5. Operations

5.1 - Radio Communications Procedures

Structure & Formatting Reminder

This presentation is provided as a reference to help you prepare for the your exam. It seeks to go beyond memorization and provide explanation and rationale.

While this reference considers many of the points covered in the exam, given the bredth it is in no way exhaustive. It is suggested to consult a variety of resources when preparing for the exam.

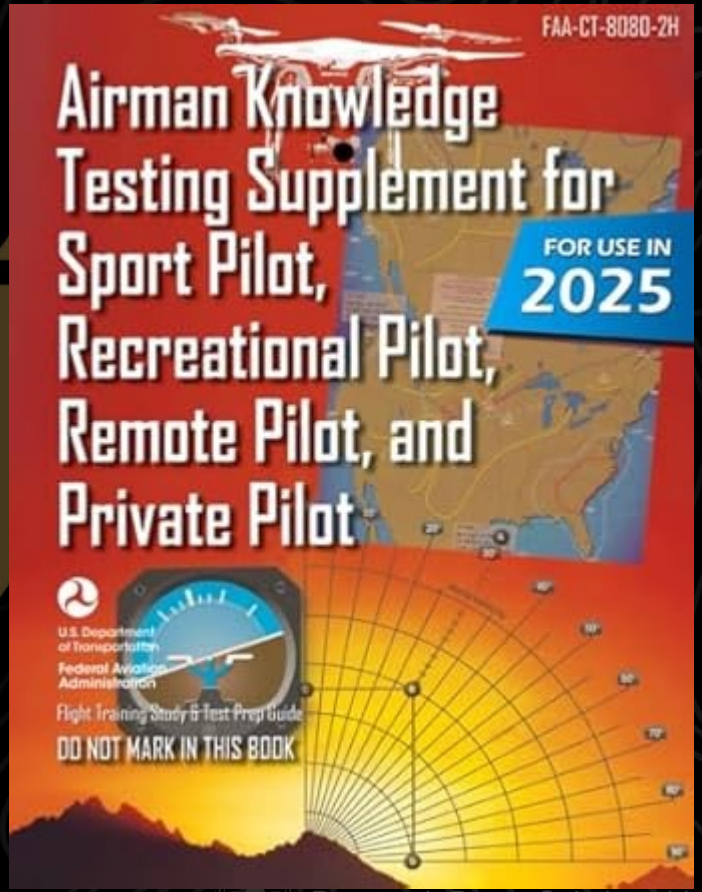
Text that is marked in YELLOW has a high probability of being referenced directly in one of the exam's nearly 400 possible questions.

Take the quiz at the end to gauge your understanding.

Airman Knowledge Testing Supplement

Many of the points covered in the slideshow and quiz reference images and concepts found in the “Airman Knowledge Testing Supplement”.

You can download the document from the FAA here. Alternatively, a hard copy can be purchased online for around $10.



How do airplanes communicate with each other and ATC?

How do airplanes communicate with each other and ATC?

Airplanes and air traffic control (ATC) communicate primarily through radio communications, using specific frequencies regulated by aviation authorities.

5.1 - VHF & Airband Radio

5.1 - VHF Radio & Airband

VHF radio uses a Very High Frequency radio signal to enable two-way communication between airplanes and between airplane and ATC.

Airband is a group of frequencies in the VHF spectrum allocated for communication in civil aviation.

Yaesu

Listen to https://www.liveatc.net/ for some examples

5.1 - VHF Radio & Airband

The airband frequency ranges from 108 to 137 MHz

- 108-117.95 is reserved for navigational aids including VOR beacons
  - VOR is system of fixed transmitters that help pilots determine position and stay on course)

- 118-136.975 MHz is used for voice communication.

