or on VR routes will squawk 4000 unless another code has been assigned or coordinated with ATC.

BEACON CODE REQUIREMENTS *(CONT'D)*

Code Changes

JO 7110.65, par. 5-2-2



⊙ Do not request an aircraft to change from the code it is squawking in the transferring facility's area of responsibility, unless:

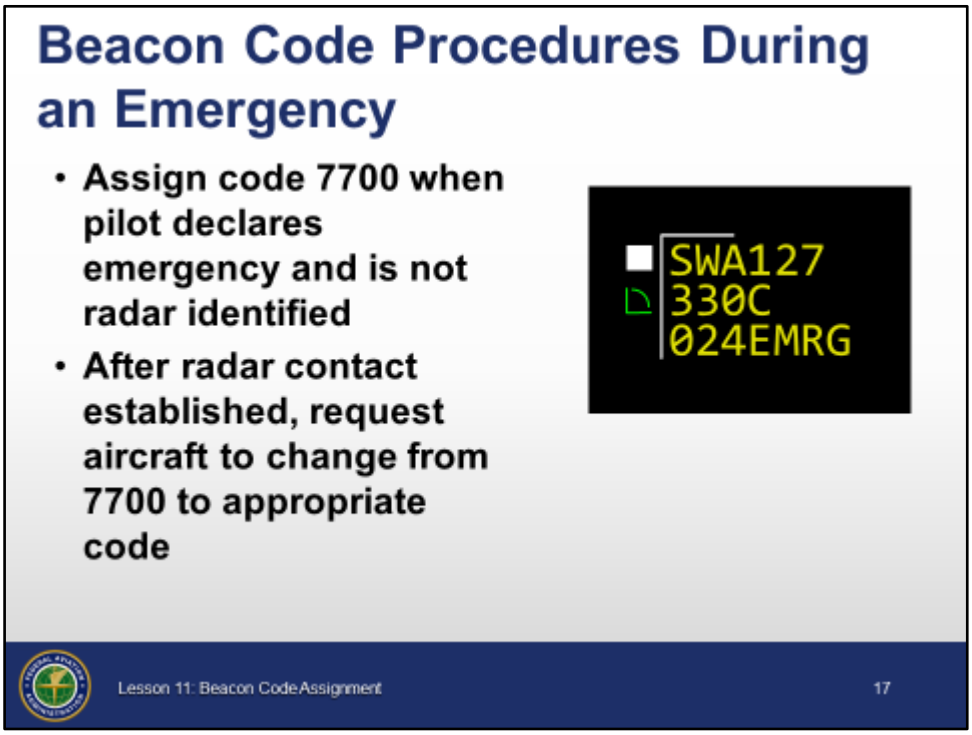
- Specified in an LOA, or
- Coordinated at the time of handoff

BEACON CODE REQUIREMENTS *(CONT'D)*

Beacon Code Procedures During an Emergency

JO 7110.65, par. 5-2-3

TI 6110.100, sec. 5.1.5.16, Table 5-4



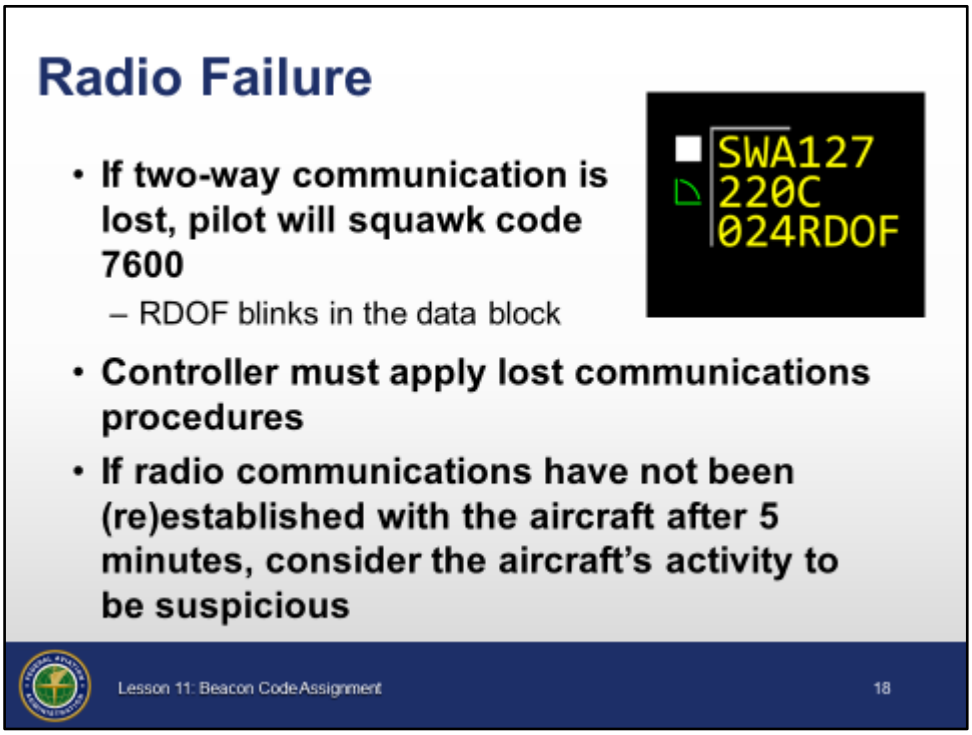
- Assign code 7700 when pilot declares an emergency and is not radar identified
  - Data block will blink EMRG
- After radio and radar contact is established, request aircraft to change from 7700 to appropriate code
  - Request a code change to an appropriate discrete code or function code
  - Leave single-piloted helicopters and single-piloted turbojet aircraft on code 7700
  - Code change will signify to other radar facilities that the emergency aircraft is identified and under ATC control

