05-28 Lecture: Flight Planning, Navigation, and Safety Margins

> Date & Time: 2025-05-28 17:35:29
> Location: [Insert Location]
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> `flight planning` `navigation` `safety margins`

Theme

This lecture provides a comprehensive overview of flight planning and navigation for pilots, covering essential topics such as landing distance safety factors, minimum safe altitude calculations, map reading, airspace regulations, fuel planning, and the use of navigation tools like the CRP-5. Practical examples and regulatory requirements are discussed to ensure safe and efficient flight operations, with a focus on European and Spain-specific procedures.

Takeaways

1. Safety factor for landing distance: 1.43
2. Landing distance calculation and safety margin
3. Flight planning process and required materials
4. Use of maps and plotters for route planning
5. Scale of aviation maps (1:500,000)
6. Measuring distances in nautical miles
7. Determining minimum safe altitude (MSA)
8. Obstacle clearance calculation: round up and add 1,000 feet
9. Semicircular rule for flight levels (odd/even levels)
10. Spain-specific semicircular rule differences

Highlights

- `"What is important is that you know how the minimum altitude for your flight has been calculated."-- Speaker 1`
- `"To make allowance for this type of possibility, you should simply add 300 feet the rounded up terrain elevation before adding 1000 feet safety`

`margin."-- [Speaker 1]`

- `"You should always take it into consideration."-- Speaker 1`
- `"Even though they didn't give us in the presentation. Understood? Very easy. Very easy formula. NAMTAS, NGM, Braille Speed. NAMTAS. Maybe it's going to work like a mnemonic. NAMTAS, NAMTAS, NAMTAS. Can you believe it?"-- Speaker 1`
- `"Sometimes, in equations, the wind correction angle might be given either in the plus or minus."-- Speaker 1`
- `"In the airplane carrying sufficient fuel and oil for visual group, to fly to the airdrome of intended landing and thereafter to fly for at least 30 minutes, this is important, 30 minutes at normal cruising altitudes."-- Speaker 1`

Chapters & Topics

Safety Factor for Landing Distance

> The safety factor for landing distance is 1.43. This means the calculated landing distance must be multiplied by 1.43 to ensure a safety margin. For example, if the calculated landing distance is 500 feet, the required runway length is 1.43 × 500 = 715 feet.

- **Keypoints**
  - Safety factor is 1.43.
  - Multiply calculated landing distance by 1.43.
  - Ensures a safety margin for landing.
  - Common exam question: ‘What is the factor for the safety landing distance?’
- **Explanation**
  The instructor emphasized remembering the number 1.43 for the safety factor. The calculation involves multiplying the actual landing distance by 1.43 to account for safety. For example, if the landing distance required is 500 feet, the total distance with the safety margin is 1.43 × 500 = 715 feet.
- **Examples**
  > If the real distance on the runway is 500 meters, and the safety factor is 1.43, then the required landing distance is 1.43 × 500 = 715 meters.

  - Identify the actual landing distance (e.g., 500 meters).
  - Multiply by the safety factor (1.43).
  - Result: 715 meters is the minimum runway length required for landing.
- **Considerations**
- Always use the safety factor in performance calculations.

- Remember the specific value (1.43) for exams.

Minimum Safe Altitude (MSA) and Obstacle Clearance

> MSA is the minimum altitude that provides safe clearance over obstacles along the flight route. The calculation involves finding the highest obstacle within 5 nautical miles of the route (and around departure, destination, and turning points), rounding up to the next 100 feet, and adding 1,000 feet.

- **Keypoints**
  - Search for the highest obstacle within 5 nautical miles on either side of the route.
  - Include a 5 nautical mile radius around departure, destination, and turning points.
  - Round the highest obstacle up to the next 100 feet.
  - Add 1,000 feet to the rounded obstacle height.
  - Result is the minimum safe altitude for the route.
- **Explanation**
  The instructor explained that to determine the minimum safe altitude, you must find the highest obstacle within 5 nautical miles of the route and around key points. Round this height up to the next 100 feet, then add 1,000 feet. For example, if the highest obstacle is 380 feet, round to 400, add 1,000, resulting in 1,400 feet as the minimum safe altitude.
- **Examples**
  > If the highest obstacle along the route is 380 feet, round up to 400 feet, then add 1,000 feet. The minimum safe altitude is 1,400 feet.

  - Identify the highest obstacle (380 feet).
  - Round up to next 100 (400 feet).
  - Add 1,000 feet (400 + 1,000 = 1,400 feet).
  - 1,400 feet is the minimum safe altitude for the route.
- **Considerations**
- Always round up obstacle heights.
- Check within 5 nautical miles on both sides of the route and around key points.
- Use the highest obstacle for calculation.
- **Special Circumstances**
- If encountering multiple obstacles, always use the highest one for calculation.
- If visibility is good and ground is visible, VFR flights may be conducted below the calculated minimum altitude, but not below regulatory minimums.

Semicircular Rule for Flight Levels

> The semicircular rule separates traffic by assigning odd or even flight levels based on magnetic track. For westbound flights (magnetic track 180° to 359°), maintain even flight levels (e.g., 2,500, 4,500, 6,500, 8,500 feet). For eastbound flights (magnetic track 000° to 179°), maintain odd flight levels (e.g., 3,500, 5,500, 7,500, 9,500 feet). In Spain, the rule is different: from 270° to 089°, maintain even levels; from 090° to 269°, maintain odd levels.

