Approaches - Types, Limitations, Regulations

Objective

To demonstrate the kinds of approaches, approach limitations, and regulations that govern how we fly approach procedures.

Introduce basic approach concepts for precision, non-precision, GPS, and other types of approaches.

Overview

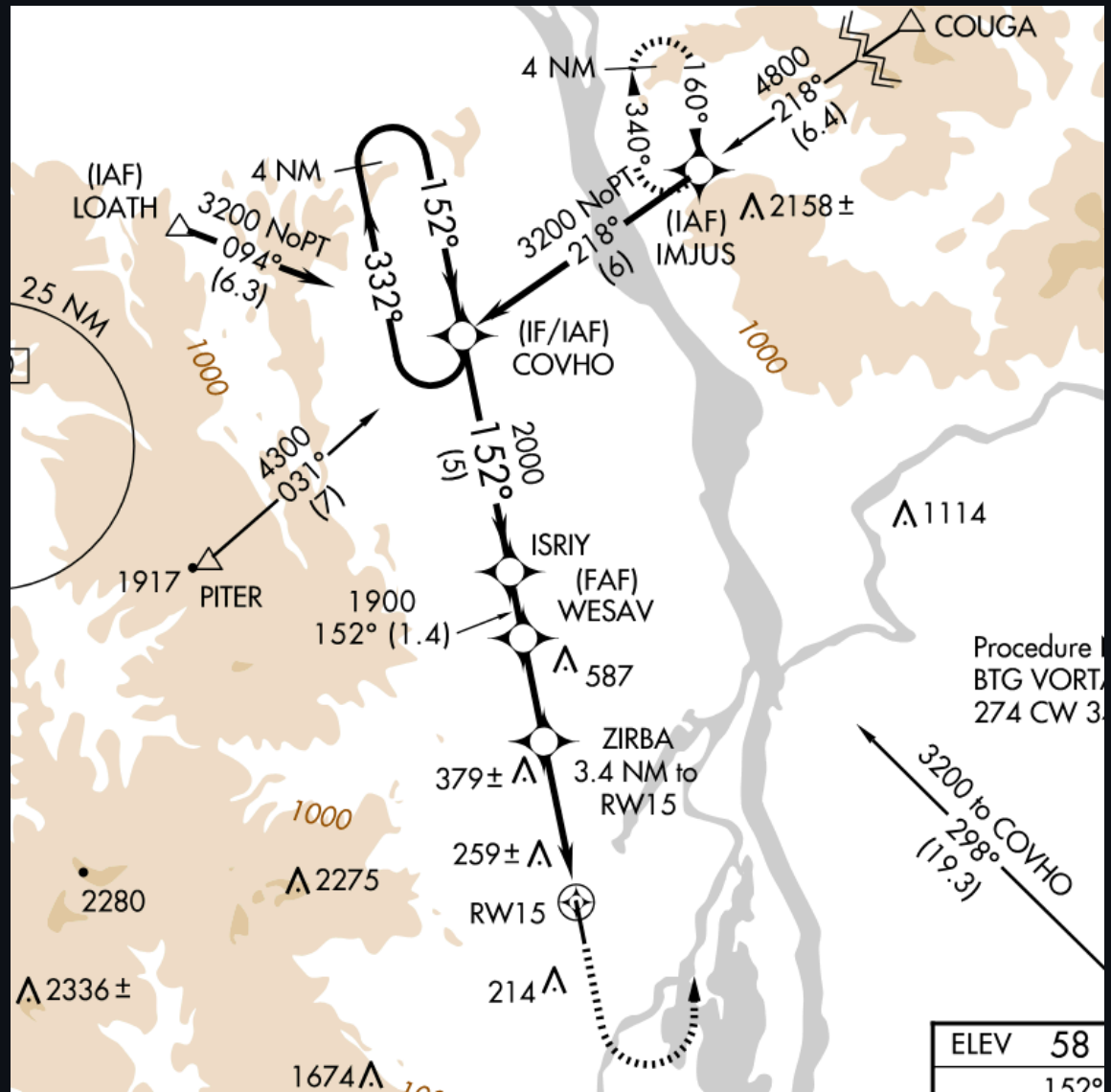
- Getting established on an approach
- Types of approaches
  - Precision (ILS)
  - Non-precision (VOR)
  - GPS approaches (LNAV, LPV)
- When can we land?
- Circle to land, sidesteps
- Other Approach Types
  - LDA Approaches
  - Backcourse Approaches
  - Visual and Contact Approaches
- Inoperative Equipment
- Cold Weather Operations