Garmin

5.1 - VHF Radio & Airband

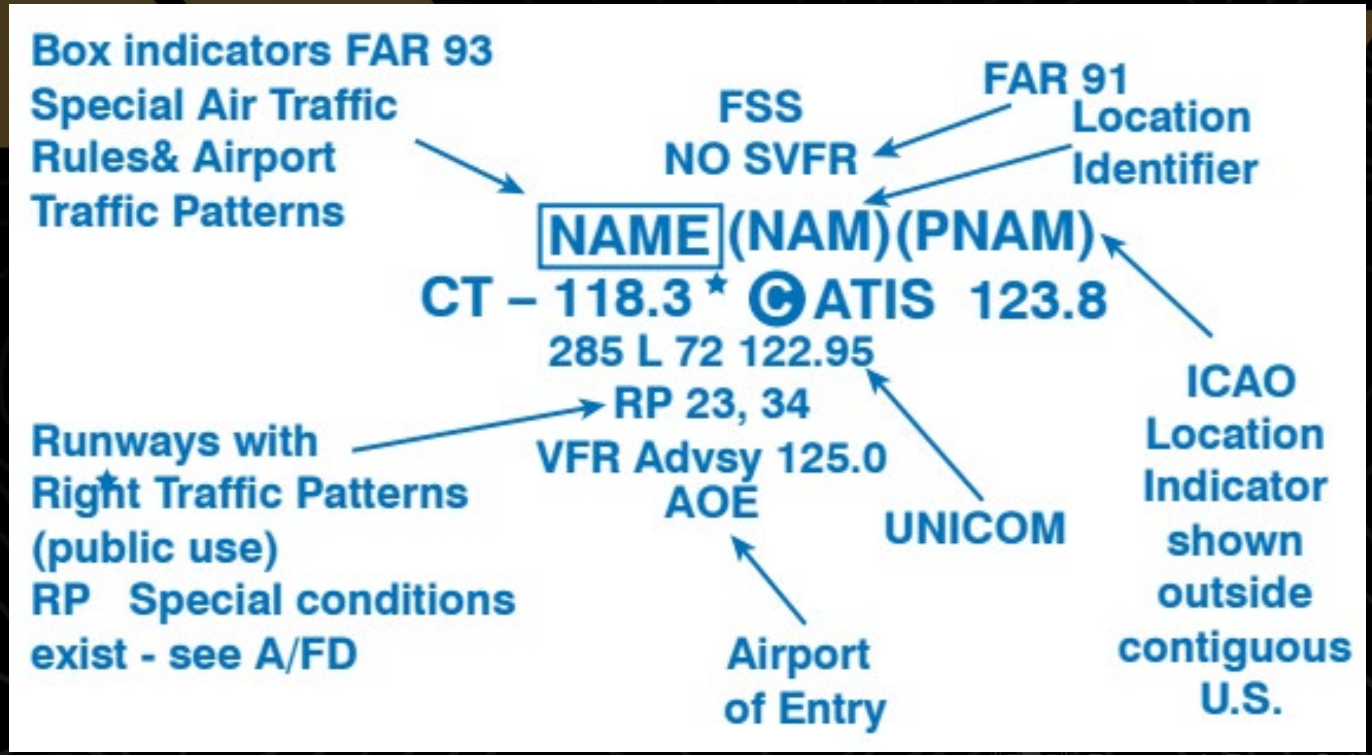
Common Frequencies

- MULTICOM = 122.9
- UNICOM = 122.8
- FSS = 122.2

5.1 - Airport Operations and Control Towers

5.1b - Airport Operations & Control Towers

Sectional Chart Notations



5.1 - Airport Operations & Control Towers

Operating a UAV around an airport takes significant planning and heightened situational awareness.

Factors influencing UAV operations around airports:

- Authorization requirements for controlled airspace
- Traffic congestion
- Climb and descent attitudes
- Aircraft pilot preoccupation with cockpit duties.
- Weather conditions

Geospatial World

5.1 - Airport Operations & Control Towers

Radio Communications

- When a control tower is in operation crewed aircraft pilots are required to maintain two-way radio contact in class B, C, and D airspace.
- Crewed aircraft typically call in about 15 miles out.
- When necessary the tower controller will issue clearance for arriving or departing aircraft.

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Why are tower operations relevant to a UAV pilot?

How do airplanes communicate with each other and ATC?

Tower operations are relevant to a pilot because they involve controlled airspace and safety protocols that directly affect where and how UAVs can be flown.

5.1 - Airport Operations & Control Towers

UAV operators are prohibited from communicating over VHF radio frequencies (except in case of an emergency).

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Monitoring radio traffic is important because it will aid in situational awareness during an operation where there is significant air traffic.