BEACON CODE REQUIREMENTS *(CONT'D)*

Radio Failure

JO 7110.65, pars. 5-2-4, 10-4-4

TI 6110.100, sec. 5.1.5.16, Table 5-4

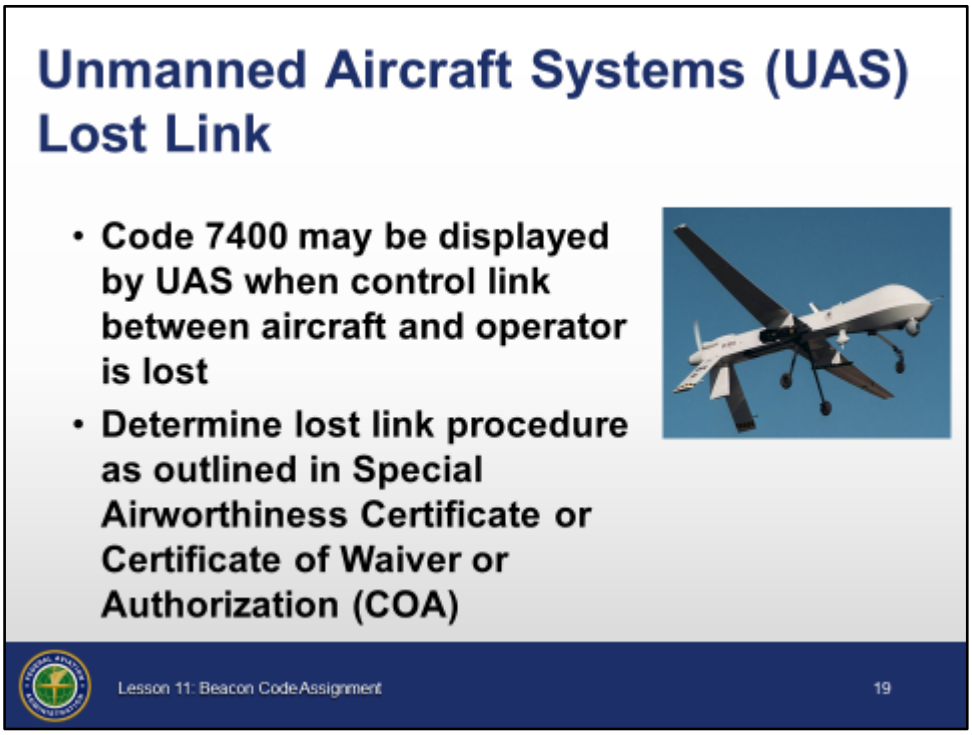


- If two-way communication is lost, pilot will squawk code 7600
  - RDOF blinks in the data block
- Controller must apply lost communications procedures
  - Broadcast clearance through any available means, including:
    - Flight Service Station (FSS)
    - Contract datalink service provider
    - Voice feature of a NAVAID
    - Emergency frequency 121.5 or 243.0 MHz
- If radio communications have not been (re)established with the aircraft after 5 minutes, consider the aircraft's activity to be suspicious
  - Notify supervisor/CIC

BEACON CODE REQUIREMENTS *(CONT'D)*

Unmanned Aircraft Systems (UAS) Lost Link

JO 7110.65, par. 5-2-6



- Code 7400 may be displayed by Unmanned Aircraft Systems (UAS) when the control link between the aircraft and the operator is lost
- When you observe a Code 7400 display, determine lost link procedure as outlined in Special Airworthiness Certificate or Certificate of Waiver or Authorization (COA)
  - Notify supervisor/CIC

NOTE: Some UA airframes (Global Hawk) will not be programmed upon the NAS Automation roll out to squawk 7400. These airframes will continue to squawk 7600 should a lost link occur. The ATC Specialist must apply the same procedures described above.

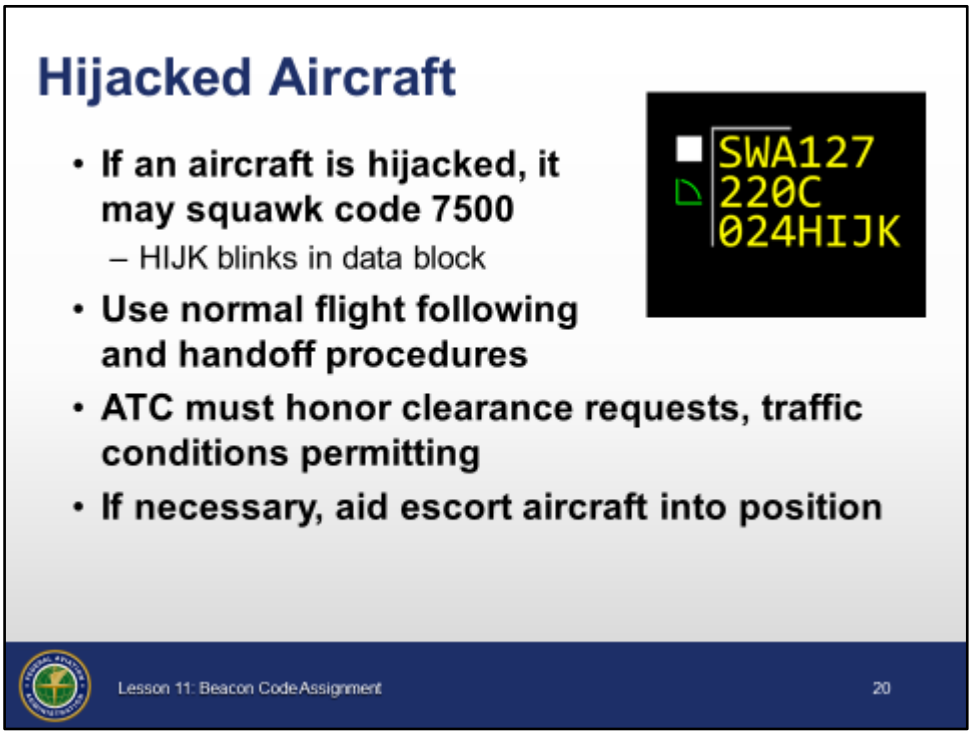
BEACON CODE REQUIREMENTS *(CONT'D)*

Hijacked Aircraft

JO 7110.65, par. 10-2-6

JO 7610.4, pars. 7-3-1, 7-4-2

TI 6110.100, sec. 5.1.5.16, Table 5-4



- If an aircraft is hijacked, it may squawk code 7500
  - HIJK blinks in data block
- Use normal flight following and handoff procedures
- ATC must honor clearance requests, traffic conditions permitting
- If necessary, aid escort aircraft into position