- **Keypoints**
  - Westbound (180°–359°): even flight levels (2,500, 4,500, 6,500, 8,500 feet).
  - Eastbound (000°–179°): odd flight levels (3,500, 5,500, 7,500, 9,500 feet).
  - VFR flights add 500 feet to the base level.
  - IFR flights use whole thousands (2,000, 4,000, etc.).
  - Spain-specific: 270°–089° even; 090°–269° odd.
- **Explanation**
  The instructor detailed the semicircular rule, emphasizing the difference between international (ICAO) and Spain-specific rules. For ICAO, odd levels are for 000°–179°, even for 180°–359°. In Spain, even levels are for 270°–089°, odd for 090°–269°. VFR flights add 500 feet to the base level.
- **Examples**
  > If flying on a magnetic track of 050°, use an odd flight level (e.g., 3,500 feet). If flying on 280°, use an even flight level (e.g., 4,500 feet). In Spain, if flying 280°, use even; if flying 100°, use odd.

  - Determine magnetic track.
  - Apply ICAO or Spain-specific rule.
  - Select appropriate odd/even flight level.
- **Considerations**
- Remember the specific ranges for odd/even levels.
- Spain uses a different semicircular rule than ICAO.
- VFR and IFR flights have different base levels.
- **Special Circumstances**
- If flying in Spain, always check the local semicircular rule, as it differs from ICAO.

Map Reading and Distance Measurement

> Aviation maps are typically at a scale of 1:500,000. Distances are measured using a plotter or ruler, with scales for nautical miles and statute miles. For flight planning, only nautical miles are used.

- **Keypoints**
  - Map scale is 1:500,000.
  - Use plotter/ruler to measure distances.

    - Nautical miles are standard for aviation.
    - Plotter shows increments (5, 10, 15, 20, 25 NM).
- **Explanation**
  The instructor demonstrated how to use the map and plotter to measure distances for flight planning. Only nautical miles are used for aviation purposes.
- **Considerations**
- Always use nautical miles for flight planning.
- Check the map scale before measuring.

Obstructions and Altitude Markings on Maps

> Obstructions such as windmills, mountains, and towers are marked on aviation maps. Heights are shown as AMSL (above mean sea level) and AGL (above ground level). The first number is AMSL, the second is AGL.

- **Keypoints**
    - Obstructions are marked with symbols and numbers.
    - First number: AMSL; second number: AGL.
    - Windmills and wind farms are common in Castilla and León.
    - Obstructions too low for maps may still be listed in AIP.
- **Explanation**
  The instructor explained how to identify obstructions on the map and interpret their altitude markings. If unsure, refer to the map legend, which is available in English and German.
- **Considerations**
- Check both AMSL and AGL values.
- Refer to AIP for obstructions not shown on maps.
- **Special Circumstances**
- If encountering an area with many windmills or other obstacles, ensure to use the highest marked value for obstacle clearance.

Aeronautical Information Publication (AIP) Usage

> The AIP contains detailed information about aerodromes, including charts, parking, and significant terrain or obstructions. For Spain, access AIP España online and search by aerodrome code.

- **Keypoints**
    - AIP provides aerodrome charts and information.
    - Significant terrain and obstructions are listed in the AIP.
    - Access AIP España online using aerodrome code (e.g., LERJ for Logroño).
    - Charts include ADC (aerodrome chart), parking, SID, IAC, etc.

- **Explanation**
  The instructor showed how to access AIP España online, filter by aerodrome code, and find relevant charts and information for flight planning.
- **Considerations**
- Always check AIP for updated aerodrome and obstruction information.
- Use the correct aerodrome code when searching.

Standard European Codes for Minimum Heights

> European regulations specify minimum heights for flight: 600 meters (2,000 feet) over mountainous areas, 300 meters (1,000 feet) over built-up areas, and 150 meters (500 feet) elsewhere.

- **Keypoints**
  - 600 meters / 2,000 feet over mountainous areas.
  - 300 meters / 1,000 feet over built-up areas.
  - 150 meters / 500 feet elsewhere.
- **Explanation**
  The instructor referenced the standard European codes, which are also covered in the air law curriculum.
- **Considerations**
- Do not fly below these minimum heights except in emergencies.

Obstacle Heights and Chart Depiction

> Obstacles in the attack area are measured in both Mean Sea Level (MSL) and Above Ground Level (AGL). For example, a lighted obstacle at 373 feet MSL at an airport with an elevation of 352 feet MSL results in an AGL height of 21 feet. Not all obstacles are depicted on aeronautical charts; only those above a certain threshold (100 meters or 329 feet) are shown. Lower obstructions, such as antennas or windmills, may not be depicted, requiring pilots to add a margin for safety.

- **Keypoints**
  - Obstacles are listed with both MSL and AGL heights.
  - Obstructions below 100 meters (329 feet) are not shown on VFR charts.
  - Pilots must add 300 feet to terrain elevation to account for possible unmarked obstructions before adding a 1000 feet safety margin.
- **Explanation**
  When planning a flight, pilots must check charts for obstacles. If an obstacle is listed as 373 feet MSL and the airport elevation is 352 feet MSL, the AGL is 21 feet. However, not all obstacles are shown, especially those under 100 meters. To ensure safety, pilots add 300 feet to the highest terrain elevation before adding the standard 1000 feet safety margin.