- Flight path
- Direction
- Speed

Listen In On Live ATC Traffic - https://www.liveatc.net

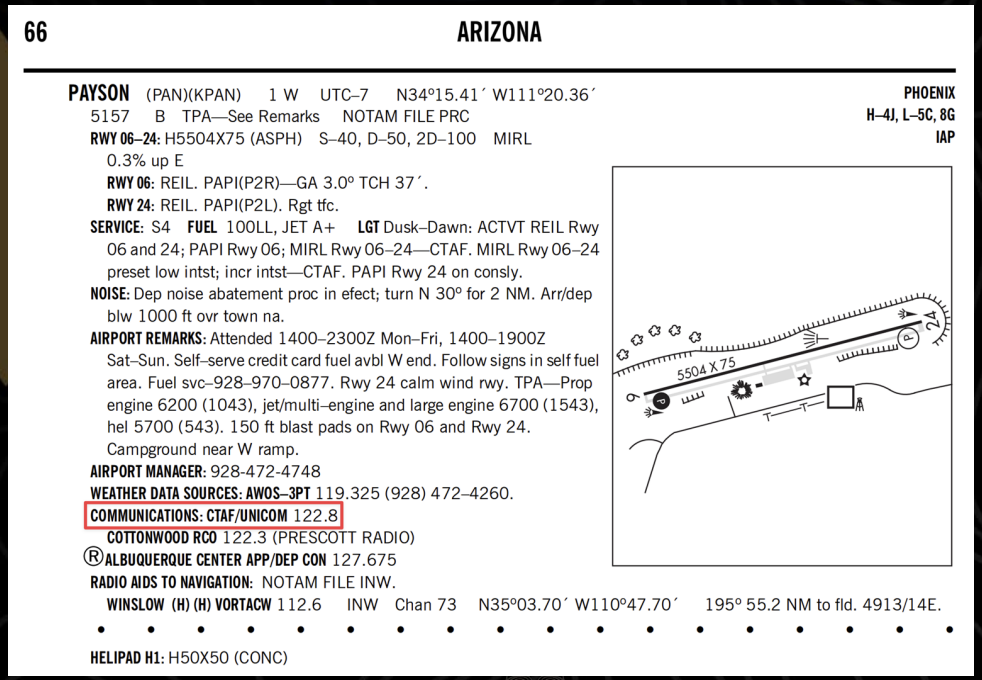
5.1 - Common Traffic Advisory Frequency (CTAF)

5.1 - Common Traffic Advisory Frequency (CTAF)

CTAF is a specific frequency set aside for broadcasting airport advisory practices for airports without a control tower.

CTAF Frequencies can be

- UNICOM
- MULTICOM
- FSS
- Tower Frequencies



66 ARIZONA

PAYSON (PAN)(KPAN) 1 W UTC–7 N34°15.41´ W111°20.36´ PHOENIX
5157 B TPA—See Remarks NOTAM FILE PRC H–4J, L–5C, 8G
RWY 06–24: H5504X75 (ASPH) S–40, D–50, 2D–100 MIRL IAP
0.3% up E
RWY 06: REIL. PAPI(P2R)—GA 3.0° TCH 37´.
RWY 24: REIL. PAPI(P2L). Rgt tfc.
SERVICE: S4 **FUEL** 100LL, JET A+ **LGT** Dusk–Dawn: ACTVT REIL Rwy 06 and 24; PAPI Rwy 06; MIRL Rwy 06–24—CTAF. MIRL Rwy 06–24 preset low intst; incr intst—CTAF. PAPI Rwy 24 on consly.
NOISE: Dep noise abatement proc in efect; turn N 30° for 2 NM. Arr/dep blw 1000 ft ovr town na.
AIRPORT REMARKS: Attended 1400–2300Z Mon–Fri, 1400–1900Z Sat–Sun. Self–serve credit card fuel avbl W end. Follow signs in self fuel area. Fuel svc–928–970–0877. Rwy 24 calm wind rwy. TPA—Prop engine 6200 (1043), jet/multi–engine and large engine 6700 (1543), hel 5700 (543). 150 ft blast pads on Rwy 06 and Rwy 24. Campground near W ramp.
AIRPORT MANAGER: 928-472-4748
WEATHER DATA SOURCES: AWOS–3PT 119.325 (928) 472–4260.
COMMUNICATIONS: CTAF/UNICOM 122.8
COTTONWOOD RCO 122.3 (PRESCOTT RADIO)
Ⓡ**ALBUQUERQUE CENTER APP/DEP CON** 127.675
RADIO AIDS TO NAVIGATION: NOTAM FILE INW.
WINSLOW (H) (H) VORTACW 112.6 INW Chan 73 N35°03.70´ W110°47.70´ 195° 55.2 NM to fld. 4913/14E.