BEACON CODE REQUIREMENTS *(CONT'D)*

Pressure Suit Flights and Flights Above FL600

JO 7110.65, par. 5-2-8

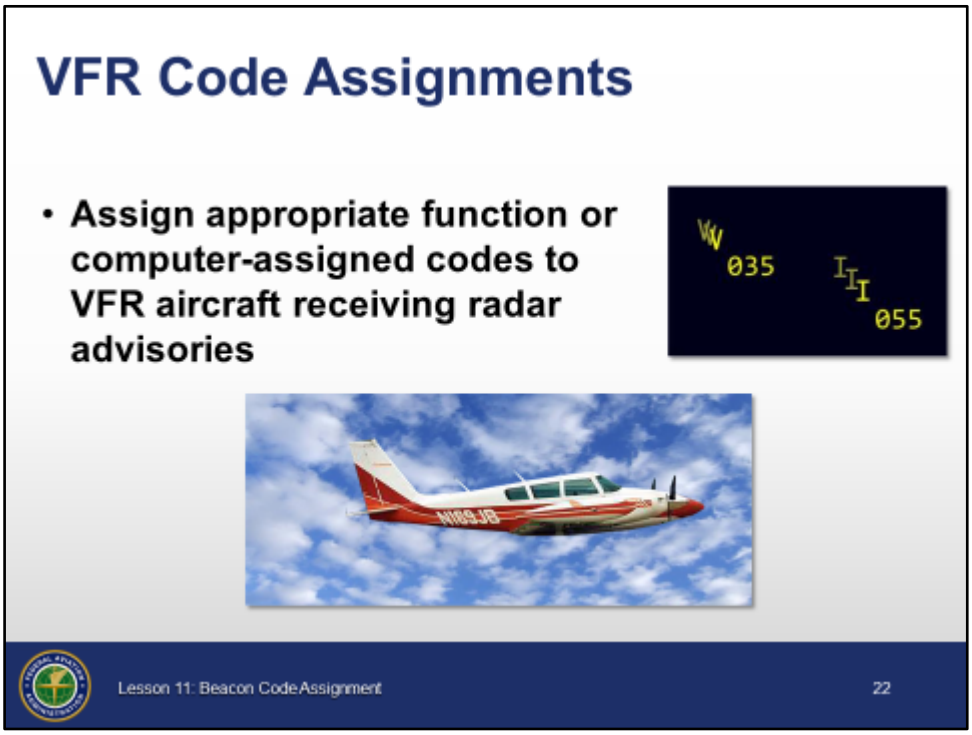
- Code 4400 and discrete codes 4440 through 4465 are reserved for use by:
  - Pressure suit flights
  - Aircraft operations above FL600
- Ensure that aircraft remain on code if filed as part of the flight plan
- Codes are preset on the ground
  - Same code is used above and below FL600
- Not all aircraft may be able to accept transponder changes
  - Emergency code 7700 can be activated

BEACON CODE REQUIREMENTS *(CONT'D)*

VFR Code Assignments

JO 7110.65, par. 5-2-7

JO 7110.66, Appendix A



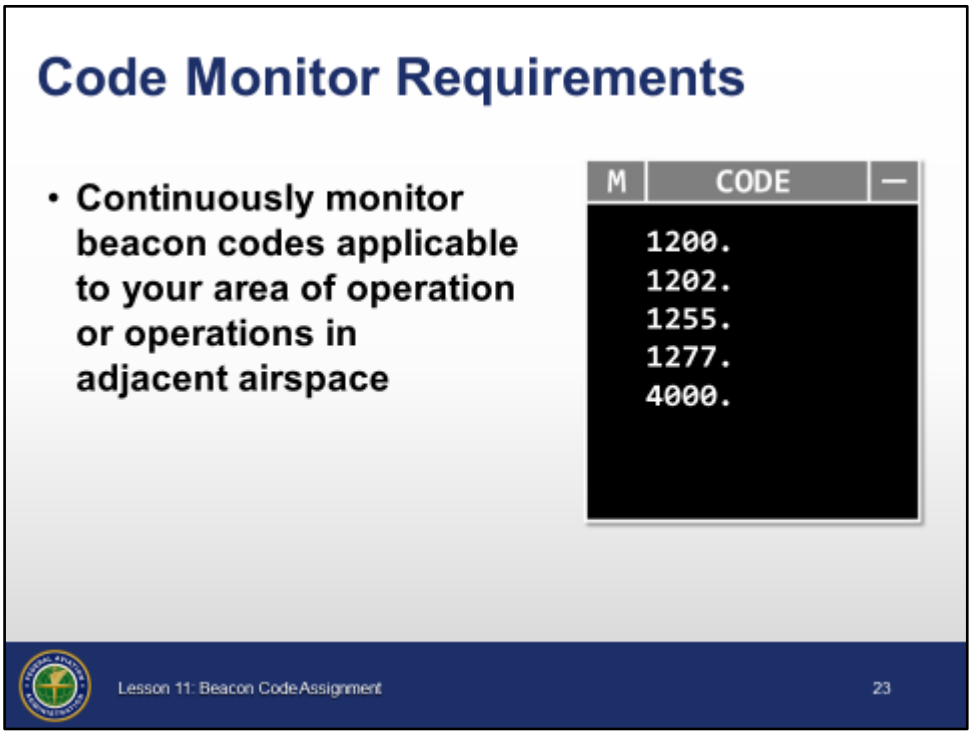
- Assign appropriate function or computer-assigned codes to VFR aircraft receiving radar advisories
- If the aircraft is outside your area of responsibility, retain it on your frequency only if operational benefit is gained
  - Coordination should be effected:
    - As soon as possible after position identification, and
    - Prior to issuing control instructions or providing a service other than a safety alert or traffic advisory
- Code 1200 is used by:
  - VFR aircraft not being provided services by an ATC facility
  - IFR aircraft that cancel IFR flight plan and do not request radar advisories
  - VFR aircraft when terminating radar services
  - VFR gliders should squawk 1202 in lieu of 1200 when they are required to have a transponder or ADS-B Out equipment
- When aircraft change from VFR to IFR, ensure Mode C aircraft are assigned beacon codes that allow Minimum Safe Altitude Warning (MSAW) alarms

BEACON CODE REQUIREMENTS *(CONT'D)*

Code Monitor

JO 7110.65, par. 5-2-11

JO 7210.3, par. 3-6-3

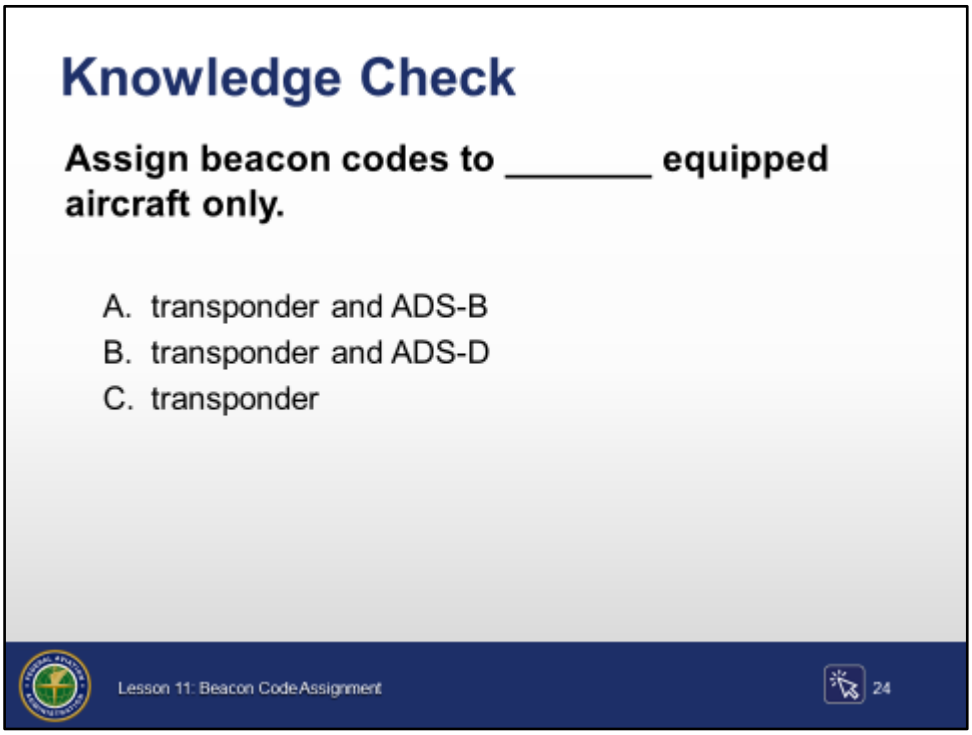


⊙ Continuously monitor codes:

- Assigned to aircraft in your area of responsibility
- Unless your area of responsibility contains only Class A airspace, monitor VFR codes:
  - 1200
  - 1202 - gliders
  - 1255 - aircraft within designated firefighting areas
  - 1277 - search and rescue aircraft
- 4000 when your area of responsibility contains or is adjacent to:
  - Warning areas
  - Restricted areas
  - VR routes
- Other codes as required by facility directives

BEACON CODE REQUIREMENTS *(CONT'D)*

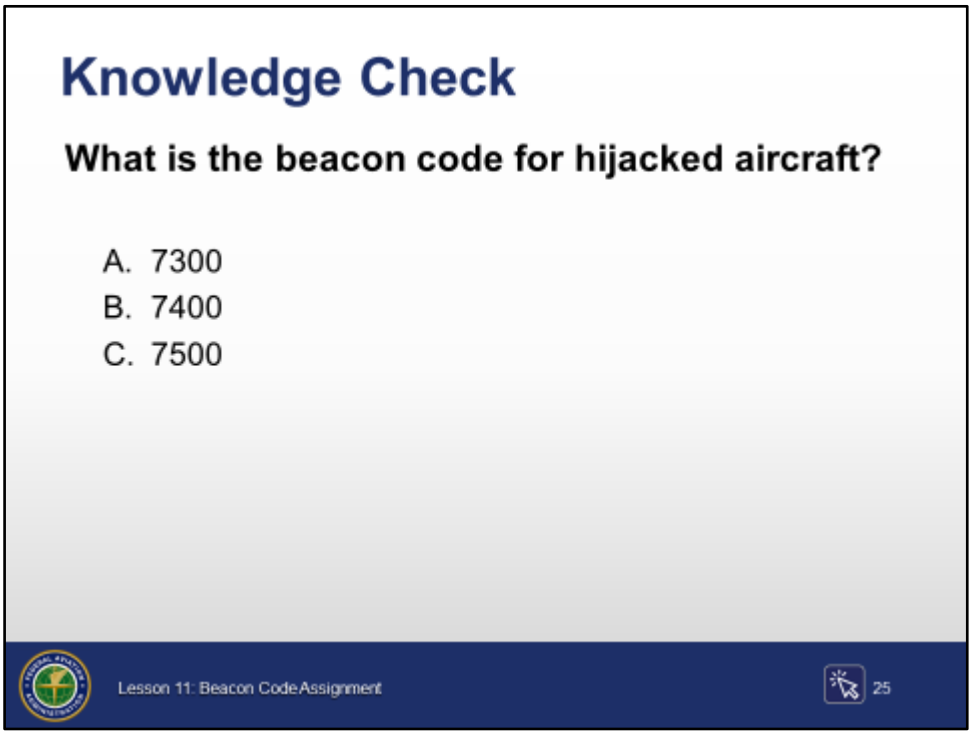
Knowledge Check



Question: Assign beacon codes to _____ equipped aircraft only.

BEACON CODE REQUIREMENTS *(CONT'D)*

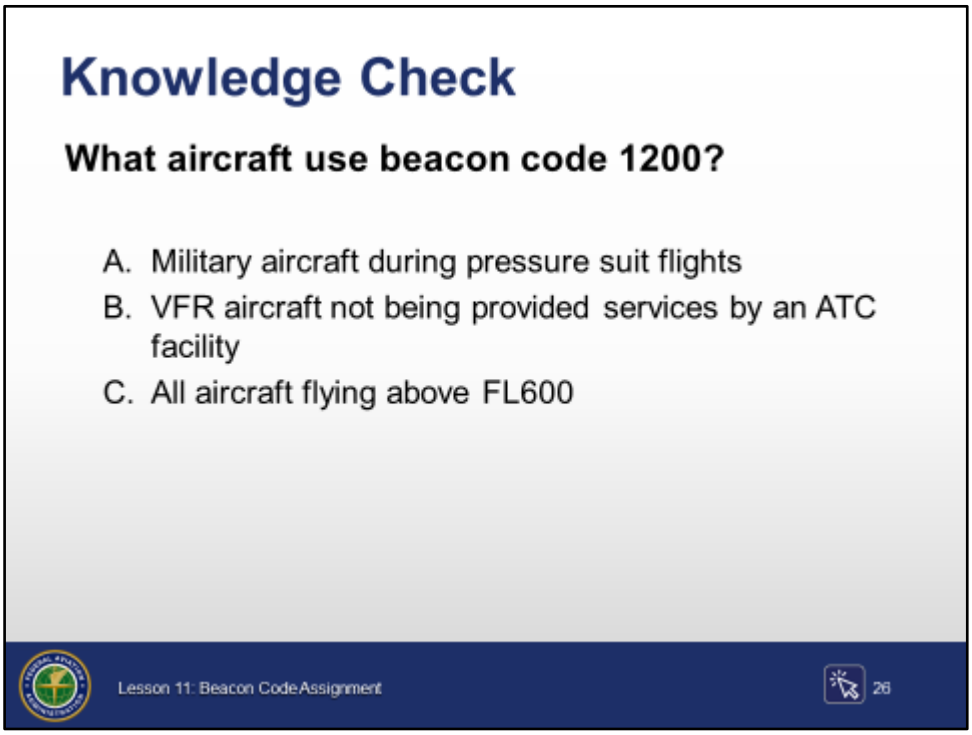
Knowledge Check



Question: What is the beacon code for hijacked aircraft?