- **Examples**
  > A lighted obstacle is listed as 373 feet MSL at an airport with an elevation of 352 feet MSL. The AGL is calculated as 373 - 352 = 21 feet.

  - Identify the obstacle’s MSL height (373 feet).
  - Identify the airport’s elevation (352 feet MSL).
  - Subtract airport elevation from obstacle MSL: 373 - 352 = 21 feet AGL.
- **Considerations**
- Always check both MSL and AGL values for obstacles.
- Be aware that not all obstacles are depicted on charts.
- **Special Circumstances**
- If encountering a mountain with possible unmarked antennas or structures, add 300 feet to the terrain elevation before adding the 1000 feet safety margin.

Maximum Elevation Figure (MEF)

> MEF indicates the maximum possible elevation of an obstruction within a defined area (30 minutes latitude by 30 minutes longitude), providing a clearance of 1000 feet (or 2000 feet if terrain exceeds 5000 feet). It is not a safety altitude but a reference for the highest obstacle in the area.

- **Keypoints**
  - MEF is shown for each 30-minute latitude by 30-minute longitude box.
  - Provides 1000 feet clearance if highest point is 5000 feet or lower, 2000 feet if above 5000 feet.
  - Spot elevations and airspace structures are indicated in feet.
- **Explanation**
  On aeronautical maps, MEF is depicted as a red number in each grid box. Pilots refer to the legend to interpret these numbers. For example, if the highest point in a box is 4556 feet, the MEF would provide a 1000 feet clearance, resulting in a figure of 5556 feet.
- **Examples**
  > A map shows a red number in a 30-minute grid box. The legend states this is the MEF, which includes a 1000 feet clearance over the highest terrain or obstacle in that box.

  - Locate the red number in the grid box.
  - Refer to the legend for MEF definition.
  - Understand that the number includes the highest obstacle plus 1000 feet (or 2000 feet if terrain exceeds 5000 feet).
- **Considerations**
- Always refer to the map legend for MEF definitions.

- Understand the difference between MEF and minimum safe altitude.
- **Special Circumstances**
- If flying in an area where the highest terrain exceeds 5000 feet, ensure the MEF provides a 2000 feet clearance.

VFR Navigation Plan (PMO) and Time Calculation

> The VFR navigation plan includes all relevant flight details: date, call sign, registration, departure/arrival/alternate airports, takeoff/landing masses, elevations, fuel calculations, weather, frequencies, squawk, and actual onboard time (AOVT). All times are recorded in Zulu (UTC), with Spain observing UTC+2 in summer and UTC+1 in winter.

- **Keypoints**
  - AOVT is the actual time the pilot boards and signals the aircraft, recorded in Zulu time.
  - In Spain, summer is UTC+2, winter is UTC+1.
  - Flight schedules and logs must use UTC to avoid confusion.
- **Explanation**
  Pilots must fill out the navigation plan with all required details. For example, if a flight is scheduled at 09:00 Zulu in December, the local time is 10:00. Mistaking local time for UTC can result in being late for a flight.
- **Examples**
  > A flight is scheduled at 09:00 Zulu in December (winter). The local time in Spain is 10:00.

  - Identify the Zulu (UTC) time: 09:00.
  - Determine the time difference for winter in Spain: +1 hour.
  - Add 1 hour to 09:00: 10:00 local time.
- **Considerations**
- Always use Zulu time for flight logs and schedules.
- Memorize the time difference for summer and winter in Spain for exams.
- **Special Circumstances**
- If encountering a change from summer to winter time, check for official notifications to avoid scheduling errors.

Course Plotting and Distance Measurement

> Plotting a course involves using a plotter and map to draw a line from departure to destination, aligning with magnetic lines, and reading the true course. On a 1:500,000 scale map, the width of a thumb approximates 10 nautical miles.

- **Keypoints**

  - Align the plotter’s arrows with magnetic lines on the map.
  - Read the true course from the appropriate arrow.
  - Use thumb width as a quick estimate for 10 nautical miles on a 1:500,000 map.
- **Explanation**
  To plot a course from Logroño to Pamplona, draw a line between the two points, align the plotter, and read the true course (e.g., 060° true). Measure the distance (e.g., 35 nautical miles).
- **Examples**
  > Draw a line from Logroño to Pamplona, align the plotter with magnetic lines, and read the true course (060° true). Measure the distance as 35 nautical miles.

  - Place the plotter on the drawn line.
  - Align the plotter’s arrows with the map’s magnetic lines.
  - Read the true course from the plotter.
  - Measure the distance using the map scale.
- **Considerations**
- Use the correct scale for distance measurement.
- Apply variation if present (in Castilla and León, variation is zero).
- **Special Circumstances**
- If variation is not zero, use mnemonic techniques to determine whether to add or subtract the variation.

True Airspeed Calculation

> True airspeed is calculated using altitude, outside temperature, and calibrated airspeed. For example, at 7000 feet, 0°C, and 120 knots calibrated airspeed, the true airspeed is 133 knots.

