I2202

WORKSHEET

Planned Route:

Takeoff: KSAT, RWY 31R
Altitude: 6,000’
Route: KRND via Radar vectors RND

Syllabus Notes

None

Special Syllabus Requirements

None

Discuss

a. Radial-arc intercepts **HSI EXAMPLE**

- Application
- FTI Procedures
  - Lead-point math
  - Arcing directions (cardinal direction N, NE = left or right turn?)
  - Initial actions once bearing pointer is placed on 90° benchmark (DME dependent)

b. Arcing **HSI EXAMPLE**

- Application
- FTI Procedures
  - DME response to bearing pointer position in relation to the 90° benchmark (no-wind)
  - Wind detection and correction

c. Arc-radial intercepts **HSI EXAMPLE**

- Application
- FTI Procedures
  - Lead-point math
  - CDI setup (appropriate inbound or outbound course set)

d. OBOGS malfunctions

- NATOPS Procedures

e. Hyperventilation / Hypoxia

- AIM

f. Ground Operations (Taxi) at unfamiliar airports (OPTIONAL ITEM)

- **Use of Airport Diagram**
  - Example: KSAT
    - Reporting position on airport in call for taxi
      - Understanding taxi instructions and readback requirements

T-6B Basic Instruments
I2200 Block

STUDENT GRADE SHEET DATE __________________ INSTRUCTOR __________________________

MEDIA: UTD VT- ________ BRIEF TIME: ________ NAME: ________________________________ EVENT:__________

#	MANEUVER	MIF	**I2201**	**I2202**	**I2203**	
1	GENERAL KNOWLEDGE / PROCEDURES	3+	X	X	X	
2	EMERGENCY PROCEDURES	3+	X	X	X	
3	HEADWORK / SITUATIONAL AWARENESS	3+	X	X	X	
4	BASIC AIRWORK	3+	X	X	X	
5	IN-FLIGHT CHECKS / FUEL MANAGEMENT	3+	X	X	X	
7	TASK MANAGEMENT	3+	X	X	X	
8	COMMUNICATION	3				
9	MISSION PLANNING / BRIEFING / DEBRIEFING	3				
10	GROUND OPERATIONS	3				
11	TAKEOFF	2				
12	DEPARTURE	2				
42	IFR UNUSUAL ATTITUDES	3+		X		
44	RADIAL INTERCEPTS	3+	X	X	X	
45	POINT-TO-POINT	3+			X	
46	ARCING	3+		X	X	
50	ENROUTE PROCEDURES	3				
51	ENROUTE DESCENT	3+	X	X	X	

DISCUSS ITEMS:

I2201: HSI orientation, direct to a VOR, over-the-station intercepts, and radial intercept procedures.

I2202: Arcing, radial-arc, arc-radial, OBOGS malfunctions, and hyperventilation / hypoxia.

I2203: Point-to-point, battery and generator failure.

DEPART ______________ ARRIVE ______________ SIDE # ______________ SIM TIME ___________

Figure 6-7 Double-the-Angle Intercept Inbound

__Outbound/Inbound Intercepts__

1. Turn onto new course/radial. Maintain the intercept heading until able to make a SRT onto the new course. The rate of bearing pointer and CDI movement will increase close to the station due to radial spacing.

2. Track on the desired course/radial.

Common Errors

1. Setting the wrong course into the CDI.

2. Turning in wrong direction.

605. RADIAL / ARC INTERCEPTS

Description

On some approaches, missed approaches and departure procedures, you will be required to transition from a radial onto an arc. In these situations a lead point will be calculated to determine when to start your turn off of the radial onto the arc.

Procedure

In the following example, consider an aircraft tracking outbound from a station, flying at 180 knots groundspeed, and turning onto an arc.

Determining Lead Point DME

1. Determine the turn radius of the aircraft (for 90° of turn). This is 0.5% of the groundspeed.

In this example: 0.5% of 180 = 0.9 NM

2. In this case, required Lead Point DME is 0.9 NM prior to reaching the arcing DME.

NOTE

1. If groundspeed is not available or cannot be computed in time for the turn, indicated airspeed may be used in the computation. This it is a ***no-wind*** lead point and should be adjusted for any known winds.

2. When intercepting an arc at speeds that preclude the use of a full SRT, using 1.0% of groundspeed will allow for a ½ SRT.

606. ARCING

Description

Arcing is defined as flying at a constant distance from a NAVAID by referencing DME from that station. Arcing about a NAVAID may be required to comply with an ATC clearance and is an integral part of many approaches, departure procedures, and arrivals. In practice, you do not actually fly a "perfect arc," but by varying AOB and heading, a close approximation of an arc can be achieved.