BEACON CODE REQUIREMENTS *(CONT'D)*

Knowledge Check



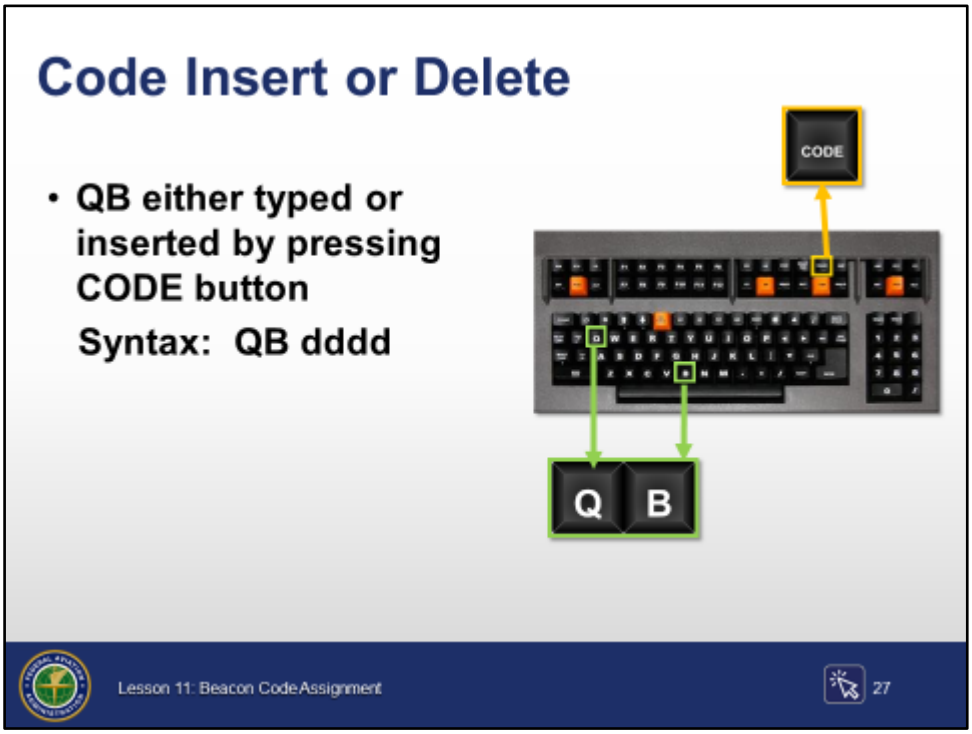
Question: What aircraft use beacon code 1200?

BEACON CODE COMMANDS

Code Insert or Delete

TI 6110.100, sec. 4.2.4.2

TI 6110.108, p. 7



- Code Insert or Delete command
  - Inserts a new code in the beacon code list
  - Deletes an existing code from the list
- Typing the letters QB or pressing the CODE button can be used to begin code commands in the Message Composition Area (MCA)

  Syntax: QB dddd

  Examples: `QB 2473`

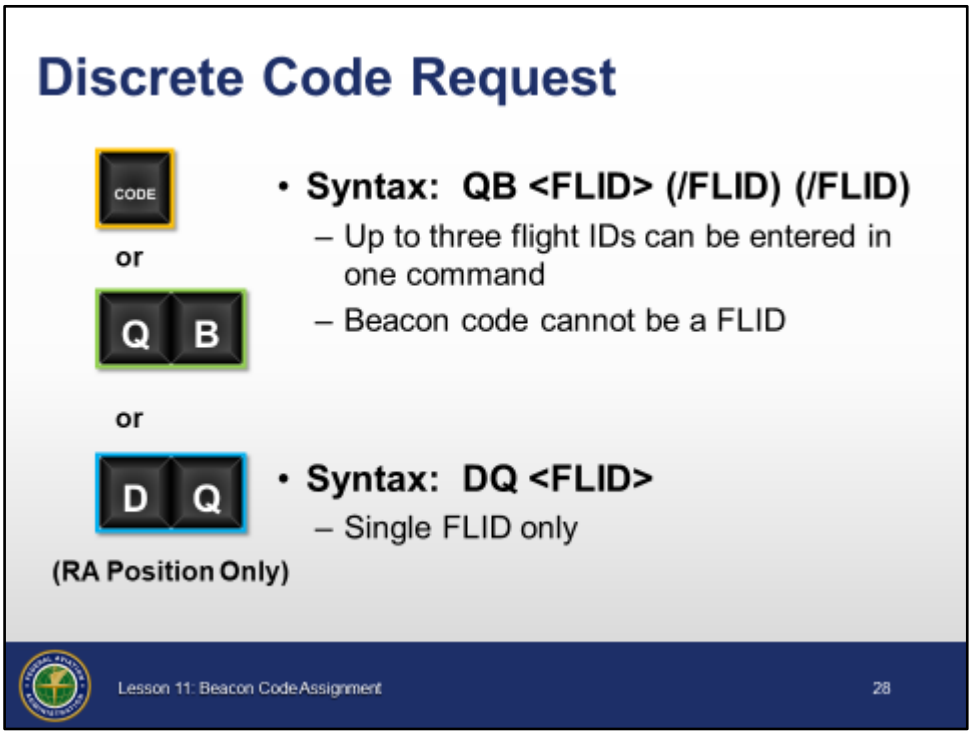
  `QB 3456 3476 3477`
  - If the code is in the list, it is deleted; if it is not in the list, the code will be added
  - Up to nine codes may be entered in one command
- In the Beacon Code view, a period following a code indicates a manually inserted code

BEACON CODE COMMANDS *(CONT'D)*

Discrete Code Request

TI 6110.101, Appendix B, Table B-1

TI 6110.108, p. 7



⊙ Used to request or change a discrete beacon code assignment for an aircraft

Syntax: QB <FLID> (/FLID) (/FLID)

- Up to three flight IDs can be entered in one command, separated by a "/"
- Beacon code cannot be used as the FLID in a QB command