Getting Established on an Approach

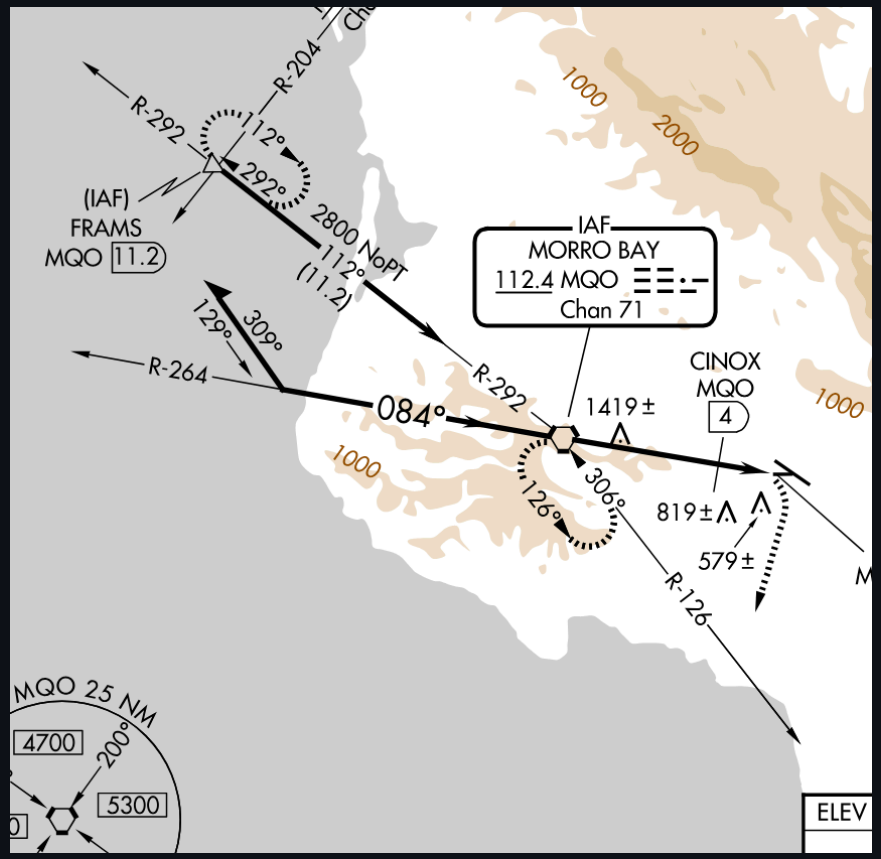
How do we get from the enroute phase to the final approach phase?

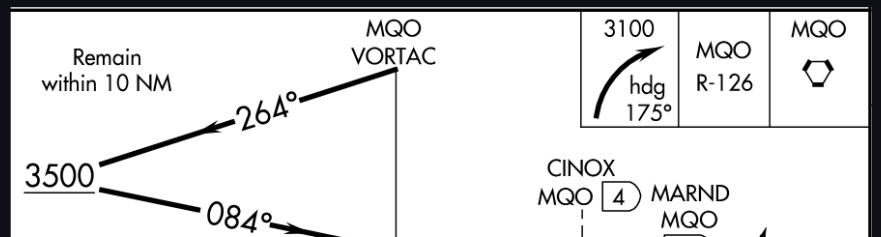
- **Direct to an IAF** (e.g. LOATH)
- **Published feeder routes** (e.g. COUGA)
- **Vectors to final**
  - ATC-assigned headings, intercept to the final approach course
  - Entry behind the FAF