Procedure

1. Proceed direct to the arc entry point (radial and DME that defines the beginning of the arc).

2. Calculate the lead-point.

3. Determine the direction of turn at the lead-point.

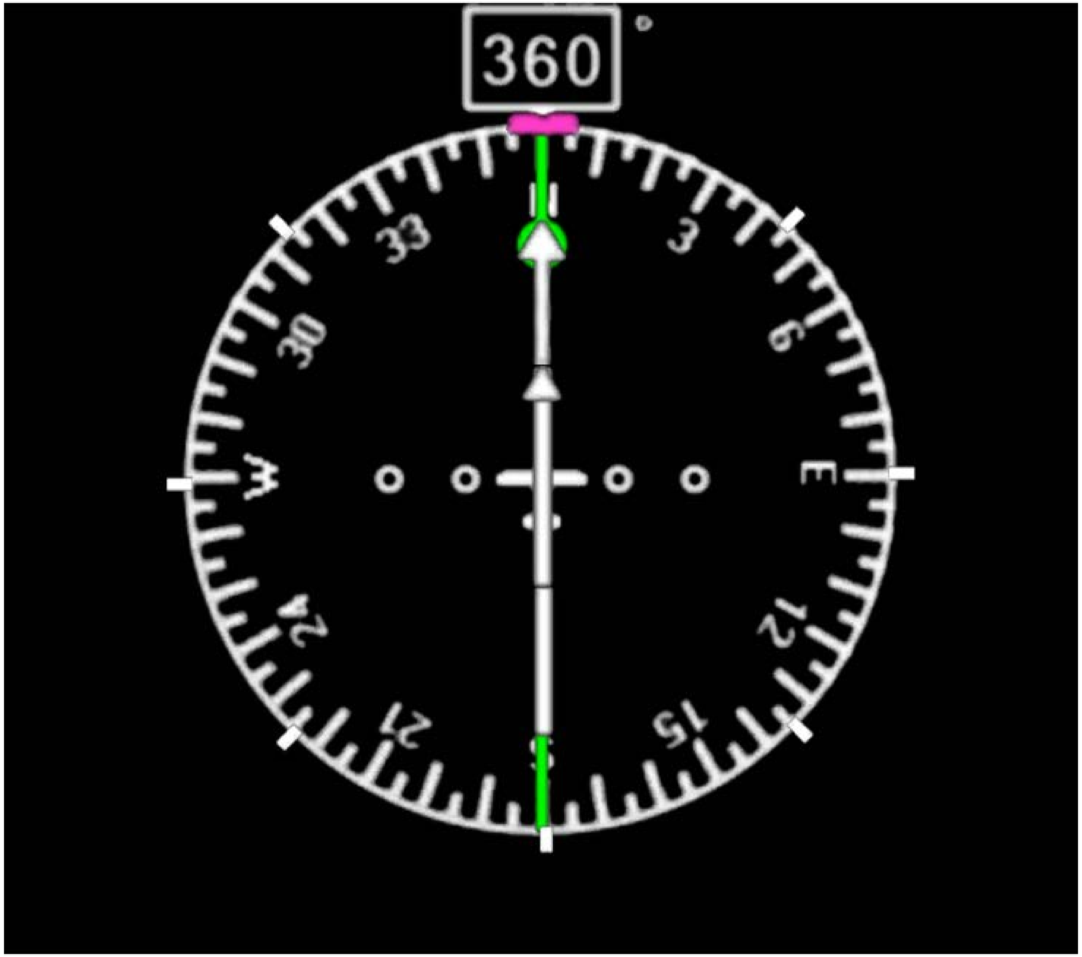
4. At the lead-point, start a SRT in the appropriate direction. Continue the turn to place the head of the bearing pointer on the 90º benchmark.

5. Check DME.

   a. If ***DME is less*** than desired, the aircraft is inside the arc. To correct back to the arc, simply maintain the heading. If excessively inside the arc (0.5 DME or more inside the arc), make a turn to place the head of the bearing pointer up to 15º below the 90º benchmark to return the aircraft back to the arc. Approaching the arc, lead the turn onto the arc and resume Arcing Procedures.

   b. If ***DME is greater*** than desired, the aircraft is outside the arc. To correct, turn to place the head of the bearing pointer up to 15º above the 90º benchmark.

Radial/ARC Intercepts



TASK: Track inbound on the SAT 180 Radial at 150 KIAS to intercept and arc east on the 10 DME arc. Use SRTs.

1. **Determine Lead DME**
   (SRT Lead DME = 0.5% of GS)
2. **Determine direction of turn**
   (in this case arcing east requires a right turn. This instruction may also be given as “ARC CCW”)

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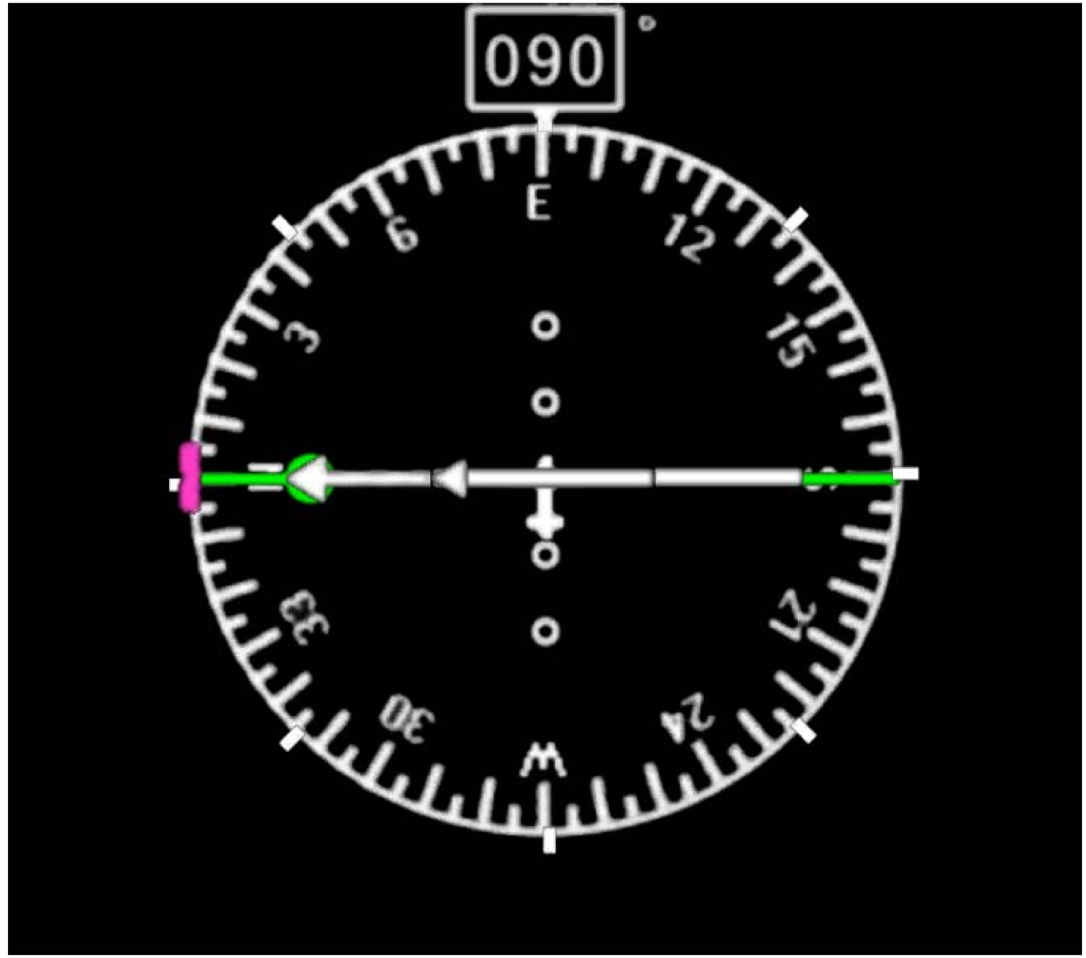
   (SRT Lead DME = 0.5% of GS)
2. **Determine direction of turn**
   (in this case arcing east requires a right turn. This instruction may also be given as "ARC CCW")
3. **At Lead DME, turn to place head of bearing pointer on the 90° benchmark**.
4. **Check DME**
   - **If DME <.5 inside arc, maintain heading to establish on the arc**
   - **If DME >/= .5 inside the arc, place head of bearing pointer below 90° benchmark to establish on the arc.**
   - **If DME > ARC, place head of bearing pointer above 90° benchmark to establish on the arc.**
5. **Commence arcing procedures**