Examples: `QB AAL72`

`QB 365`

`QB AAL345/SWA236`

`QB SWA476/545/213`

Alternate syntax for RA position: DQ <FLID>

- Only one FLID can be entered

Examples: `DQ AAL72`

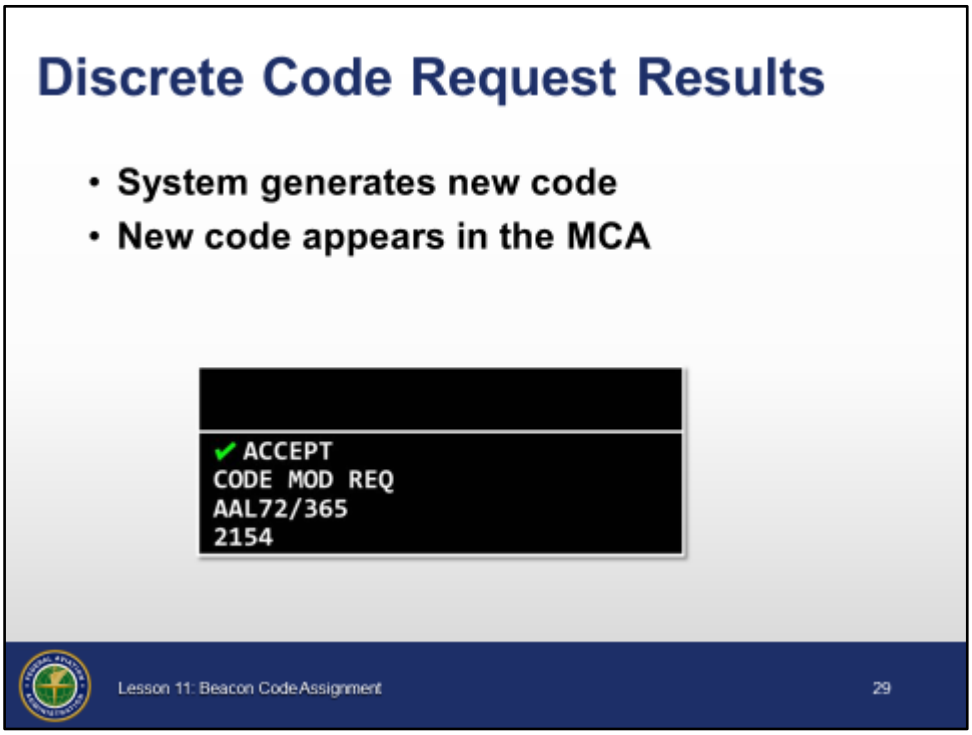
`DQ 346`

BEACON CODE COMMANDS *(CONT'D)*

Discrete Code Request Results

ERAM EDSM SRS 210.04 V1B1, par. 3.2.3.3.1

FAA-ERAM-2008-0467 3.2.1.2.5



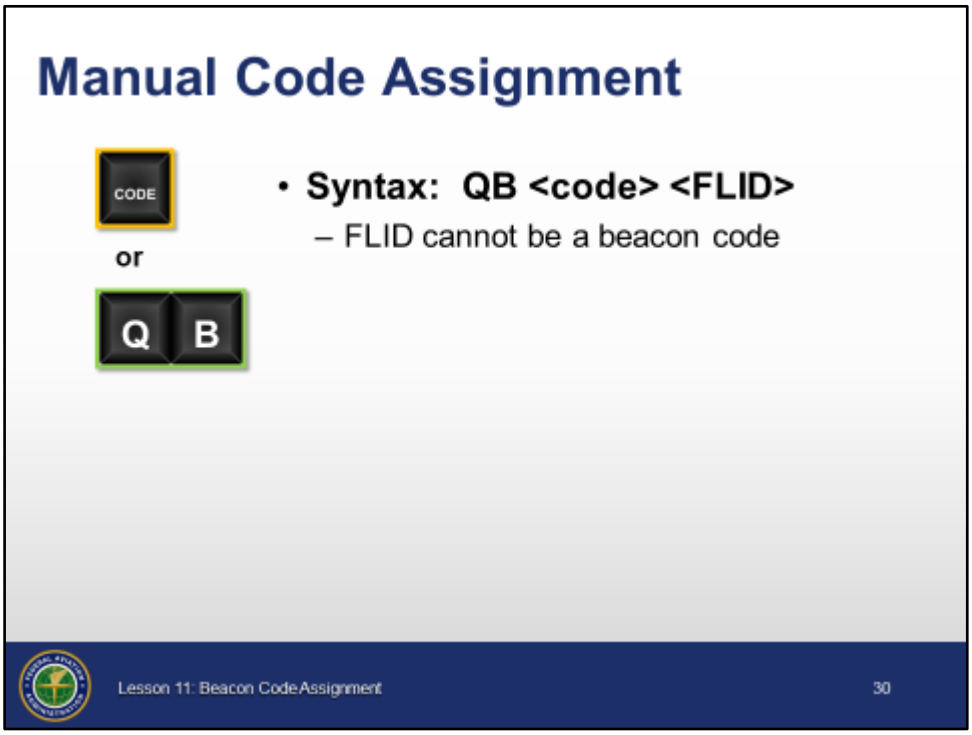
- Results of command entry:
  - The system will generate a new code
  - New code appears in the MCA Feedback Area
  - A tentative flight plan is created for pop up aircraft
  - Aircraft is made eligible for automatic track association
  - Beacon Code view is updated
  - Update messages are sent to other sectors

BEACON CODE COMMANDS *(CONT'D)*

Manual Code Assignment

NAS-MD-311, par. 2.4.2, Appendix E

TI 6110.108, p. 7



⊙ Used to assign or change a non-discrete beacon code or to assign a specific beacon code not presently assigned to another aircraft

Syntax: QB <code> <FLID>

- Beacon code cannot be used as the FLID in a QB command

Examples: `QB 4000 VIPER41`

`QB 1066 365`

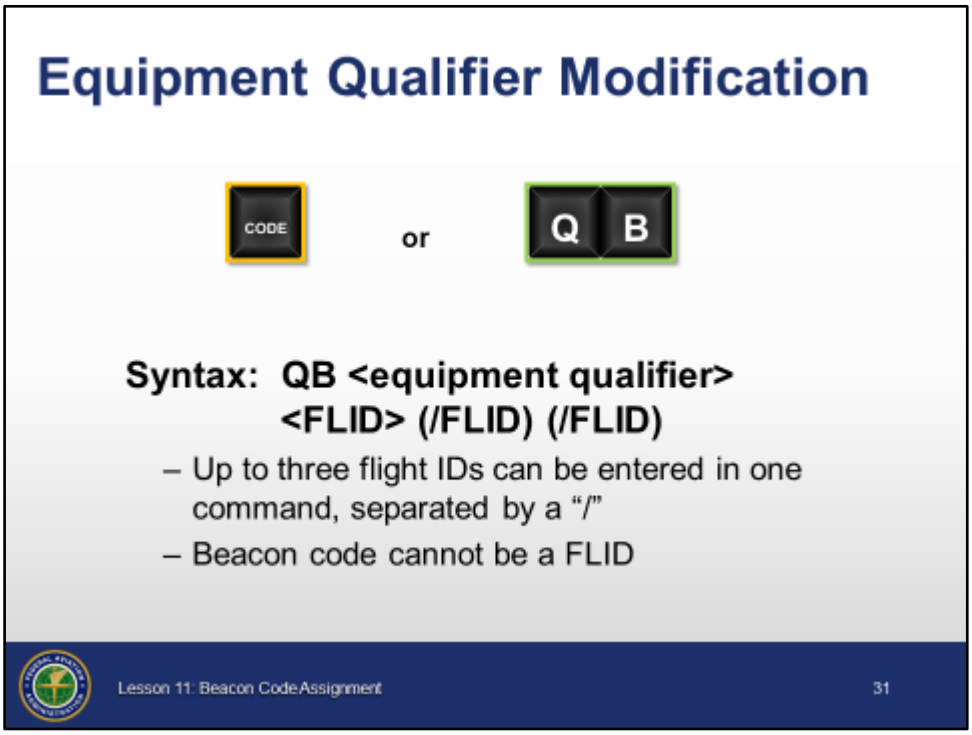
`QB 1066 AAL72`

BEACON CODE COMMANDS *(CONT'D)*

Equipment Qualifier Modification

TI 6110.100, Appendix B, Table B-1

TI 6110.108, p. 7



- Used to change, delete, or add an equipment qualifier

  Syntax: QB <equipment qualifier> <FLID> (/FLID) (/FLID)