AIM 5-4-6, IFH Ch 10



Procedure Turns



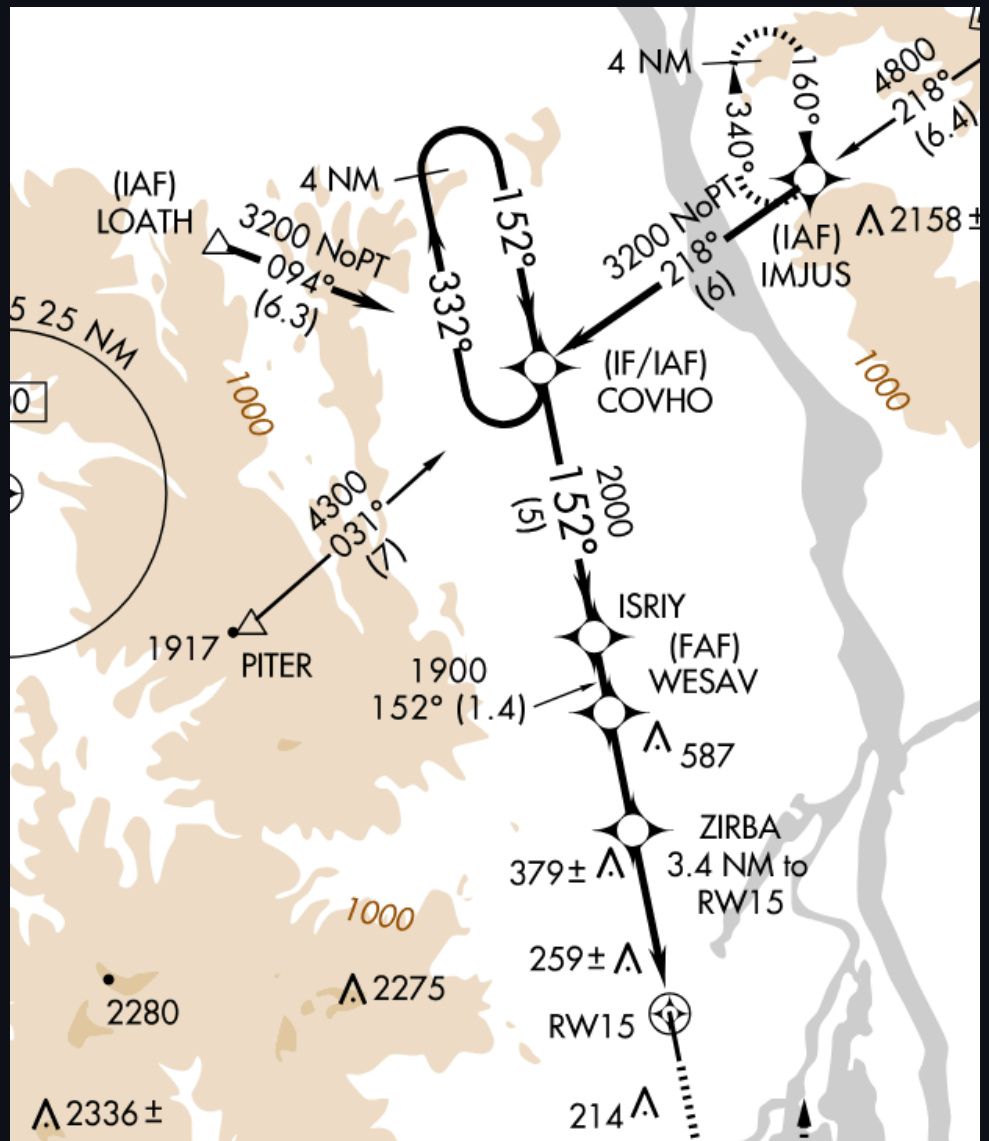


A published 180-degree turn to align you with the final approach course.

- Types of turns, up to the pilot what to use
  - 45/180
  - 80/260
  - Teardrop
  - Racetrack
- Protected turn area, "Remain within 10NM"
- Descend to lower altitude after established inbound

AIM 5-4-9, IFH Ch 10

Hold-in-Lieu of Procedure Turn (HILPT)



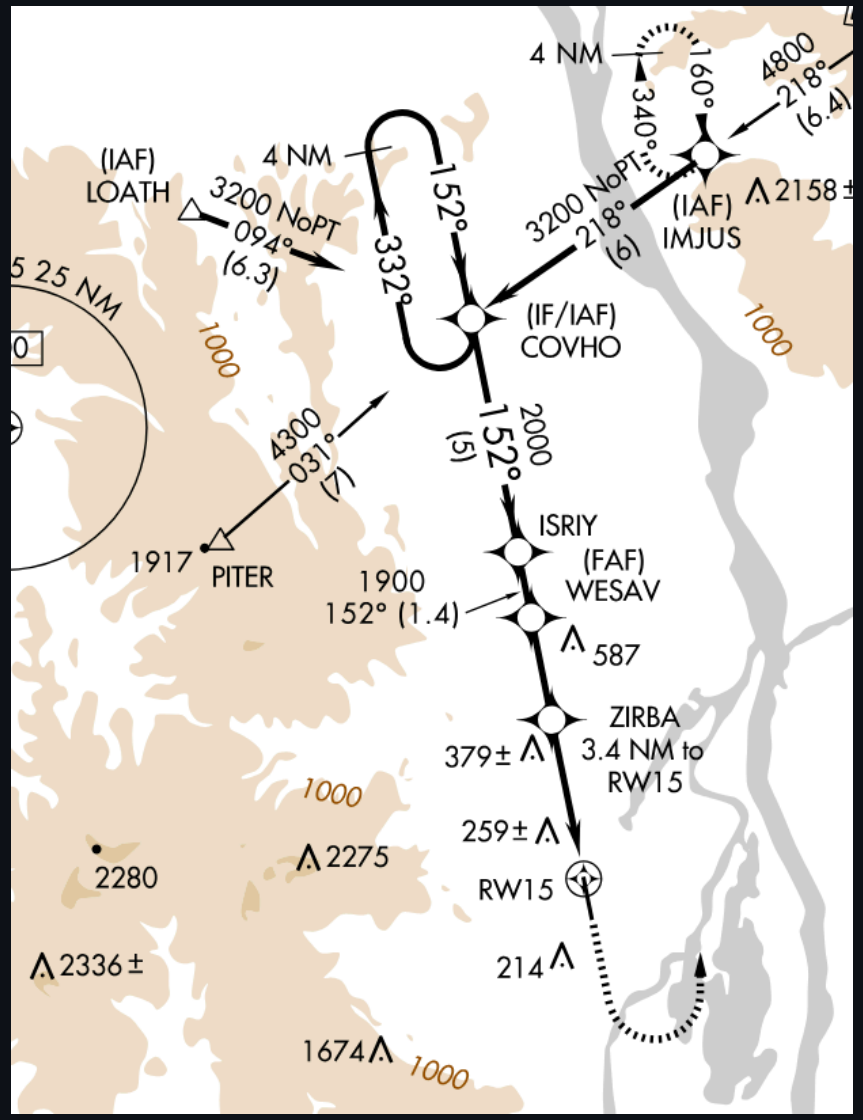
- Published hold used for getting you aligned with final approach course (e.g. PITER transition)
- Fly standard hold entry and begin the approach
- ATC will not expect you to make additional turns in the hold
- These are become more common than barbed PTs