In this example: 0.5% of 180 = 0.9 NM

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1. If groundspeed is not available or cannot be computed in time for the turn, indicated airspeed may be used in the computation. This it is a ***no-wind*** lead point and should be adjusted for any known winds.

2. When intercepting an arc at speeds that preclude the use of a full SRT, using 1.0% of groundspeed will allow for a ½ SRT.

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   b. If ***DME is greater*** than desired, the aircraft is outside the arc. To correct, turn to place the head of the bearing pointer up to 15º above the 90º benchmark.

6. Once established on the ARC in a no-wind situation, remain on the arc by altering aircraft heading and/or bank to maintain the head of the bearing pointer on or near the 90° benchmark. When altering aircraft heading, consider the position of the bearing pointer relative to the 90° benchmark. In a no-wind situation:

a. Head of the bearing pointer ***on*** 90° benchmark…DME constant (Figure 6-8).

b. Head of the bearing pointer ***below*** 90° benchmark…DME increases (Figure 6-9).

c. Head of the bearing pointer ***above*** 90° benchmark…DME decreases (Figure-6-10).

Figure 6-8 DME Constant

Figure 6-9 DME Increasing

Figure 6-10 DME Decreasing

Common Errors

1. Inadequate lead for heading corrections, (overshooting the arc).

2. Turning in the wrong direction to correct for arc deviations.

607. ARC / RADIAL INTERCEPTS

General

Turn off an arc to establish the aircraft on a radial (inbound or outbound) to the NAVAID.

Description

During some approaches, missed approaches and departure procedures, you will be required to fly an arc and then intercept a radial (inbound or outbound) from that arc. In this situation, you need to calculate a Lead Radial (LR) at which to start your turn off the arc to intercept the radial.

Procedure

In the following example, consider an aircraft on the 12 DME ARC flying at 180 knots groundspeed, turning onto an inbound course to the NAVAID.

Determining Lead Radial

1. Determine the number of radials per mile. Based on the 60-1 rule (at 60 DME each radial is 1 NM apart), 60 divided by the arcing DME equals the number of radials in one mile.

In this example: 60/12 = 5 radials per mile on the 12 DME arc.

2. Determine the turn radius of the aircraft for a 90° turn. This is 0.5% of the groundspeed.

ARCING

TASK: Maintain The 10 DME arc correcting for winds as required.

1. **Change heading to keep head of the bearing pointer on the 90° benchmark**.

   NOTE

   Heads **WILL** fall if the heading is not actively adjusted to keep it at the 90° benchmark

2. **If DME changes with head at the 90° benchmark a crosswind will need to be adjusted for.** (zero DME change reference point may be slightly above or below the 90° benchmark)
3. **General considerations** (no-wind)
   - **To keep DME constant** place head ON the 90° benchmark (Zero DME change reference point for no-wind)
   - **To increase DME** place head BELOW 90° benchmark
   - **To decrease DME** place head ABOVE 90° benchmark