- **Keypoints**
  - Use the CRP5 or equivalent flight computer for calculation.
  - Line up the altitude with temperature, then find calibrated airspeed on the inner scale and read true airspeed on the outer scale.
- **Explanation**
  Set the CRP5 to 7000 feet and 0°C, find 120 knots on the inner scale, and read 133 knots on the outer scale.
- **Examples**
  > At 7000 feet, 0°C, and 120 knots calibrated airspeed, the true airspeed is 133 knots.

  - Set the flight computer to 7000 feet and 0°C.
  - Locate 120 knots on the inner scale.

    - Read 133 knots on the outer scale as the true airspeed.
- **Considerations**
- Ensure correct input of altitude and temperature.
- Double-check calculations for accuracy.
- **Special Circumstances**
- If unsure about using the flight computer, seek assistance or practice with simpler examples first.

Mnemonic for Heading Conversions: C, D, M, V, T

> The mnemonic C, D, M, V, T stands for Compass, Deviation, Magnetic, Variation, True. It is used to remember the sequence and relationships when converting between compass, magnetic, and true headings/tracks.

- **Keypoints**
    - C: Compass heading or track
    - D: Deviation (difference between compass and magnetic, due to electromagnetic fields and aircraft-specific factors)
    - M: Magnetic heading or track
    - V: Variation (difference between magnetic and true, due to Earth's magnetic field)
    - T: True heading or track
- **Explanation**
  The mnemonic helps students remember the order and the necessary corrections to apply when converting between different types of headings. For example, to go from compass to magnetic, apply deviation; from magnetic to true, apply variation.
- **Examples**
  > For official exams, remembering C, D, M, V, T helps in quickly determining the correct sequence of corrections when converting headings.

    - Recall the mnemonic C, D, M, V, T.
    - Identify which heading you have and which you need.
    - Apply deviation and variation in the correct order and direction (add or subtract based on East/West).
- **Considerations**
- Always remember the mnemonic for exams and practical navigation.

Rules for Adding/Subtracting Variation and Deviation (East/West)

> When converting between headings, the direction (East or West) of variation and deviation determines whether you add or subtract the value. The rule changes

> depending on the direction of conversion (left to right or right to left in the mnemonic sequence).

- **Keypoints**
  - Left to right (e.g., Compass to True): East is plus, West is minus.
  - Right to left (e.g., True to Compass): East is minus, West is plus.
  - Mnemonic: ‘East is least, West is best’ (but context-dependent).
- **Explanation**
  When converting from compass to magnetic to true (left to right), add East variation/deviation and subtract West. When converting from true to magnetic to compass (right to left), subtract East and add West.
- **Examples**
  > Compass heading: 189, variation: 5 West, deviation: 1 East. Find magnetic course.

  - From compass to magnetic (left to right): West is less, so 189 - 5 = 184.
  - Variation is 1 East: add, so 184 + 1 = 185.

  > True heading: 250, variation: 5 West, deviation: 2 East. Find compass heading.

  - From true to magnetic (right to left): West is more, so 250 + 5 = 255.
  - Deviation is 2 East: subtract, so 255 - 2 = 253.
- **Considerations**
- Carefully determine the direction of conversion before applying the rule.
- Double-check whether you are adding or subtracting based on East/West and direction.
- **Special Circumstances**
- If unsure about the direction, refer back to the mnemonic and example calculations.

Departure and Arrival Procedures for Burgos and Logroño Airports

> Specific procedures must be followed for departures and arrivals at Burgos and Logroño airports, including altitude requirements, navigation points, and visual references.

- **Keypoints**
  - Burgos departure from runway 04: climb on runway heading until passing 3500 feet AMSA, then turn right to 110 heading, at 4500 feet turn left at Eco point, climb to 5000 feet.
  - Arrival at Burgos via Echo: be at 5000 feet at Echo, descend to 4500 feet at Echo One, then descend to 4000 feet before joining the downwind.
  - Logroño arrival (runway 23): enter via Whiskey 1, overfly city, join right downwind as instructed by ATC.

    - Each runway and airport may have different procedures; always check current charts and instructions.
- **Explanation**
  Pilots must follow published procedures for each airport and runway, including specific altitudes and navigation points. Visual references such as lakes or mountains may be used. ATC instructions must be followed, especially in complex or restricted airspace.
- **Examples**
  > Departing runway 04: climb on runway heading until 3500 feet AMSA, turn right to 110 heading, at 4500 feet turn left at Eco point, climb to 5000 feet.

    - After takeoff, monitor altimeter for 3500 feet AMSA.
    - At 3500 feet, turn right to heading 110.
    - At 4500 feet, turn left at Eco point, climb to 5000 feet.
    - Continue navigation as planned.

  > Arriving at Logroño runway 23: enter via Whiskey 1, overfly city, join right downwind as instructed.

    - Approach Whiskey 1, overfly the city on the left.
    - Wait for ATC instruction (e.g., 'join right downwind, runway 23').
    - Join right downwind, then base, then final for landing.
- **Considerations**
- Always check and follow the latest published procedures for each airport and runway.
- Be aware of visual references and navigation points.
- Understand that procedures may differ for each runway.
- **Special Circumstances**
- If flying in or near military or restricted airspace, obtain necessary clearances and avoid prohibited areas.

Minimum Safety Altitude (MSA) Calculation

> MSA is calculated as 1000 feet above the highest obstacle within 5 nautical miles of the route. The result is rounded up to the next 100 feet.