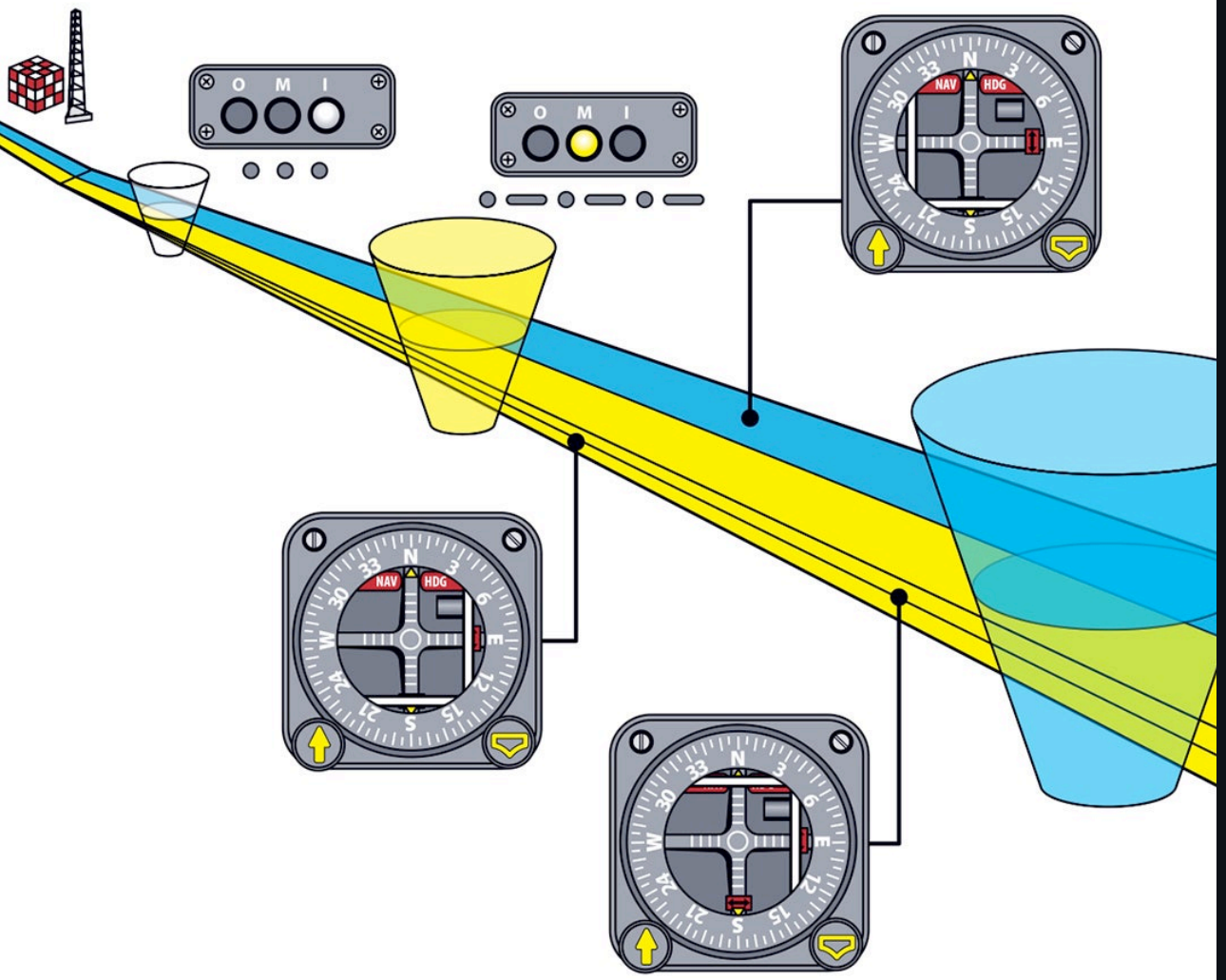
AIM 5-4-9, IFH Ch 10

When *not* to Fly a PT/HILPT - SNoRT

- **S:** "Straight-in approach" from ATC
  - "Cross COVHO at 2000, cleared straight-in RNAV runway 15 approach Scappoose airport"
- **No:** NoPT on approach chart
- **R:** Radar vectored
  - "Turn right heading 100, vectors for final approach course"
- **T:** Timed approach from a fix

AIM 5-4-9, IFH 10-13





Approach Types

- Precision
- Non-precision
- GPS Approaches

Precision Approaches

Precision approaches are characterized by **vertical and horizontal guidance** that position the aircraft close to the runway from where it can safely land.