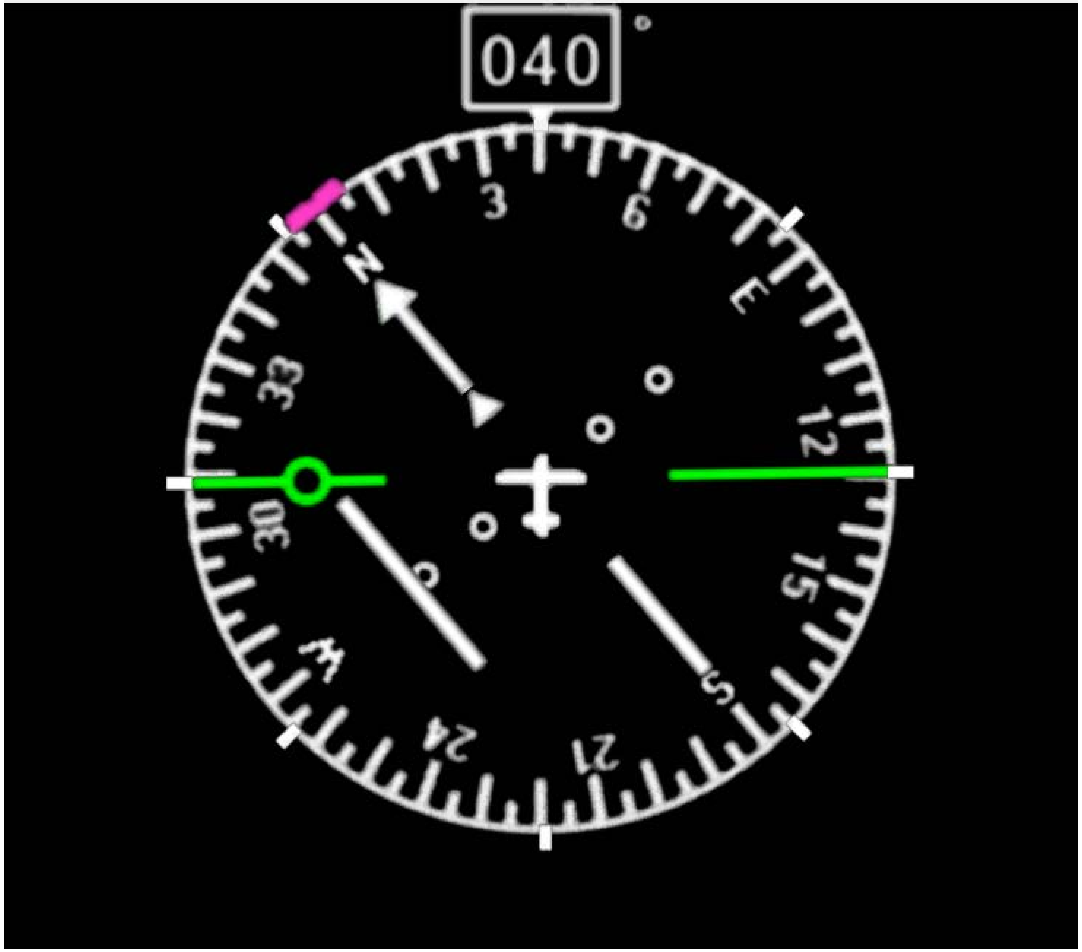

Figure 6-10 DME Decreasing

Common Errors

1. Inadequate lead for heading corrections, (overshooting the arc).

2. Turning in the wrong direction to correct for arc deviations.

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In this example: 60/12 = 5 radials per mile on the 12 DME arc.

2. Determine the turn radius of the aircraft for a 90° turn. This is 0.5% of the groundspeed.

In this example: 0.5% of 180 = 0.9 NM.

3. Multiply the turn radius by the number of radials per mile.

0.9 NM X 5 radials /NM = 4.5 radials.

This number of radials prior to the desired radial is the Lead Radial.

4. At the Lead Radial start a SRT onto new course/radial.

NOTE

1. If groundspeed is not available or cannot be computed in time for the turn, KIAS may be used in the computation. This is a No-Wind lead point and should be adjusted for any known winds.

2. When intercepting a radial from an ARC at speeds that preclude the use of a full SRT, using 1.0% of the groundspeed will allow for a ½ SRT

608. INTERSECTIONS

General

An intersection is a navigational fix that can be defined in the T-6B using VOR/DME, VOR ONLY (the intersection of two or more radials from two or more NAVAIDs) or GPS. Intersections are used to identify significant points along departure procedures, airways, arrivals, holding areas, approach procedures, and missed approaches. When referencing two or more NAVAIDs, the PRIMARY NAVAID is the one used navigate a track to the intersection. A SECONDARY NAVAID is one that provides a crosscut to identify the intersection along the primary track.

Description

Tasks that may be required at an intersection include:

1. Noting the time of arrival for a required report.

2. Turning onto a new course/airway.

3. Passing through the intersection (maintaining the same course outbound).

4. Transitions (changes in airspeed, configuration or altitude).

5. Holding entry.

ARC/RADIAL INTERCEPT

TASK: Continue arcing at 10 DME. From the ARC turn to intercept the 090 radial outbound.

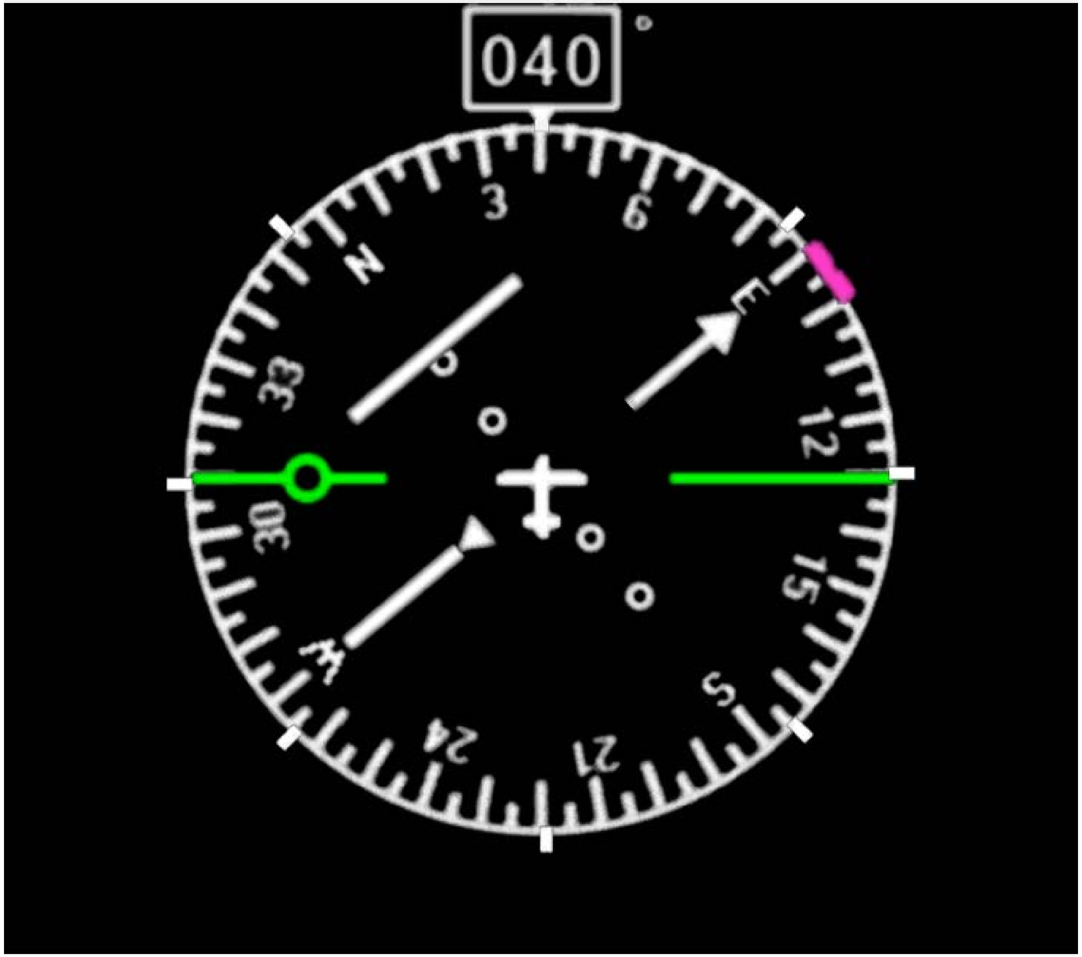
1. **Set the new course into the CDI** (090° for outbound)
2. **Determine Lead Radial** (# of radials for lead Radial = 0.5% of groundspeed * (60/ARCs DME)

Example:

160 KTS GS * .5% = .8nm lead point

60/10 DME ARC = 6 radials/nm
.8nm lead point * 6 nm/radial = 4.8 rounded up will be 5 radials prior

Lead radial will be 095



ARC/RADIAL INTERCEPT

Continue on the 10 DME arc and turn to intercept the 090 radial outbound using a SRT.