5504 X 75

HELIPAD H1: H50X50 (CONC)

Why do you think the use of CTAF was standardized?

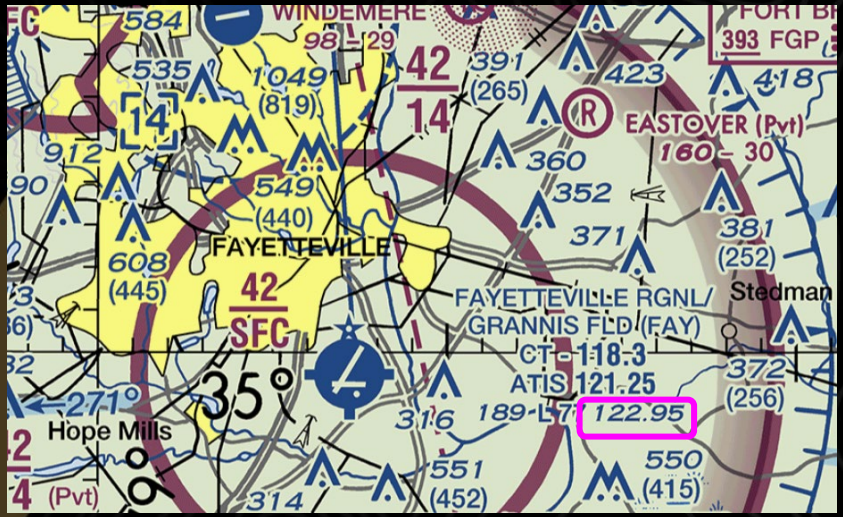
Why do you think the use of CTAF was standardized?

The use of CTAF (Common Traffic Advisory Frequency) was standardized to enhance safety and coordination at non-towered airports where there is no active air traffic control (ATC) presence. Here's why this standardization is important:

5.1 - Aeronautical Advisory Communications Station (UNICOM)

5.1 - Aeronautical Advisory Communications Station (UNICOM)

- UNICOM is a air/ground radio communication station that provides airport information at public use airports where there is no tower or FSS.
- On pilot request, UNICOM stations may provide pilots with weather information, wind direction, runway recommendations, and other necessary information.



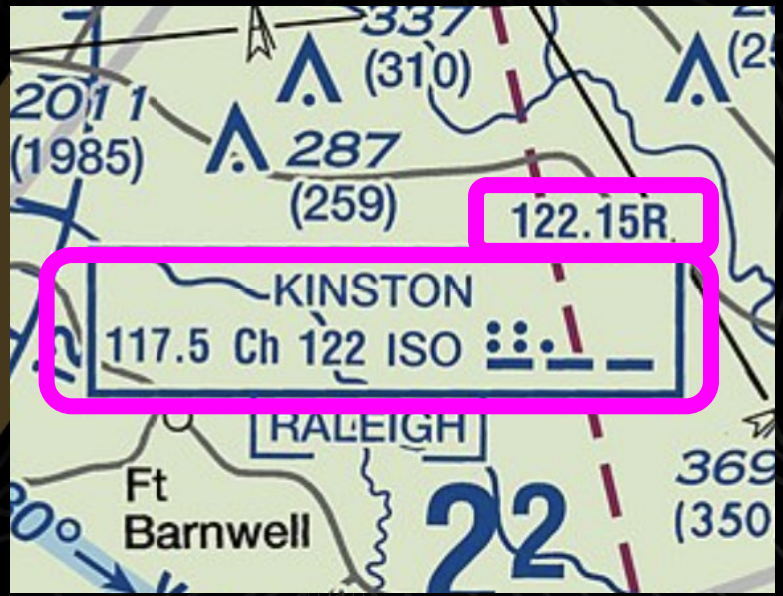
5.1 - Aeronautical Advisory Communications Station (UNICOM)

- Sometimes the UNICOM and CTAF frequencies are the same.