- **Keypoints**
    - Identify the highest point along the route (e.g., 839 feet).
    - Add 1000 feet to this value.
    - Round up to the next 100 feet.
- **Explanation**
  For example, if the highest terrain is 839 feet, add 1000 to get 1839 feet, then round up to 1900 feet for the MSA.

- **Examples**
  > Highest terrain: 839 feet. Add 1000 feet = 1839 feet. Round up to 1900 feet.

  - Find the highest obstacle: 839 feet.
  - Add 1000 feet: 839 + 1000 = 1839 feet.
  - Round up to the next 100: 1900 feet.
- **Considerations**
- Do not round down; always round up to the next 100 feet.
- Apply the 1000 feet rule within 5 nautical miles of the route.
- **Special Circumstances**
- If the highest obstacle is marked at a different value, repeat the process with the new value.

Special Airspace Considerations near Logroño

> Logroño is surrounded by military helicopter airspace and restricted areas. Flying in these areas without clearance is prohibited and may result in penalties.

- **Keypoints**
  - Military helicopter airspace is adjacent to Logroño airport.
  - Restricted areas are present; clearance is required to enter.
  - Violations may result in being reported or fined.
- **Explanation**
  Pilots must be aware of the airspace structure around Logroño and avoid entering restricted or military areas without proper clearance. Visual identification of helicopters and restricted zones is necessary.
- **Examples**
  > If flying near Logroño, avoid military helicopter airspace and restricted areas unless cleared.

  - Check charts for restricted and military zones.
  - Request clearance if necessary.
  - Avoid entry if clearance is not granted.
- **Considerations**
- Always check for restricted and military airspace before flight.
- Obtain necessary clearances before entering such areas.
- **Special Circumstances**
- If encountering military helicopters or being instructed by ATC, follow instructions and avoid restricted zones.

Formula for Calculating Nautical Air Miles (NAM)

> The formula relates nautical air miles (NAM), true airspeed, ground distance, and ground speed. It is used to determine the distance covered in the air versus on the ground, accounting for wind components.

- **Keypoints**
  - NAM / True Airspeed = Ground Distance / Ground Speed
  - Ground speed is affected by headwind or tailwind components.
  - If headwind, ground speed = true airspeed - headwind component.
  - If tailwind, ground speed = true airspeed + tailwind component.
  - NAM = (Ground Distance × True Airspeed) / Ground Speed
- **Explanation**
  In the example, true airspeed is 120, headwind component is 20, and ground distance is 200 nautical miles. Ground speed is calculated as 120 - 20 = 100. NAM = (200 × 120) / 100 = 240 nautical air miles.
- **Examples**
  > Given: True airspeed = 120, headwind component = 20, ground distance = 200 nautical miles. Ground speed = 120 - 20 = 100. NAM = (200 × 120) / 100 = 240.

  - Identify true airspeed, headwind component, and ground distance.
  - Calculate ground speed: true airspeed - headwind component.
  - Apply formula: NAM = (Ground Distance × True Airspeed) / Ground Speed.
  - Result: 240 nautical air miles.
- **Considerations**
- Always use the exact numbers provided for calculations.
- Account for wind direction (headwind or tailwind) when determining ground speed.
- **Special Circumstances**
- If wind data is missing, the formula cannot be accurately applied.

Criteria for Choosing Visual Waypoints

> Visual waypoints should be easily recognizable from the air, have unique characteristics, contrast with surroundings, and preferably have vertical extent or unique features.

- **Keypoints**
  - Waypoints large on the ground are easier to recognize from the air.
  - Waypoints that contrast with surroundings are easier to spot.
  - Waypoints with great vertical extent are easier to recognize.
  - Waypoints should be unique (e.g., C-shaped tower).
  - Lead-in features are useful.

    - Radionavigation aids (antennas) can be used if appropriate.
- **Explanation**
  The discussion covered which features make a waypoint suitable for visual navigation, emphasizing uniqueness, size, contrast, and vertical extent.
- **Considerations**
- Choose waypoints that are unique and easily distinguishable.
- Avoid waypoints that blend into the environment.
- **Special Circumstances**
- If no unique waypoint is available, use radionavigation aids if permitted.

Rounding Up Terrain Elevation and Adding Safety Margins

> When determining minimum safe altitudes, terrain elevation should be rounded up to the next hundred, and safety margins should be added for unmarked obstacles and obstacles in the area.

- **Keypoints**
    - Round up terrain elevation to the next hundred feet.
    - Add 300 feet for unmarked obstacles (e.g., antennas not shown on the map).
    - Add 1,000 feet for obstacles in the area.
    - Final minimum safe altitude is the sum of rounded elevation, 300 feet, and 1,000 feet.
- **Explanation**
  For a terrain elevation of 839 feet, round up to 900, add 300 for unmarked obstacles (total 1,200), then add 1,000 for obstacles (total 2,200 feet).
- **Examples**
  > Given: Highest terrain point = 839 feet. Round up to 900. Add 300 for unmarked obstacles = 1,200. Add 1,000 for obstacles = 2,200 feet.

    - Round 839 up to 900.
    - Add 300 for unmarked obstacles.
    - Add 1,000 for obstacles.
    - Total: 2,200 feet minimum safe altitude.
- **Considerations**
- Always round up to the next hundred.
- Add safety margins for unmarked and marked obstacles.
- **Special Circumstances**
- If obstacles are not shown on the map, always add the 300 feet margin.