1. **Set the new course into the CDI** (090° for outbound)
2. **Determine Lead Radial** (# of radials for lead Radial = 0.5% of groundspeed * (60/ARCs DME)
3. **At the lead radial begin turn onto new course.** (right SRT in this case)

WARNING

- Do not stall aircraft or slow to the point that full stick or rudder is required to maintain aircraft control. In no case should the aircraft be slowed below 90 KIAS or to activation of the stick shaker (approximately 15.5 AOA), whichever is higher.
- Do not change configuration once controllability check is complete, as additional structural damage and/or an unsafe landing condition may occur.

CAUTION

If flap system damage is known or suspected, do not reposition flaps.

NOTE

Ensure all power options (idle to max power) are attempted during the controllability check. With the PCL at IDLE, zero torque will simulate the flare and landing. This condition should demonstrate if the rudder is available for a normal landing.

3. Fly no slower than minimum controllable airspeed plus 20 KIAS until on final approach
4. Fly a power-on, straight-in approach requiring minimum flare and plan to touch down at no less than previously determined minimum controllable airspeed

WARNING

Without full rudder authority and a crosswind component greater than 5 knots, directional control on final approach may be extremely difficult due to the inability to apply proper crosswind controls. Fly a no-flap, straight-in approach. If the need arises to discontinue the approach or go-around, a slow and steady application of the PCL may prevent torque effect from exacerbating aircraft control problems. On landing roll, differential braking may be required in order to prevent departure from the prepared surface.

CAUTION

Landings have been accomplished at touchdown speeds up to approximately 110 KIAS with landing flaps and 130 KIAS with flaps up. Anticipate increased directional sensitivity and longer landing distances at touchdown speeds above 100 KIAS. High touchdown airspeeds also increase the potential for a blown tire, brake fade, and/or overheated brakes.

NOTE

Differential braking may aid in directional control upon touchdown.

OBOGS FAIL MESSAGE

If the engine has failed or has been shutdown, refer to OBOGS Failure/Physiological Symptoms procedures. Illumination of the OBOGS FAIL warning indicates the OBOGS system is no longer producing sufficient oxygen concentration or pressure. This condition may indicate a failure of the OBOGS heat exchanger, concentrator, bleed air supply, electrical system interface, or excessive system leakage. Failure of the OBOGS system may be accompanied by reduced pressure and/or quantity of breathing gas and may result in hypoxia symptoms if corrective action is not taken immediately.

WARNING

- If physiological symptoms are recognized at any point, proceed immediately to the OBOGS FAILURE/PHYSIOLOGICAL SYMPTOMS Checklist.
- If the battery is depleted or fails, OBOGS will be inoperative.

* 1. PCL - Advance

NOTE

Advance PCL as required to extinguish OBOGS FAIL warning. At low bleed air pressure conditions (e.g., PCL idle at high altitudes), bleed air pressure may drop sufficiently to momentarily illuminate the OBOGS FAIL warning. This does not necessarily indicate an OBOGS failure. If OBOGS FAIL warning extinguishes, continue flight.

2. OBOGS - CHECK (BOTH):
   a. OBOGS supply lever - ON
   b. OBOGS concentration lever - MAX
   c. OBOGS pressure lever - EMERGENCY
   d. OBOGS flow indicator - Check (flow indicator for normal operation)

3. Oxygen hose/CRU-60/P connection - Check (BOTH)
4. Oxygen mask - Check for leaks (BOTH)

WARNING

It is possible to experience hypoxia symptoms if OBOGS has malfunctioned.

CAUTION

When breathing oxygen under increased pressure, breathe at a rate and depth slightly less than normal to preclude hyperventilation.

NOTE

The OBOGS FAIL warning will illuminate if both supply levers are set to OFF with the engine running.

IF OBOGS FAIL WARNING REMAINS ILLUMINATED (AFTER 20 SECONDS):

5. OBOGS FAILURE/PHYSIOLOGICAL SYMPTOMS Checklist - Execute

OBOGS FAILURE/ PHYSIOLOGICAL SYMPTOMS

An OBOGS system failure will occur if the engine is not running or if the battery fails (OBOGS FAIL message illuminated), and also due to an OBOGS heat exchanger failure (OBOGS TEMP message illuminated). OBOGS system failure may occur without either message illumination and may be indicated by physiological symptoms to include: shortness of breath, confusion, lethargy, lack of judgment, headache, rapid heart rate, elevated respiratory rate, euphoria, sense of well-being, tingling, warm sensations, hypertension, lack of coordination and impaired vision. These symptoms may be a result of hypoxia (an insufficient supply of oxygen to the brain) or exposure to toxins. If an OBOGS system failure or physiological symptoms are recognized, proceed as follows:

* 1. **GREEN RING - PULL (AS REQUIRED) (BOTH)**

WARNING

- Emergency oxygen bottle provides approximately 10 minutes of oxygen. If aircraft pressure altitude is above 10,000 feet MSL, ensure the aircraft reaches an altitude of 10,000 feet MSL or lower prior to exhaustion of the emergency oxygen supply or the effects of hypoxia may incapacitate the crew.
- The OBOGS concentrator may malfunction resulting in zeolite dust in the breathing system without an illumination of the OBOGS FAIL light. Indications of this malfunction include respiratory irritation, coughing, or the presence of white dust in the oxygen mask. Prolonged inhalation of zeolite dust should be avoided.

CAUTION

When breathing oxygen under increased pressure, breathe at a rate and depth slightly less than normal to preclude hypertension.

NOTE

- When the emergency oxygen system is actuated, high pressure air may make verbal communication with the other crewmember or ATC more difficult.
- Once activated, emergency oxygen cannot be shut off and will provide oxygen flow until the cylinder is depleted (10 minutes). Since the emergency oxygen system is not regulated, it is normal for pressure to gradually decrease to the point it feels like the oxygen is depleted before reaching 10 minutes of use.