5.1 - Flight Service Station (FSS)

5.1 - Flight Service Station (FSS)

- FSS is used to file VFR flight plans, change ETA, and other things and is associated with certain VOR stations.
- The universal FSS frequency is 122.2.
- A heavy blue line box indicates an FSS.
- If an “r” is present its a receive only frequency. Transmissions would take place over the VOR frequency.



What is the difference between CTAF and UNICOM?

What is the difference between CTAF and UNICOM?

The difference between CTAF and UNICOM lies in their purpose and who uses them, even though they may share the same frequency at non-towered airports.

5.1 - Traffic Advisory Procedures of Crewed Aircraft

5.1 - Traffic Advisory Procedures of Manned Aircraft

If an airport has:

UNICOM	TOWER (active)	TOWER (closed)	FSS (active)	FSS (closed)
√	X	X	X	X

An airplane should: Communicate with UNICOM on published CTAF frequency.

5.1 - Traffic Advisory Procedures of Manned Aircraft

If an airport has:

UNICOM	TOWER (active)	TOWER (closed)	FSS (active)	FSS (closed)
X	X	X	X	X

An airplane should: Self-announce on MULTICOM frequency 122.9.

Outbound: Before taxing

Inbound: 10 miles out, at each leg, clearing the runway.

5.1 - Traffic Advisory Procedures of Manned Aircraft

If an airport has:

UNICOM	TOWER (active)	TOWER (closed)	FSS (active)	FSS (closed)
X	X	√	√	X

An airplane should: Communicate with FSS on CTAF

Outbound: Before taxing

Inbound: 10 miles out, at each leg, clearing the runway.

5.1 - Traffic Advisory Procedures of Manned Aircraft

If an airport has:

UNICOM	TOWER (active)	TOWER (closed)	FSS (active)	FSS (closed)
X	X	X	X	√

An airplane should: Self-announce on CTAF

5.1 - Traffic Advisory Procedures of Manned Aircraft

If an airport has:

UNICOM	TOWER (active)	TOWER (closed)	FSS (active)	FSS (closed)
X	X	√	X	√

An airplane should: Self-announce on CTAF

Why do you think it is important to have established procedures for a variety of situations?

Why do you think it is important to have established procedures for a variety of situations?

Established procedures are important because they improve safety, ensure consistency, support quick decision-making, meet FAA regulations, and promote professionalism in UAV operations.