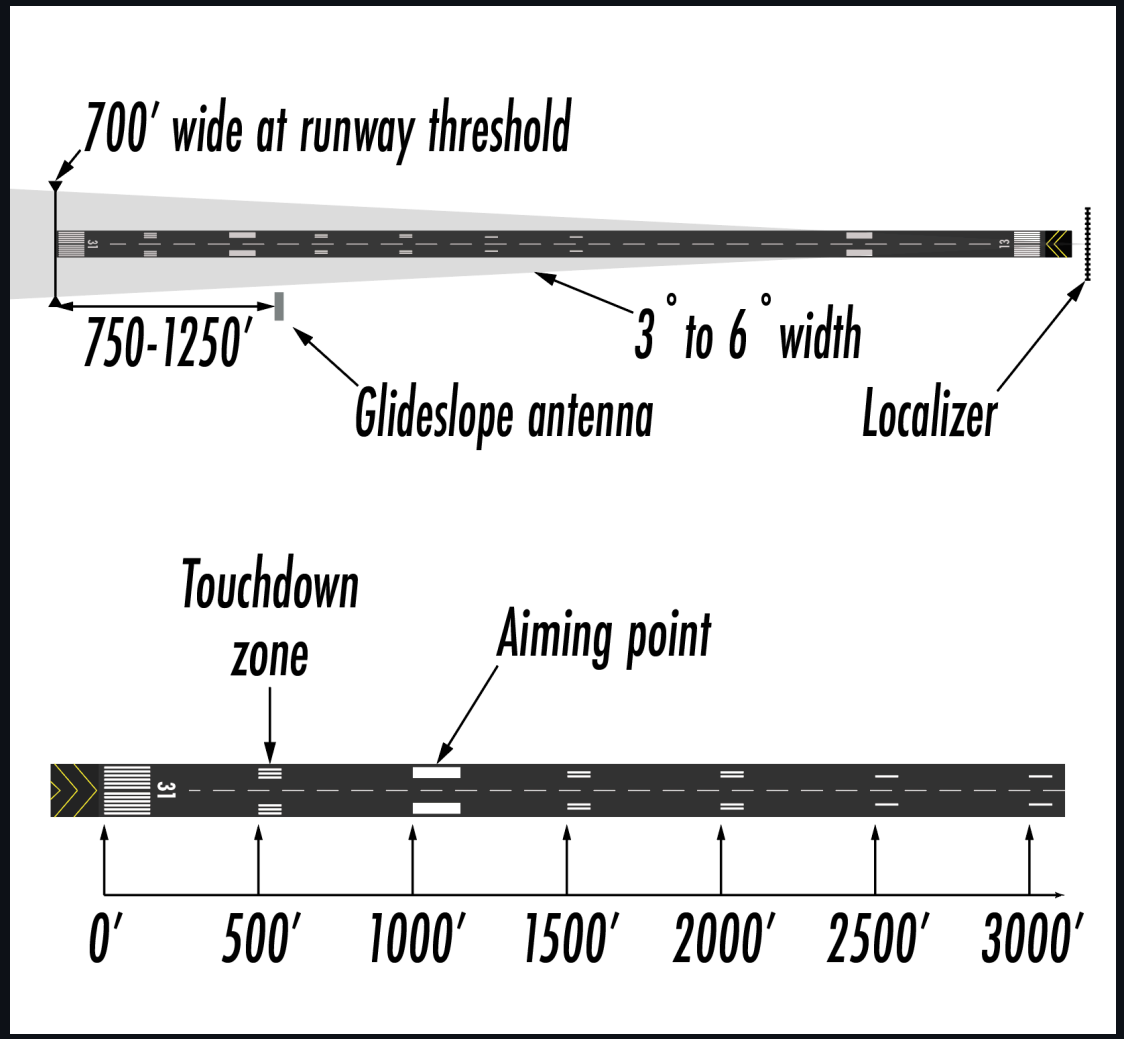
Type of precision approaches:

- **PAR** - Precision approach radar
- **GLS** - GBAS landing system
- **ILS** - Instrument landing system