* 2. **DESCENT BELOW 10,000 FEET MSL - INITIATE**

* 3. **DISCONNECT MAIN OXYGEN SUPPLY HOSE FROM CRU-60/P**

NOTE

Avoid inadvertently disconnecting COMM cable when disconnecting main oxygen hose.

4. Emergency oxygen hose - Check (BOTH)
5. Rate and depth of breathing - Normalize (BOTH)

NOTE

As the emergency oxygen flow decreases, breathing through the CRU-60/P anti-suffocation valve will become increasingly noticeable and uncomfortable.

6. OBOGS - OFF (BOTH)

Below 10,000 feet MSL

7. PRESSURIZATION switch - RAM/DUMP

NOTE

- Selecting RAM/DUMP does not shut off bleed air inflow.
- Defog is turned off when RAM/DUMP is selected.

8. BLEED AIR INFLOW switch - OFF
9. Oxygen mask - Remove (As Required) (BOTH)

WARNING

Oxygen mask must be on and secure before actuating CFS or initiating ejection.

10. Land as soon as practical

WARNING

If physiological symptoms persist and the pilot(s) feel unsafe to land, maintain below 10,000 feet MSL as long as practical before considering ejection.

Initial Aircraft Altitude (feet)	Descent Rate (feet/min) Maintained to Achieve 10,000 feet MSL Within 10 Minutes
31,000	2100
28,000	1800
25,000	1500
23,500 and lower	1350

ENVIRONMENTAL SYSTEMS DUCT OVERTEMP

Illumination of the DUCT TEMP caution indicates that bleed air temperature in the environmental systems duct has exceeded 300 °F at either or both of the temperature sensors.

1. Cockpit temperature controller - MANUAL
2. Cockpit temperature controller - COLD; hold for 30 seconds

IF CONDITIONS PERSIST:

3. DEFOG switch - OFF

IF CONDITIONS PERSIST:

4. Descent below 18,000 ft MSL - Initiate (as required)
5. BLEED AIR INFLOW switch - OFF

NOTE

Cabin pressurization will bleed out through the cabin pressurization outflow valves when the inflow switch is set to OFF. The canopy pressure seal and anti-G systems will not be operational.

DEFOG VALVE FAILS TO CLOSE IN FLIGHT

If the defog valve fails to close in flight and cockpit heat becomes very uncomfortable, the TEMP CONTROL switch can be used to minimize cockpit heat input.

Verify that appropriate time has elapsed before initiating the following procedure. The electrically controlled defog valve may take up to 40 seconds to close.

1. AIR COND switch - ON
2. Cockpit temperature controller - MANUAL
3. Cockpit temperature controller - COLD; hold for 30 seconds
4. Verify defog not needed for visibility
5. Verify DEFOG switch - OFF
6. PRESSURIZATION switch - RAM/DUMP at or below 18,000 ft MSL
7. BLEED AIR INFLOW switch - OFF
8. Land as soon as practical

TRIM SYSTEM MALFUNCTIONS

Whenever the trim interrupt button is being depressed, or when the trim disconnect switch is set to disconnect, all trim systems are disengaged and the TAD is disconnected. When an individual trim system circuit breaker is pulled, the respective trim system will be inoperative. If the rudder trim circuit breaker is pulled, automatic TAD correction inputs for power and configuration changes will be unavailable.

Runaway Trim

1. Trim interrupt button (control stick) - Depress and hold
2. Airspeed - As required to reduce control forces

NOTE

Except when trim is at full nose down, reducing airspeed to 110-150 KIAS will reduce control forces. Adding power will cause a pitch up/left yaw, while reducing power will cause a pitch down/right yaw. With full nose down trim, cruise and approach as fast as practical to reduce pitch forces.

3. TRIM DISCONNECT switch (left console) - TRIM DISCONNECT
4. Trim interrupt button (control stick) - Release
5. AIL/EL TRIM or RUD TRIM circuit breaker(s) (left front console) - Pull, as required

easily committed to memory is being distributed by the FAA in the form of a wallet-sized card.

i. PERSONAL CHECKLIST. ***I'm physically and mentally safe to fly; not being impaired by:***

Illness

Medication

Stress

Alcohol

Fatigue

Emotion

8−1−2. Effects of Altitude

a. Hypoxia.

1. Hypoxia is a state of oxygen deficiency in the body sufficient to impair functions of the brain and other organs. Hypoxia from exposure to altitude is due only to the reduced barometric pressures encountered at altitude, for the concentration of oxygen in the atmosphere remains about 21 percent from the ground out to space.

2. Although a deterioration in night vision occurs at a cabin pressure altitude as low as 5,000 feet, other significant effects of altitude hypoxia usually do not occur in the normal healthy pilot below 12,000 feet. From 12,000 to 15,000 feet of altitude, judgment, memory, alertness, coordination and ability to make calculations are impaired, and headache, drowsiness, dizziness and either a sense of well-being (euphoria) or belligerence occur. The effects appear following increasingly shorter periods of exposure to increasing altitude. In fact, pilot performance can seriously deteriorate within 15 minutes at 15,000 feet.

3. At cabin pressure altitudes above 15,000 feet, the periphery of the visual field grays out to a point where only central vision remains (tunnel vision). A blue coloration (cyanosis) of the fingernails and lips develops. The ability to take corrective and protective action is lost in 20 to 30 minutes at 18,000 feet and 5 to 12 minutes at 20,000 feet, followed soon thereafter by unconsciousness.

4. The altitude at which significant effects of hypoxia occur can be lowered by a number of factors. Carbon monoxide inhaled in smoking or from exhaust fumes, lowered hemoglobin (anemia), and certain medications can reduce the oxygen-carrying capacity of the blood to the degree that the amount of oxygen provided to body tissues will already be equivalent to the oxygen provided to the tissues when exposed to a cabin pressure altitude of several thousand feet. Small amounts of alcohol and low doses of certain drugs, such as antihistamines, tranquilizers, sedatives and analgesics can, through their depressant action, render the brain much more susceptible to hypoxia. Extreme heat and cold, fever, and anxiety increase the body's demand for oxygen, and hence its susceptibility to hypoxia.