5.1g - VOR, VORTAC, DME, & NDB

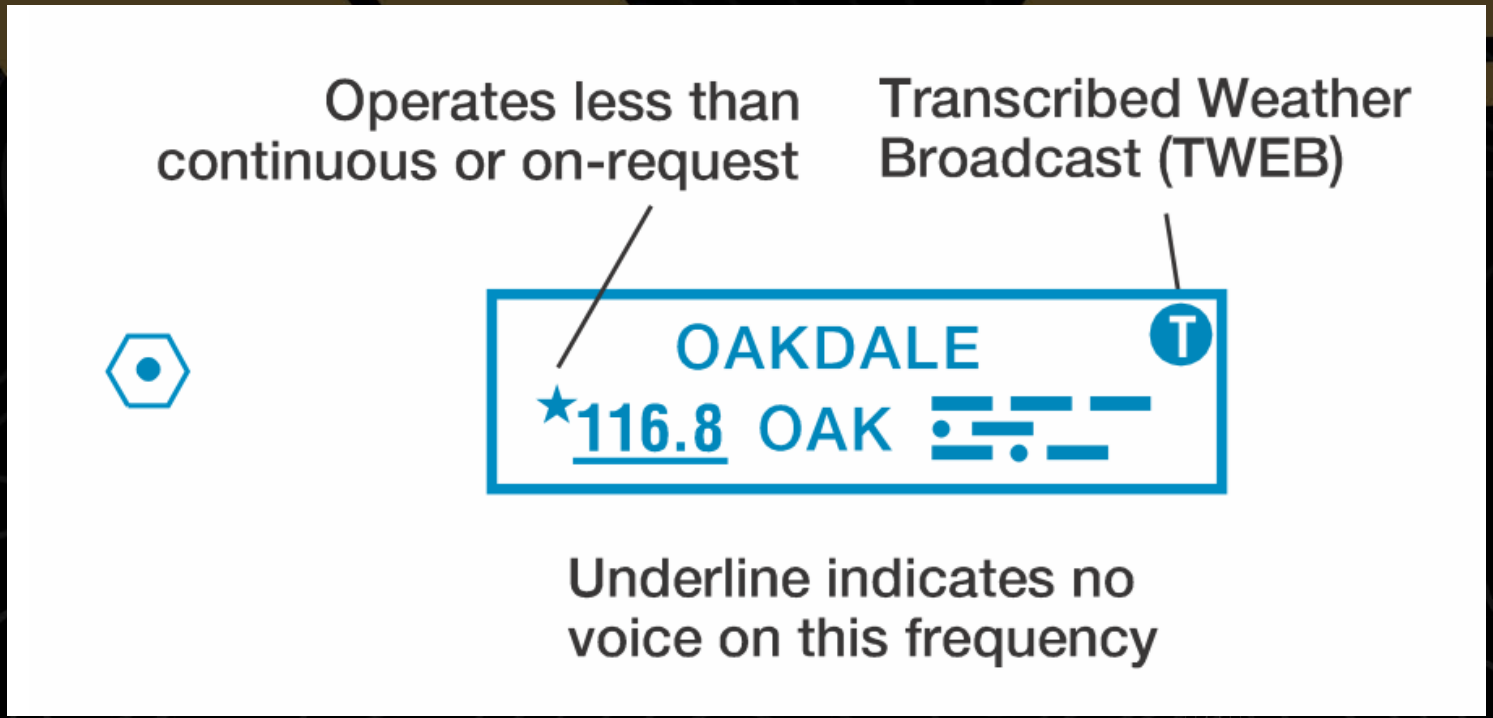
5.1 - VOR, VORTAC, DME, & NDB

Very High Frequency Omnidirectional Range Station (VOR)

- Short range radio navigation aid.
- Used to determine position and course via a network of fixed ground-based radio beacons.
- Developed in 1930s and standard until GPS in the 2000s.
- VOR stations are being decommissioned.

5.1 - VOR, VORTAC, DME, & NDB

Very High Frequency Omnidirectional Range Station (VOR)



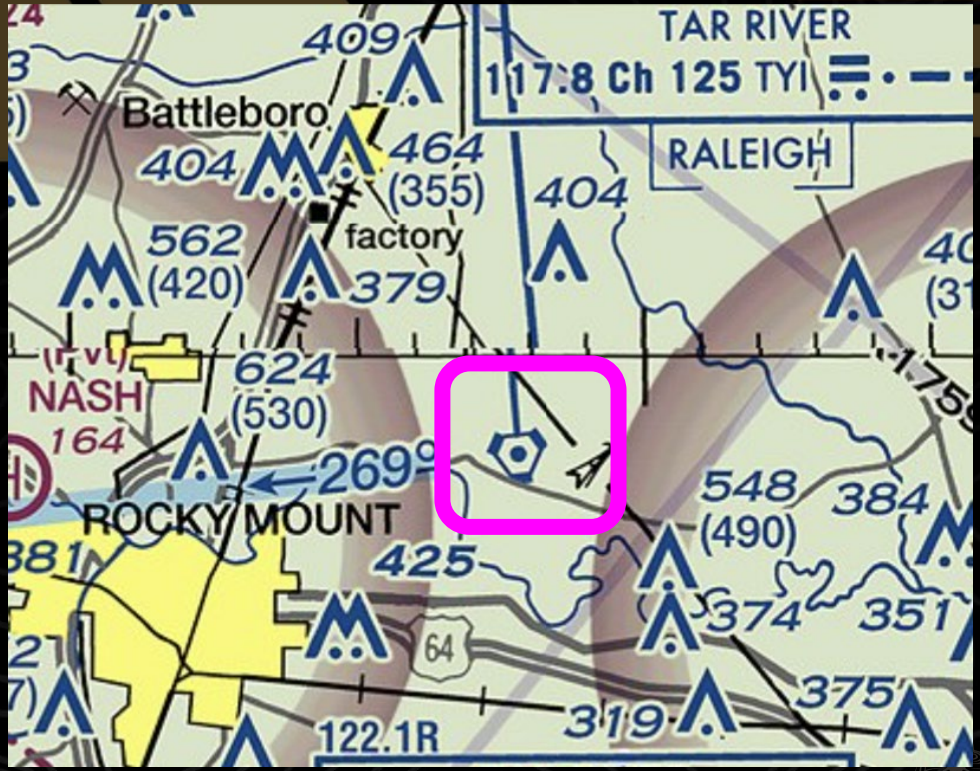
5.1 - VOR, VORTAC, DME, & NDB

VORTAC (VOR+Tactical Air Navigation System)

- VORTACs are VORs with a co-located tactical air navigation system (TACAN) used by military aircraft.
- All VORTACs are VORs but not all VORs are VORTACS.