Use of Wind Charts and Interpolation for Flight Planning

> Wind charts provide wind direction, speed, and temperature at various altitudes. Interpolation is used to estimate wind data between two altitudes.

- **Keypoints**
  - Wind charts list data for 1,000, 2,000, 5,000, 10,000, 18,000, and 24,000 feet.
  - Each entry includes wind direction, speed, and temperature.
  - To interpolate, average the values between two altitudes.
  - Example: (360 + 340) / 2 = 350 for wind direction; (35 + 30) / 2 = 32.5 for speed.
- **Explanation**
  For a flight at 2,000 feet, wind direction and speed are interpolated between the closest values to estimate the average wind for planning.
- **Examples**
  > Given: 360° at 35 knots and 340° at 30 knots. Average direction: (360 + 340) / 2 = 350°. Average speed: (35 + 30) / 2 = 32.5 knots.

  - Add the two wind directions and divide by 2.
  - Add the two wind speeds and divide by 2.
  - Use the averages for flight planning.
- **Considerations**
- Use the closest wind chart data to the departure airport.
- Interpolate when the desired altitude is between charted values.
- **Special Circumstances**
- If wind data is unavailable for a specific altitude, interpolate between the nearest available values.

Using the CRP-5 for Wind Correction Angle and Ground Speed

> The CRP-5 flight computer is used to determine wind correction angle, ground speed, and heading adjustments based on wind direction, speed, and aircraft airspeed.

- **Keypoints**
  - Align the blue dot with airspeed on the CRP-5.
  - Set wind direction on the device.
  - Mark wind speed down from airspeed.
  - Rotate to align with intended track.
  - Read drift (wind correction angle) and ground speed.
  - Adjust heading by subtracting or adding drift angle.
- **Explanation**
  Example: Airspeed 100 knots, wind 360° at 30 knots, track 090°. Mark 30 knots

down from 100 (at 70), rotate to 090, read drift (17° right), adjust heading to 073°, ground speed 95 knots.

- **Examples**

  > Given: Airspeed 100 knots, wind 360° at 30 knots, track 090°. Mark 30 knots down from 100 (at 70), rotate to 090, read drift (17° right), adjust heading to 073°, ground speed 95 knots.

  - Align blue dot with 100.
  - Set wind direction to 360.
  - Mark 30 knots down from 100 (at 70).
  - Rotate to 090.
  - Read drift (17° right), adjust heading to 073°.
  - Read ground speed (95 knots).
- **Considerations**
- Be precise when marking wind speed and aligning headings.
- Always adjust heading into the wind to correct for drift.
- **Special Circumstances**
- If wind is from the left, drift will be to the right; correct by turning left.

Application of Digital Tools like Windy for Wind Data

> Digital tools such as Windy can provide real-time wind data at various altitudes, aiding in flight planning and wind correction calculations.

- **Keypoints**
  - Windy provides wind direction and speed at selected altitudes.
  - Wind direction and speed can change rapidly with altitude.
  - Digital tools are recommended for up-to-date wind information.
- **Explanation**
  In Spain, instructors and students use Windy to retrieve wind data at different altitudes for flight planning.
- **Considerations**
- Download and use Windy or similar tools for accurate wind data.
- Wind direction and speed may vary significantly with altitude.
- **Special Circumstances**
- If digital tools are unavailable, use standard wind charts and interpolate as needed.

Wind Correction Methods (Wind-down and Wind-up)

> Two primary methods for applying wind correction in navigation are the wind-down and wind-up methods. The wind-down method involves placing the true airspeed

> dot below the circle, while the wind-up method places it above. The wind-down method is preferred by the instructor.

- **Keypoints**
  - Wind-down: Place true airspeed dot below the circle.
  - Wind-up: Place true airspeed dot above the circle.
  - Wind correction angle is measured and applied to the track.
  - Wind correction angle can be positive (right) or negative (left).
- **Explanation**
  The wind-down method is demonstrated step by step: align the blue circle with true airspeed (e.g., 80 knots), set wind direction (e.g., 180), measure down the wind speed (e.g., 40 knots), and then rotate to the desired track (e.g., 270). The wind correction angle is then read and applied to the heading. For example, if the wind correction angle is 27 degrees to the right, subtract it from the track (270 - 27 = 243). The ground speed is then read at this corrected heading.
- **Examples**
  > Given: Track 270, wind from 180 at 40 knots, true airspeed 80 knots. Find wind correction angle and ground speed.

  - Align blue circle with true airspeed (80 knots).
  - Set wind direction (180).
  - Measure down 40 knots from the blue circle.
  - Rotate to track (270).
  - Read wind correction angle (27 degrees to the right).
  - Correct heading: 270 - 27 = 243.
  - Read ground speed at 243 (72 knots).
- **Considerations**
- Always clarify if wind correction angle is given as positive or negative.
- Choose wind-down or wind-up method based on personal preference and exam requirements.
- **Special Circumstances**
- If wind correction angle is given as a negative value, subtract it from the track to turn left.
- If wind correction angle is given as a positive value, add it to the track to turn right.

Triangle of Speed, Time, and Distance

> The triangle of speed, time, and distance is a fundamental concept in navigation. Distance equals speed multiplied by time, and time can be found by dividing distance by speed.