ILS typically have minimums of 200 feet above TDZE

AIM 5-4-5, 5-4-11, IFH Ch 10

Components of an ILS

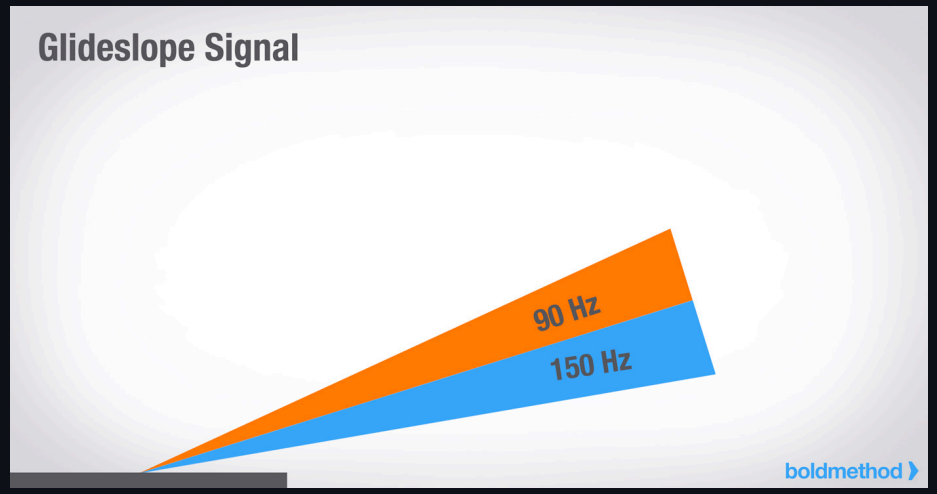


Localizer:

- Positioned at the end of the runway
- Angular width is 700' wide at the threshold
- Gives precise L/R angular guidance aligned with the runway
- Note: Sensitivity depends on runway length

AIM 1-1-9, IFH Ch 10

Components of an ILS



Glideslope:

- Positioned to the side of the runway
- Gives angular vertical guidance, usually a 3° glideslope
- Gets more sensitive as we get closer to the runway
- Note: There can be interference on the glideslope signal which can cause "false" glideslopes

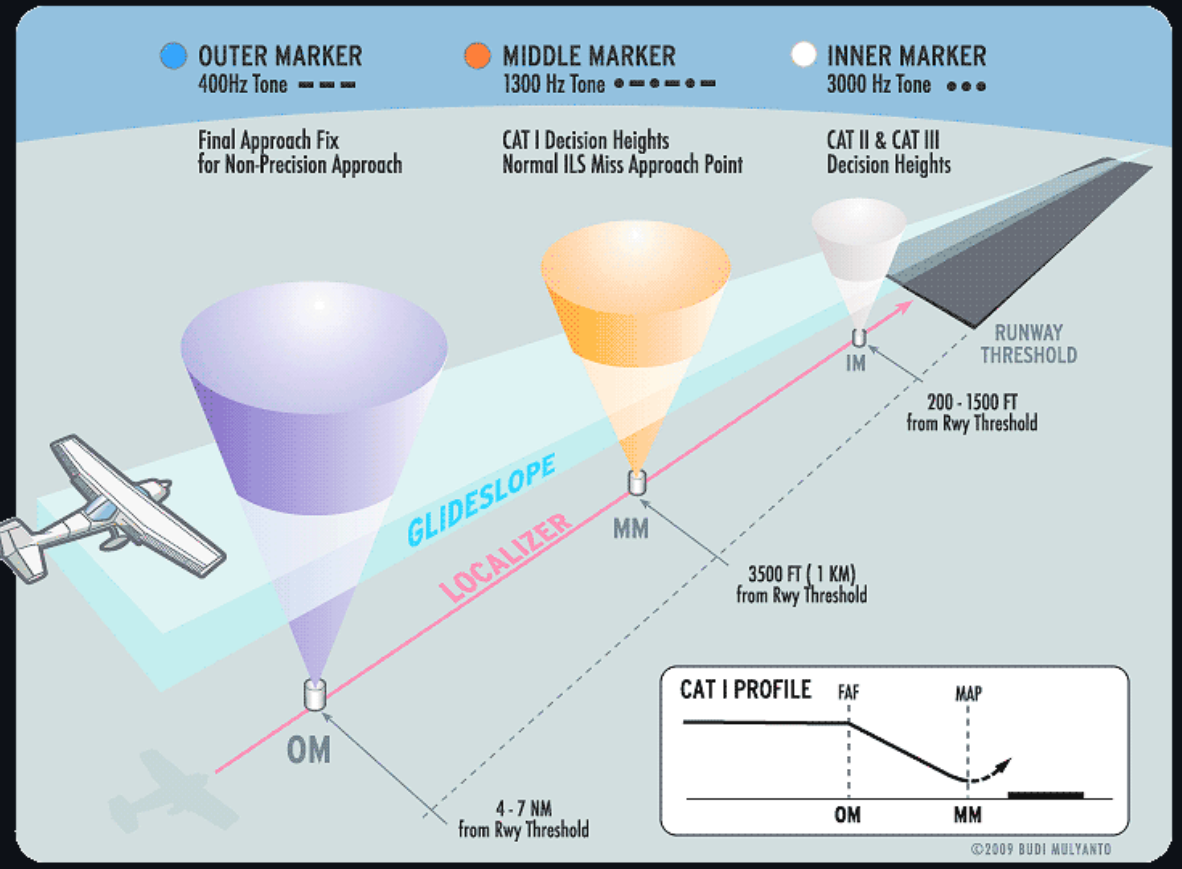
AIM 1-1-9

ILS Marker Beacons

Used to be standard on an ILS. They were identified with a tone and light on the audio panel.