5. The effects of hypoxia are usually quite difficult to recognize, especially when they occur gradually. Since symptoms of hypoxia do not vary in an individual, the ability to recognize hypoxia can be greatly improved by experiencing and witnessing the effects of hypoxia during an altitude chamber "flight." The FAA provides this opportunity through aviation physiology training, which is conducted at the FAA Civil Aeromedical Institute and at many military facilities across the U.S. To attend the Physiological Training Program at the Civil Aeromedical Institute, Mike Monroney Aeronautical Center, Oklahoma City, OK, contact by telephone (405) 954−6212, or by writing Aerospace Medical Education Division, AAM−400, CAMI, Mike Monroney Aeronautical Center, P.O. Box 25082, Oklahoma City, OK 73125.

NOTE−
To attend the physiological training program at one of the military installations having the training capability, an application form and a fee must be submitted. Full particulars about location, fees, scheduling procedures, course content, individual requirements, etc., are contained in the Physiological Training Application, Form Number AC 3150−7, which is obtained by contacting the accident prevention specialist or the office forms manager in the nearest FAA office.

6. Hypoxia is prevented by heeding factors that reduce tolerance to altitude, by enriching the inspired air with oxygen from an appropriate oxygen system, and by maintaining a comfortable, safe cabin pressure altitude. For optimum protection, pilots are encouraged to use supplemental oxygen above

10,000 feet during the day, and above 5,000 feet at night. The CFRs require that at the minimum, flight crew be provided with and use supplemental oxygen after 30 minutes of exposure to cabin pressure altitudes between 12,500 and 14,000 feet and immediately on exposure to cabin pressure altitudes above 14,000 feet. Every occupant of the aircraft must be provided with supplemental oxygen at cabin pressure altitudes above 15,000 feet.

b. Ear Block.

1. As the aircraft cabin pressure decreases during ascent, the expanding air in the middle ear pushes the eustachian tube open, and by escaping down it to the nasal passages, equalizes in pressure with the cabin pressure. But during descent, the pilot must periodically open the eustachian tube to equalize pressure. This can be accomplished by swallowing, yawning, tensing muscles in the throat, or if these do not work, by a combination of closing the mouth, pinching the nose closed, and attempting to blow through the nostrils (Valsalva maneuver).

2. Either an upper respiratory infection, such as a cold or sore throat, or a nasal allergic condition can produce enough congestion around the eustachian tube to make equalization difficult. Consequently, the difference in pressure between the middle ear and aircraft cabin can build up to a level that will hold the eustachian tube closed, making equalization difficult if not impossible. The problem is commonly referred to as an "ear block."

3. An ear block produces severe ear pain and loss of hearing that can last from several hours to several days. Rupture of the ear drum can occur in flight or after landing. Fluid can accumulate in the middle ear and become infected.

4. An ear block is prevented by not flying with an upper respiratory infection or nasal allergic condition. Adequate protection is usually not provided by decongestant sprays or drops to reduce congestion around the eustachian tubes. Oral decongestants have side effects that can significantly impair pilot performance.

5. If an ear block does not clear shortly after landing, a physician should be consulted.

c. Sinus Block.

1. During ascent and descent, air pressure in the sinuses equalizes with the aircraft cabin pressure through small openings that connect the sinuses to the nasal passages. Either an upper respiratory infection, such as a cold or sinusitis, or a nasal allergic condition can produce enough congestion around an opening to slow equalization, and as the difference in pressure between the sinus and cabin mounts, eventually plug the opening. This "sinus block" occurs most frequently during descent.

2. A sinus block can occur in the frontal sinuses, located above each eyebrow, or in the maxillary sinuses, located in each upper cheek. It will usually produce excruciating pain over the sinus area. A maxillary sinus block can also make the upper teeth ache. Bloody mucus may discharge from the nasal passages.

3. A sinus block is prevented by not flying with an upper respiratory infection or nasal allergic condition. Adequate protection is usually not provided by decongestant sprays or drops to reduce congestion around the sinus openings. Oral decongestants have side effects that can impair pilot performance.

4. If a sinus block does not clear shortly after landing, a physician should be consulted.

d. Decompression Sickness After Scuba Diving.

1. A pilot or passenger who intends to fly after scuba diving should allow the body sufficient time to rid itself of excess nitrogen absorbed during diving. If not, decompression sickness due to evolved gas can occur during exposure to low altitude and create a serious inflight emergency.

2. The recommended waiting time before going to flight altitudes of up to 8,000 feet is at least 12 hours after diving which has not required controlled ascent (nondecompression stop diving), and at least 24 hours after diving which has required controlled ascent (decompression stop diving). The waiting time before going to flight altitudes above 8,000 feet should be at least 24 hours after any SCUBA dive. These recommended altitudes are actual flight altitudes above mean sea level (AMSL) and not pressurized cabin altitudes. This takes into consideration the risk of decompression of the aircraft during flight.

8−1−3. Hyperventilation in Flight

a. Hyperventilation, or an abnormal increase in the volume of air breathed in and out of the lungs, can occur subconsciously when a stressful situation is encountered in flight. As hyperventilation "blows off" excessive carbon dioxide from the body, a pilot can experience symptoms of lightheadedness, suffocation, drowsiness, tingling in the extremities, and coolness and react to them with even greater hyperventilation. Incapacitation can eventually result from incoordination, disorientation, and painful muscle spasms. Finally, unconsciousness can occur.

b. The symptoms of hyperventilation subside within a few minutes after the rate and depth of breathing are consciously brought back under control. The buildup of carbon dioxide in the body can be hastened by controlled breathing in and out of a paper bag held over the nose and mouth.

c. Early symptoms of hyperventilation and hypoxia are similar. Moreover, hyperventilation and hypoxia can occur at the same time. Therefore, if a pilot is using an oxygen system when symptoms are experienced, the oxygen regulator should immediately be set to deliver 100 percent oxygen, and then the system checked to assure that it has been functioning effectively before giving attention to rate and depth of breathing.