- **Keypoints**

- Distance = Speed × Time
- Time = Distance ÷ Speed
- Speed = Distance ÷ Time

- **Explanation**
  To find the time required for a flight segment, divide the distance by the ground speed. For example, if ground speed is 124 knots and distance is 13.9, time = 13.9 ÷ 124. Use a scientific calculator to convert the decimal result into minutes and seconds.
- **Examples**
  > Given: Ground speed 124 knots, distance 13.9 nautical miles.

  - Time = 13.9 ÷ 124 = 0.11209677 hours.
  - Convert to minutes and seconds using calculator: 6 minutes, 17 seconds.
- **Considerations**
- Use a scientific calculator (CASIO FX82MS recommended) for accurate conversion.
- Be prepared to perform these calculations in exams.
- **Special Circumstances**
- If a calculator is not available, round the result appropriately but note that precision is important for exams.

Fuel Consumption and Legal Requirements

> Accurate calculation of fuel requirements is essential for safe flight planning. This includes trip fuel, taxi fuel, diversion fuel, contingency fuel, and legal reserves as per European regulations.

- **Keypoints**
  - Trip fuel: Fuel required for the planned route.
  - Taxi fuel: Fuel for taxiing at both departure and destination (e.g., 2 × 1.2 US gallons for 10 minutes each).
  - Diversion fuel: Fuel for alternate route (e.g., 13 minutes, 1.5 US gallons).
  - Final reserve: 30 minutes at normal cruising altitude (3.5 US gallons for day, 45 minutes for night).
  - Contingency fuel: 5% of trip fuel.
  - Total fuel = trip fuel + taxi fuel + diversion fuel + final reserve + contingency.
- **Explanation**
  Calculate each component: trip fuel (e.g., 4.9 gallons), taxi fuel (2.4 gallons for two airports), diversion fuel (1.5 gallons for 13 minutes), and final reserve (3.5 gallons for 30 minutes). Add all components for total required fuel (e.g., 4.9 + 2.4 + 1.5 + 3.5 = 12.3 gallons). Contingency fuel is calculated as 5% of trip fuel. For night flights, the final reserve is 45 minutes.

- **Examples**
  > Given: Trip fuel 4.9 gallons, taxi fuel 2.4 gallons, diversion fuel 1.5 gallons, final reserve 3.5 gallons.

  - Add all components: 4.9 + 2.4 + 1.5 + 3.5 = 12.3 gallons.
  - Ensure compliance with legal requirements for reserve fuel.
- **Considerations**
- Always include taxi fuel for both departure and destination.
- Include diversion and final reserve as per regulations.
- Contingency fuel is mandatory (5% of trip fuel).
- **Special Circumstances**
- If flying at night, increase final reserve to 45 minutes.
- If unable to land at destination, ensure sufficient fuel for alternate and 30-minute hold.

CDMVD Rule for Heading Conversion

> The CDMVD rule is used to convert between true, magnetic, and compass headings in navigation.

- **Keypoints**
  - CDMVD: Compass Deviation Magnetic Variation Deviation.
  - Used to convert from true to compass heading and vice versa.
- **Explanation**
  The instructor referenced the CDMVD rule for converting between different heading references. This is essential for accurate navigation and is often tested in exams.
- **Considerations**
- Remember the order and application of CDMVD for heading conversions.

Unit Conversion Using CRP-5

> CRP-5 is a navigation computer used for unit conversions in aviation, such as speed, distance, and fuel.

- **Keypoints**
  - CRP-5 can be used for all necessary unit conversions.
  - Memorization of values is optional if CRP-5 is available.
- **Explanation**
  The instructor advised students to use CRP-5 for conversions unless they prefer to memorize values. This tool is especially useful for exams and practical navigation.
- **Considerations**
- Familiarize yourself with CRP-5 before exams.

Calculation of Expected Lag Time and Ground Speed

> The process of determining expected lag time and ground speed using provided parameters such as lag track, distance, 2SP, wind, and CRT-5 for higher speeds.

- **Keypoints**
  - Align circles with current speed (e.g., 3, 5, 0)
  - Set wind direction (e.g., 0, 3, 0)
  - Measure wind speed down from reference (e.g., 350 below, so 250)
  - Set track (e.g., 090), determine drift direction and degrees (e.g., right, 60 degrees)
  - Adjust heading accordingly (e.g., 090 minus 16 = 74)
  - Calculate ground speed (e.g., 290) and use distance (e.g., 100)
  - Divide distance by ground speed to get time (e.g., 100/290 = 22)
- **Explanation**
  The instructor guides students through aligning navigation tools to current speed, setting wind direction, measuring wind speed, and adjusting heading based on drift. The ground speed is then used with the distance to calculate the expected lag time.
- **Examples**
  > Align circles with speed 3, 5, 0. Set wind direction 0, 3, 0. Wind speed down from 350 below, so 250. Track is 090. Drift to the right by 60 degrees. Heading is 090 minus 16, which is 74. Ground speed is 290. Distance is 100. 100 divided by 290 equals 22.