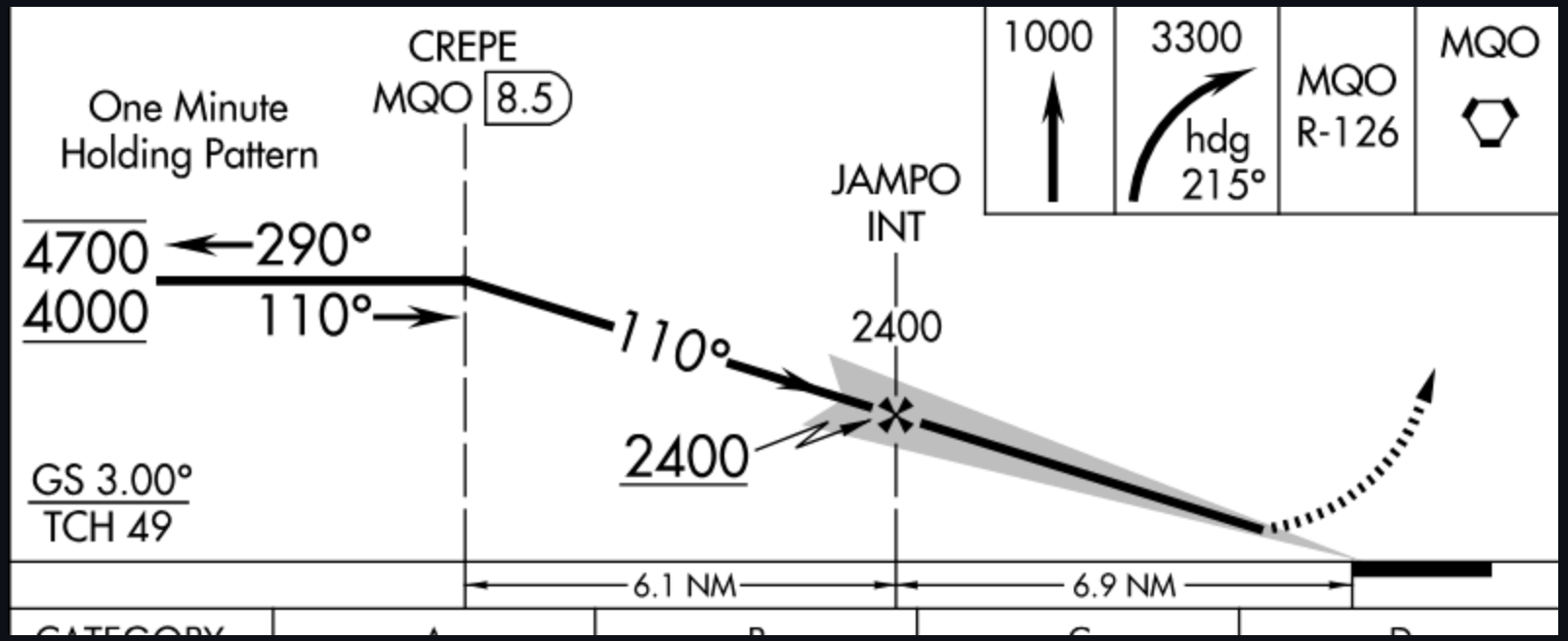
- **Outer marker:** FAF (tone)
- **Middle marker:** Standard minimums (tone)
- **Inner marker:** Used to identify lower minimums of CAT II or III ILS (tone)