8−1−4. Carbon Monoxide Poisoning in Flight

a. Carbon monoxide is a colorless, odorless, and tasteless gas contained in exhaust fumes. When breathed even in minute quantities over a period of time, it can significantly reduce the ability of the blood to carry oxygen. Consequently, effects of hypoxia occur.

b. Most heaters in light aircraft work by air flowing over the manifold. Use of these heaters while exhaust fumes are escaping through manifold cracks and seals is responsible every year for several nonfatal and fatal aircraft accidents from carbon monoxide poisoning.

c. A pilot who detects the odor of exhaust or experiences symptoms of headache, drowsiness, or dizziness while using the heater should suspect carbon monoxide poisoning, and immediately shut off the heater and open air vents. If symptoms are severe or continue after landing, medical treatment should be sought.

8−1−5. Illusions in Flight

a. Introduction. Many different illusions can be experienced in flight. Some can lead to spatial disorientation. Others can lead to landing errors. Illusions rank among the most common factors cited as contributing to fatal aircraft accidents.

b. Illusions Leading to Spatial Disorientation.

1. Various complex motions and forces and certain visual scenes encountered in flight can create illusions of motion and position. Spatial disorientation from these illusions can be prevented only by visual reference to reliable, fixed points on the ground or to flight instruments.

2. The leans. An abrupt correction of a banked attitude, which has been entered too slowly to stimulate the motion sensing system in the inner ear, can create the illusion of banking in the opposite direction. The disoriented pilot will roll the aircraft back into its original dangerous attitude, or if level flight is maintained, will feel compelled to lean in the perceived vertical plane until this illusion subsides.

(a) Coriolis illusion. An abrupt head movement in a prolonged constant-rate turn that has ceased stimulating the motion sensing system can create the illusion of rotation or movement in an entirely different axis. The disoriented pilot will maneuver the aircraft into a dangerous attitude in an attempt to stop rotation. This most overwhelming of all illusions in flight may be prevented by not making sudden, extreme head movements, particularly while making prolonged constant-rate turns under IFR conditions.

(b) Graveyard spin. A proper recovery from a spin that has ceased stimulating the motion sensing system can create the illusion of spinning in the opposite direction. The disoriented pilot will return the aircraft to its original spin.

(c) Graveyard spiral. An observed loss of altitude during a coordinated constant-rate turn that has ceased stimulating the motion sensing system can create the illusion of being in a descent with the wings level. The disoriented pilot will pull back on the controls, tightening the spiral and increasing the loss of altitude.

(d) Somatogravic illusion. A rapid acceleration during takeoff can create the illusion of being

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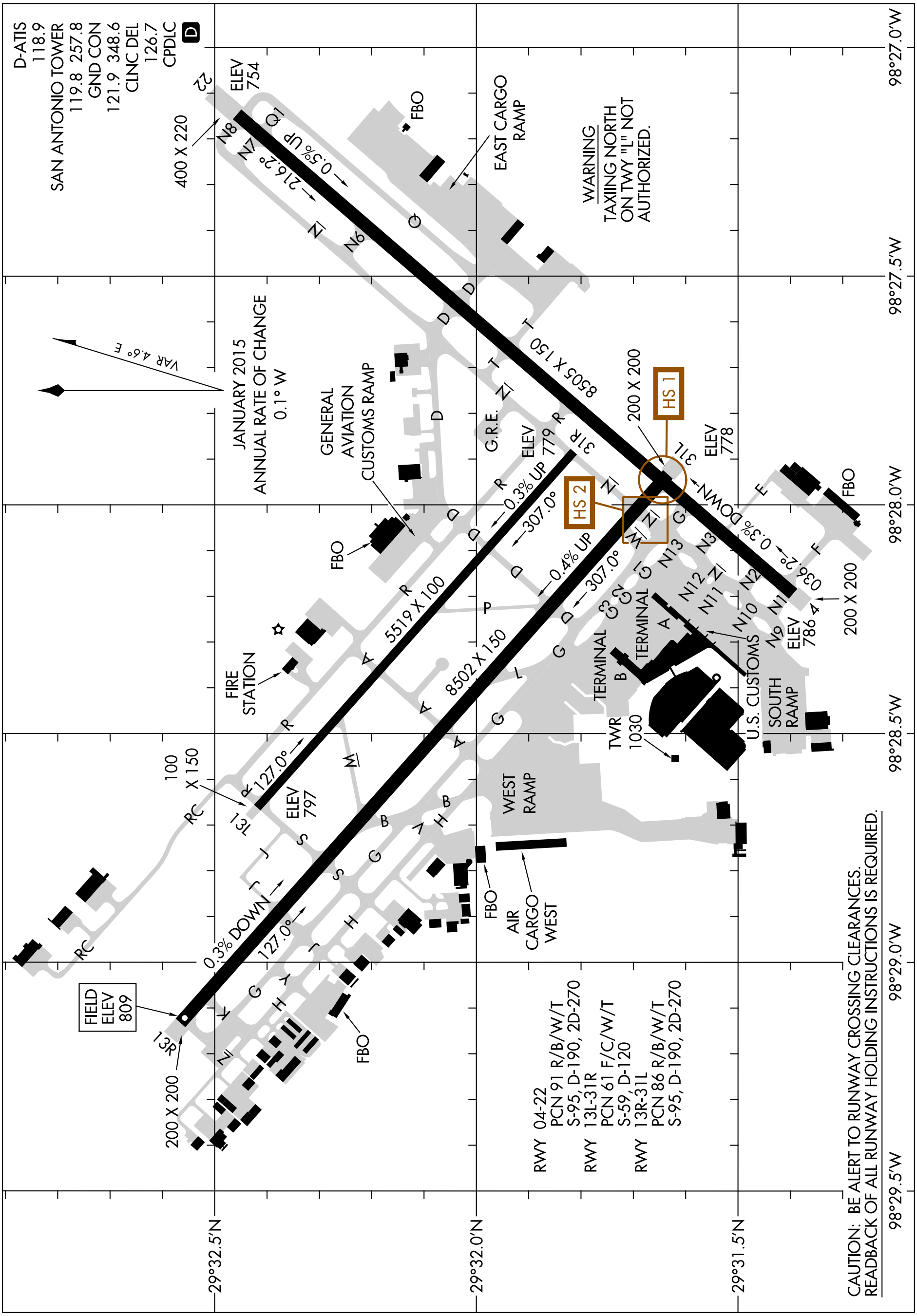

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