5.1 - VOR, VORTAC, DME, & NDB

VORTAC (VOR+Tactical Air Navigation System)



5.1 - VOR, VORTAC, DME, & NDB

VOR-Distance Measuring Equipment (DME)

- Combines VOR with Distance Measuring Equipment (DME)
- Signals are sent from the airplane to the DMC, the DME returns the signal and the aircraft determines distance by measuring time between signals.

5.1 - VOR, VORTAC, DME, & NDB

VOR-Distance Measuring Equipment (DME)

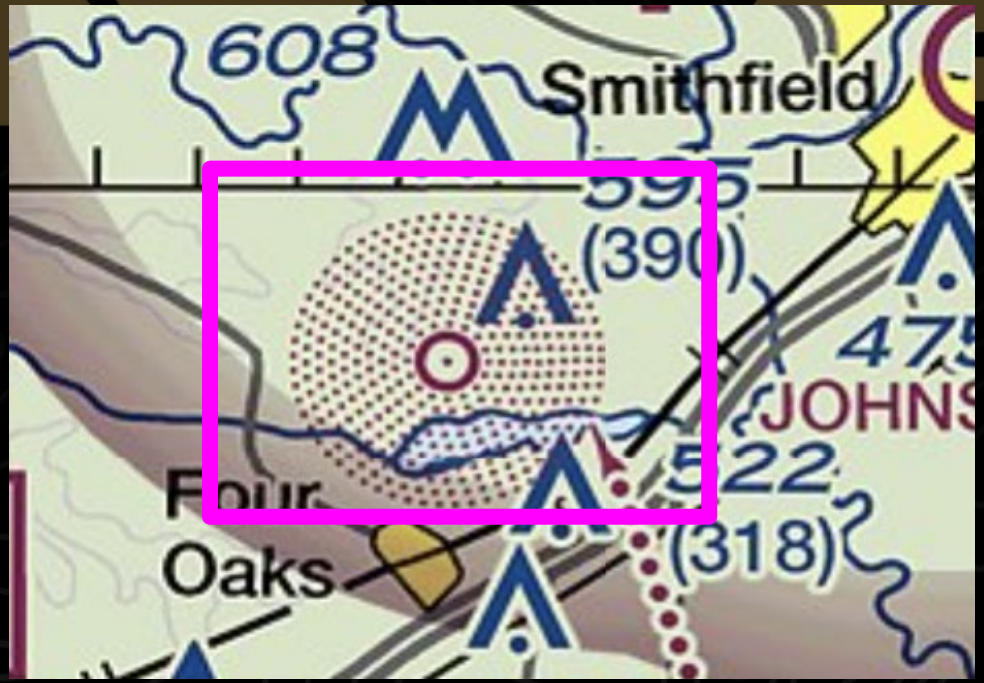
5.1 - VOR, VORTAC, DME, & NDB

Non-Directional Radio Beacon (NDB)

- Non-Directional Beacon
- Doesn’t include directional information but can provide a bearing target or “fix.”

5.1 - VOR, VORTAC, DME, & NDB

Non-Directional Radio Beacon (NDB)



How could drone pilots use VOR, VORTAC, DME, or NDB?

How could drone pilots use VOR, VORTAC, DME, or NDB?

Drone pilots typically don’t rely directly on VOR, VORTAC, DME, or NDB systems for navigation like manned aircraft do, but understanding them can still be useful in certain scenarios like situational awareness, mission planning, and avoiding interference with radio systems.

5.1 - Aircraft Call Signs and Registration Numbers

5.1 - Aircraft Call Signs and Registration Numbers

In the US each registered aircraft has a unique call sign and registration number.