  - Align navigation circles to current speed (3, 5, 0).
  - Set wind direction (0, 3, 0).
  - Measure wind speed down from 350 below, so 250.
  - Set track to 090.
  - Determine drift: right by 60 degrees.
  - Adjust heading: 090 - 16 = 74.
  - Ground speed is 290.
  - Distance is 100.
  - Time = 100 / 290 = 22.
- **Considerations**
- Ensure all numerical values are used as given, without rounding or conversion.
- Double-check heading adjustments for drift direction and degrees.
- **Special Circumstances**
- If wind direction or speed changes during calculation, realign navigation tools and recalculate heading and ground speed.

Fuel Calculation for Flight Planning

> Detailed calculation of trip fuel, reserve fuel, taxi fuel, and total flight time, including conversion between kilograms and minutes, and calculation of fuel consumption rate.

- **Keypoints**
  - Trip fuel: 136 kg
  - Flight time: 2 hours 45 minutes
  - Calculated reserve: 30% of trip fuel
  - Taxi fuel: 3 kg
  - Convert flight time to minutes (2 hours = 120 minutes, plus 45 = 165 minutes)
  - Calculate consumption rate: 136 kg / 165 minutes = 0.8 kg/min
  - Reserve time: 40.8 kg / 0.8 kg/min = 51 minutes
  - Total time: 2 hours 45 minutes + 51 minutes = 3 hours 36 minutes
  - Taxi fuel time: 3 kg / 0.8 kg/min = 3.75 minutes
  - Final total time: 3 hours 38 minutes (rounded)
- **Explanation**
  The instructor walks through each step: calculating reserve fuel as 30% of trip fuel, converting flight time to minutes, determining fuel consumption rate, and then using these to find how many minutes the reserve will last. All times are summed, including taxi fuel, to get the total required time.
- **Examples**
  > Trip fuel is 136 kg. Reserve is 30% of 136 = 40.8 kg. Flight time is 2 hours 45 minutes = 165 minutes. Consumption rate is 136 / 165 = 0.8 kg/min. Reserve time is 40.8 / 0.8 = 51 minutes. Total time is 2 hours 45 minutes + 51 minutes = 3 hours 36 minutes. Taxi fuel is 3 kg, which is 3.75 minutes. Final total time is 3 hours 38 minutes.

  - Calculate reserve: 30% of 136 = 40.8 kg.
  - Convert flight time: 2 hours 45 minutes = 165 minutes.
  - Consumption rate: 136 / 165 = 0.8 kg/min.
  - Reserve time: 40.8 / 0.8 = 51 minutes.
  - Sum times: 2 hours 45 minutes + 51 minutes = 3 hours 36 minutes.
  - Taxi fuel: 3 / 0.8 = 3.75 minutes.
  - Final total: 3 hours 38 minutes.
- **Considerations**
- Always use exact numbers as provided.
- Include all components: trip, reserve, taxi fuel.
- Convert all times and units accurately.
- **Special Circumstances**

- If fuel flow changes during flight, recalculate consumption rate and adjust total time accordingly.

Calculation of Endurance and Range

> Determining possible flight time (endurance) and range based on maximum fuel, fuel flow, true airspeed, and wind (tailwind).

- **Keypoints**
  - Maximum fuel: 50
  - Fuel flow: 9.6 per hour
  - Endurance: 50 / 9.6 = 5 hours 12 minutes (rounded up to 13)
  - True airspeed: 100 knots
  - Tailwind: 15
  - Ground speed: 150
  - Range: 5 hours 30 minutes x 150 = 599 nautical miles
- **Explanation**
  The instructor explains that endurance is calculated by dividing maximum fuel by fuel flow. Ground speed is determined by adding true airspeed and tailwind. Range is then calculated by multiplying endurance (in hours) by ground speed.
- **Examples**
  > Maximum fuel is 50. Fuel flow is 9.6 per hour. Endurance is 50 / 9.6 = 5 hours 12 minutes (rounded up to 13). True airspeed is 100 knots. Tailwind is 15. Ground speed is 150. Range is 5 hours 30 minutes x 150 = 599 nautical miles.

  - Calculate endurance: 50 / 9.6 = 5 hours 12 minutes.
  - Add true airspeed and tailwind: 100 + 15 = 115 (but ground speed given as 150).
  - Multiply endurance by ground speed: 5.5 hours x 150 = 599 nautical miles.
- **Considerations**
- Ensure all values are used as given.
- Convert time to decimal hours for multiplication.
- **Special Circumstances**
- If wind changes during flight, recalculate ground speed and range.

Performance Exam Preparation

> Instructions for preparing for the performance exam, specifying what materials to study and what to exclude.

- **Keypoints**
  - Study the slides provided.

    - Do not study the graphs.
    - Focus on theory and questions without graphs.
    - Certain topics are explicitly not included in the exam.
- **Explanation**
  Students are advised to review the slides but not the graphs for the performance exam. Only theory and non-graph questions will be included. Repeated clarification is given that certain content is not on the exam.
- **Considerations**
- Do not waste time on graphs.
- Clarify with the instructor if unsure about included topics.
- **Special Circumstances**
- If unsure whether a topic is included, confirm with the instructor before the exam.

Assignments & Suggestions

- Practice wind correction and ground speed calculations at home.
- Write down the steps for wind correction methods as instructed.
- Prepare for the quiz using the provided fuel calculation and navigation examples.
- Obtain a scientific calculator (CASIO FX82MS) for exam preparation.
- Review and practice unit conversions using CRP-5.