  - Up to three flight IDs can be entered in one command, separated by a "/"
  - Beacon code cannot be used as the FLID in a QB command

    Examples: `QB A SWA236`

    `QB L AAL457/395`

- Modifying the equipment qualifier via the Equipment Template or using the amendment command ensures ICAO data is not inadvertently deleted or amended

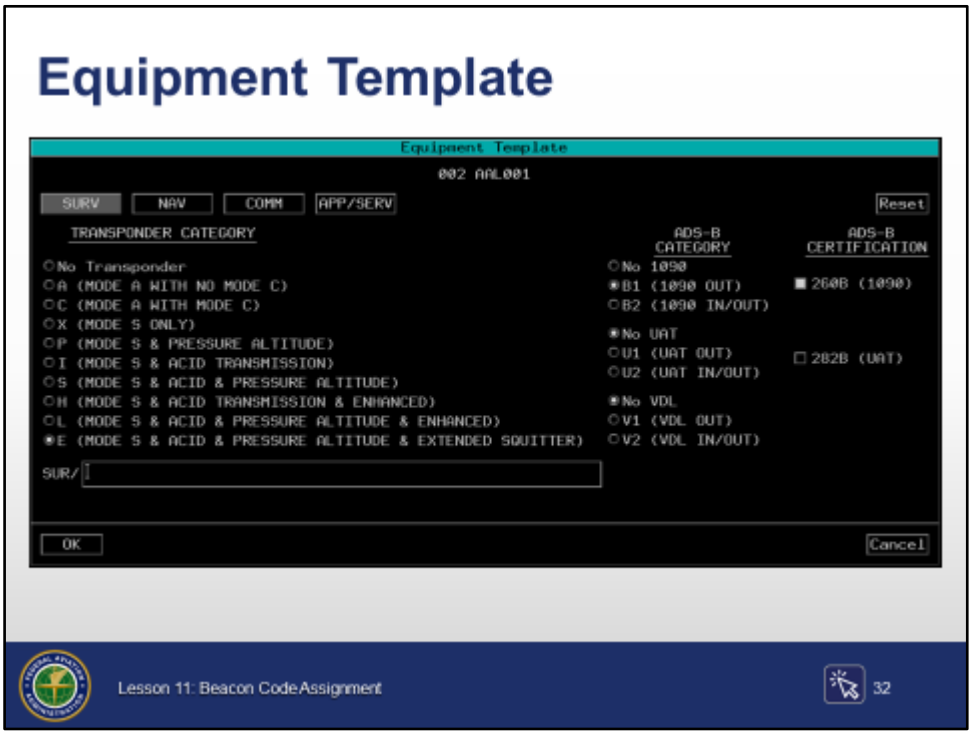
  - The Equipment Template is the preferred method of updating qualifiers

NOTE: The equipment qualifiers are listed in the appendix of the lesson.

BEACON CODE COMMANDS *(CONT'D)*

Equipment Template

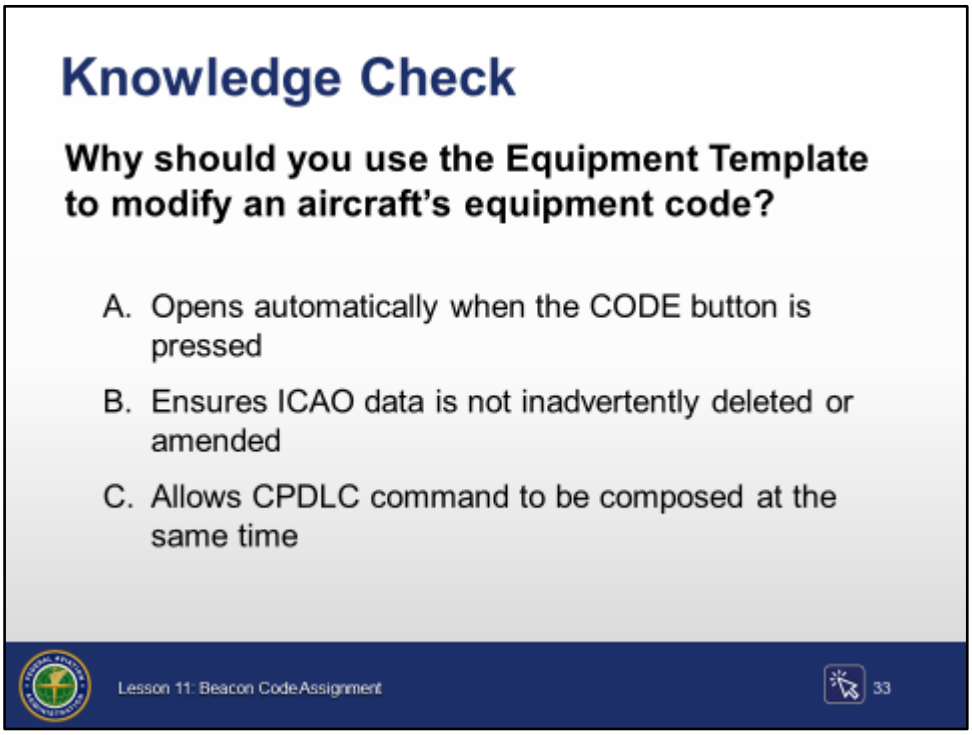
TI 6110.101, Table 4-21, sec. 4.23.1



- Provides an interface for displaying, entering, or modifying a flight's ICAO equipment qualifier in a flight plan command or amendment command
  - Accessed by selecting EQP on the Flight Plan Template or Amendment Template on the EDST
- Using the Equipment Template ensures accurate reflection of aircraft surveillance and navigation capabilities
  - Select from a list of equipment qualifiers
  - Ensures ICAO data is not inadvertently deleted or amended
  - Processes the selected or edited aircraft equipment qualifier(s) into a single letter code populating the EQP text entry field
  - Selection of a particular type of Equipment Template is made from a corresponding tab on the Equipment Template main window