The registration number is preceded by the letter N and must meet the following characteristics:

- One to five numbers (N12345)
- One to four numbers followed by one letter (N1234Z)
- One to three numbers followed by two letters (N123AZ)

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5.1 - Aircraft Call Signs and Registration Numbers

Call signs are used for radio communications and are read using the phonetic alphabet.

For example:

- N759AB would be identified as:
  - November-Seven-Five-Niner-Alpha-Bravo
- In the USA the “N” is often omitted and the aircraft manufacturer or model is used.
  - Example Cessna-Seven-Five-Niner-Alpha-Bravo

Why is it important for each aircraft to have a unique call sign and registration number?

Why is it important for each aircraft to have a unique call sign and registration number?

Unique call signs and registration numbers ensure clear identification, improve safety, help air traffic control manage traffic, and enable accountability for each aircraft.

5.1 - The Phonetic Alphabet

5.1 - The Phonetic Alphabet

- The International Civil Aviation Organization (ICAO) developed a list of codes tied to the standard English alphabet.
- The purpose is to standardize communication between pilots and those detailing with air traffic throughout the world.
- Having a standard set of words avoids confusion brought on by similar sounding letters (for example “N” and “M”).

5.1 - The Phonetic Alphabet - Letters

- A – Alpha
- B – Bravo
- C – Charlie
- D – Delta
- E – Echo
- F – Foxtrot
- G – Golf
- H – Hotel
- I – India
- J - Juliet
- K – Kilo
- L – Lima
- M – Mike
- N – November
- O – Oscar
- P – Papa
- Q – Quebec
- R – Romeo
- S - Sierra
- T – Tango
- U – Uniform
- V – Victor
- W – Whisky
- X – X-Ray
- Y – Yankee
- Z – Zulu

5.1 - The Phonetic Alphabet - Numbers

- 0 – Zee-row
- 1 – Wun
- 2 – Too
- 3 – Tree
- 4 – Fow-er
- 5 – Fife
- 6 – Six
- 7 – Sev-en
- 8 – Ait
- 9 – Niner
- - Tack

Why do you think the phonetic alphabet was established?

Why do you think the phonetic alphabet was established?

The phonetic alphabet was established to ensure clear, unambiguous communication over radios, especially in noisy or poor signal conditions, reducing misunderstandings.

5.1 - PHONETIC PRACTICE

Question #1

How would you say “Taxiway J”?

Answer #1

How would you say “Taxiway J”?

Taxiway Juliet

Question #2

How would you say “Runway 39”?

Answer #2

How would you say “Runway 39”?

Runway Three Niner

Question #3

How would you say the tail number “N98710”

Answer #3

How would you say the tail number “N98710”

November Niner Eight Seven One Zero

Question #4

How would you say the tail number “XL-T1A”

Answer #4

How would you say the tail number “XL-T1A”

X-Ray Lima Tango One Alpha

5.1 - Phraseology

5.1 - Phraseology - Altitude

Altitudes are pronounced with each digit in the number of hundreds or thousands followed by the word “hundred” or “thousand”.

Example:

5,000 = Five thousand

10,000 = One zero thousand

11,500 = One one thousand five hundred

Altitudes can be restated in groups for added clarity.

Example:

10,000 - Ten thousand ——— 11,500 - Eleven thousand five hundred

5.1 - Phraseology - Speed

Speed is referenced by the number (in phonetics) followed by “knots”

Examples:

95 knots = Niner five knots

139 knots = One three niner knots

250 knots = Two five zero knots

5.1 - Phraseology - Time

Time is expressed in Universal Coordinated Time (UTC) in four separate digits of the hour and minutes.

Example

0115 (UTC) - “Zero one one five”

1315 (UTC) - “One three one five”

Sometimes local time is referenced.

Example: 2:30pm — “Two Thirty P-M local”

Why is it important to establish standardized phraseology?

Why is it important to establish standardized phraseology?

Standardized phraseology ensures clear, concise, and consistent communication between pilots and controllers, reducing confusion and increasing safety in aviation operations.

Unit 5 Operations – 5.1 Review Quiz

- 5.1 - Radio Communications Procedures – QUIZ
- This quiz contains 27 questions.
  - You may take it as many times as you like.
  - The order of questions are randomized each time.
  - The large majority of the questions are worded exactly as they appear on the exam.