BEACON CODE COMMANDS *(CONT'D)*

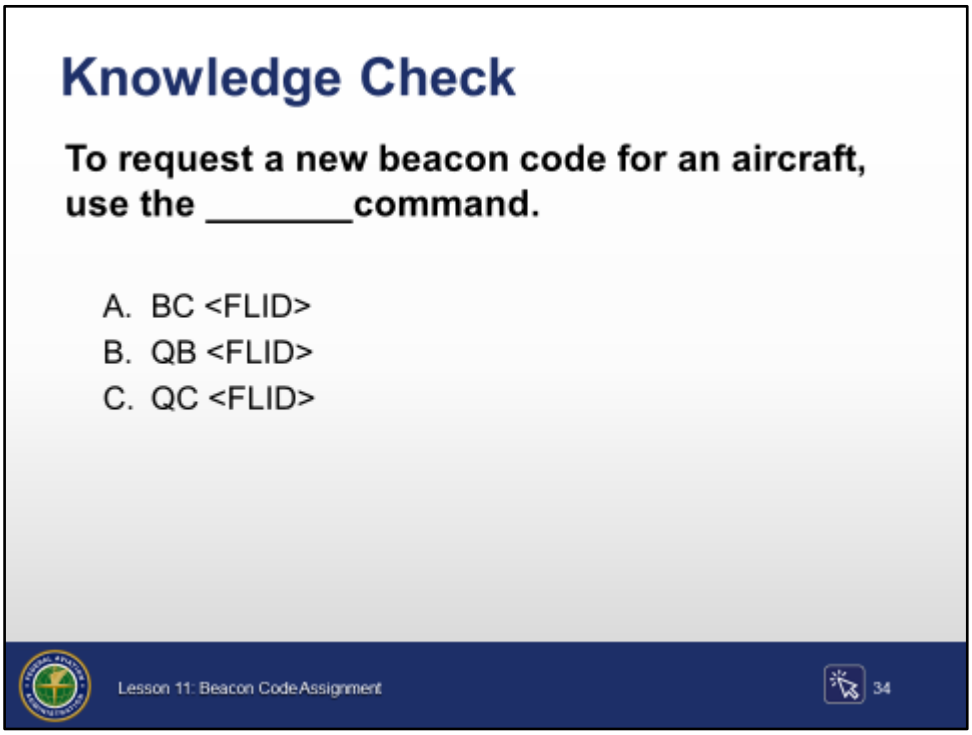
Knowledge Check



Question: Why should you use the Equipment Template to modify an aircraft's equipment code?

BEACON CODE COMMANDS *(CONT'D)*

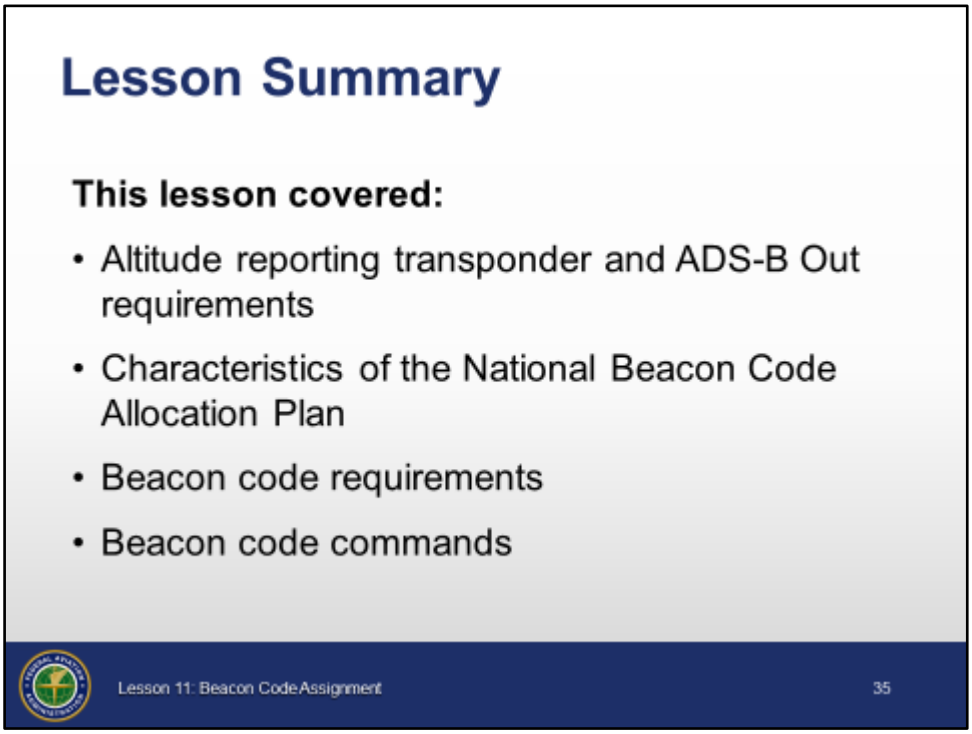
Knowledge Check



Question: To request a new beacon code for an aircraft, use the _____command.

CONCLUSION

Lesson Summary



This lesson covered:

- Altitude reporting transponder and ADS-B Out requirements
  - Equipment
  - Operations
  - Inflight deviation requests 10,000’ - 18,000’ MSL
  - Failed transponder or ADS-B Out
- National Beacon Code Allocation Plan
  - Code assignment

Continued on next page

CONCLUSION *(CONT'D)*

Lesson Summary (Cont'd)

- Beacon code requirements
  - Assignment criteria
  - Code change
  - Beacon code procedures during an emergency
  - Radio failure
  - Unmanned Aircraft Systems (UAS) lost link
  - Hijacked aircraft
  - Pressure suit flights and flights above FL600
  - VFR code assignments
  - Code monitor
- Beacon code commands
  - Code insert/delete
  - Discrete code request
  - Manual code assignment
  - Equipment qualifier modification
  - Equipment Template

APPENDIX: EQUIPMENT SUFFIXES, JO 7110.65, TABLE 2-3-10

Aircraft Equipment Suffixes			
Separation Standard	**Navigation Capability**	**Transponder Capability**	**Suffix**
RVSM	Any	Failed transponder	/H
	Any	Failed Mode C	/O
	No RNAV, No GNSS	Transponder with Mode C	/W
	RNAV, No GNSS	Transponder with Mode C	/Z
	GNSS	Transponder with Mode C	/L
Non−RVSM	No DME	No transponder	/X
		Transponder, no Mode C	/T
		Transponder with Mode C	/U
	DME	No transponder	/D
		Transponder, no Mode C	/B
		Transponder with Mode C	/A
	TACAN	No transponder	/M
		Transponder, no Mode C	/N
		Transponder with Mode C	/P
	RNAV, No GNSS	No transponder	/Y
		Transponder, no Mode C	/C
		Transponder with Mode C	/I
	GNSS	No transponder	/V
		Transponder, no Mode C	/S
		Transponder with Mode C	/G