We now use DME, 2nd VOR, or GPS to identify these points



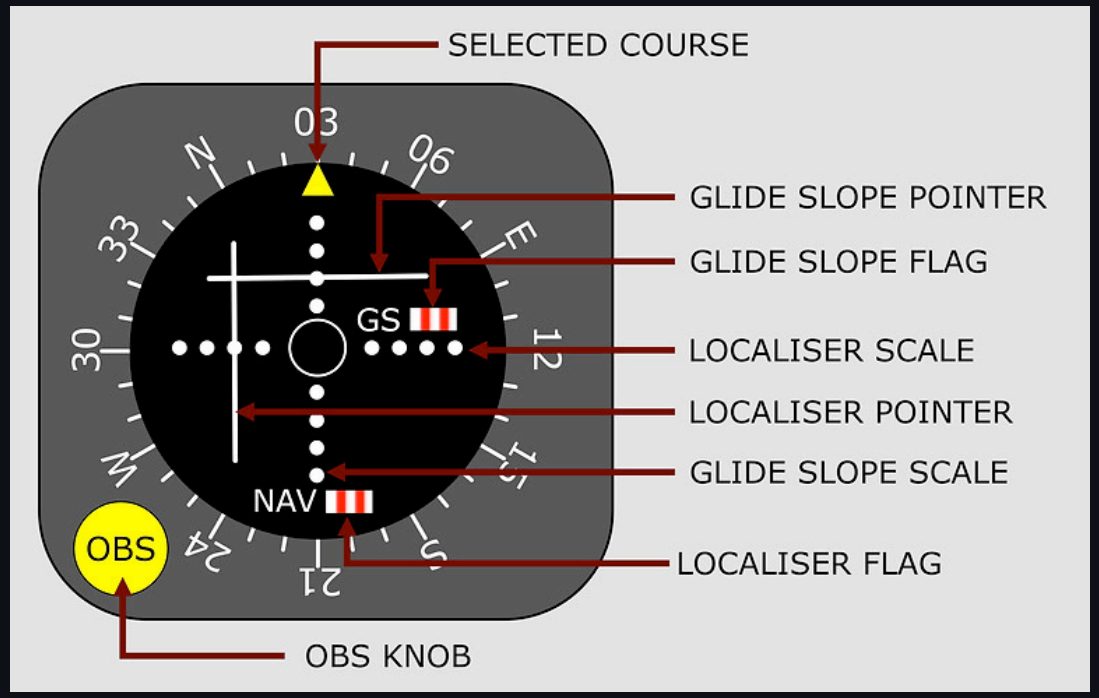
AIM 1-1-9

Capturing an ILS



- Glideslope needle starts above us
- As we approach the GS intercept (lightning bolt), glideslope needle will come down
- One dot below glideslope: Reconfigure for your approach

Flying an ILS



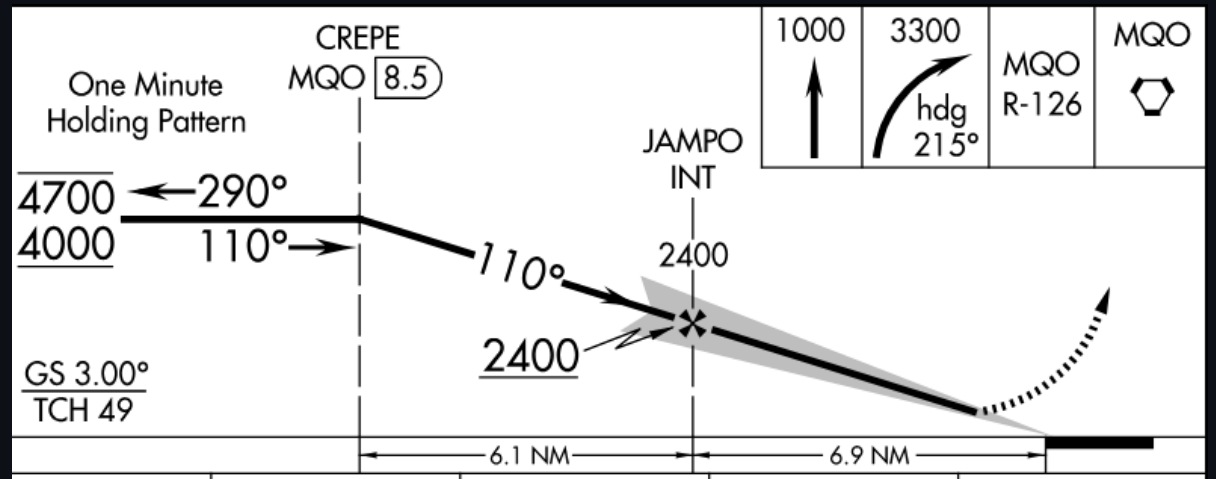
Fly to keep the needles centered

- GS needle moves up: Too low
- GS needle moves down: Too high
- LOC needle moves left: Right of course
- LOC needle moves right: Left of course

Both needles get more sensitive as we get closer to the runway.

IFH Ch 8

Precision Approaches Minimums



CATEGORY	A	B	C	D
S-ILS 11*	398-½ 200 (200-½)			
S-ILS 11	495-½ 297 (300-½)			
S-LOC 11	1420-¾ 1222 (1300-¾)	1420-1 1222 (1300-1)	1420-3 1222 (1300-3)	
CIRCLING	1420-1¼ 1208 (1300-1¼)	1420-1½ 1208 (1300-1½)	1500-3 1288 (1300-3)	1760-3 1548 (1600-3)

- We fly our glideslope and localizer until the **Decision Altitude**
- DA is listed in MSL altitude., along with required flight visibility
  - E.g. 398 ft MSL, 1/2 s.m. vis.
- At the D.A. we can continue our descent if we have the required visibility and have the runway envionment in sight
  - More on this

AIM 5-4-20, 14 CFR 91.175

When Can We Land? - FAR 91.175

An aircraft may not descend from the DA/MDA unless:

1. Aircraft is continuously in a position from which a descent to a landing can be made on the intended runway
2. The descent can be made at a normal rate of descent using normal maneuvers
3. For 121/135 ops: A descent that allows for touchdown in the touchdown zone
4. The **flight visibility** must be greater than prescribed on the chart
5. At least one of the following visual references for the intended runway is visible

14 CFR 91.175, AIM 5-4-5

Visual References

- Approach lighting system*
- Threshold marking/lights
- Runway end identifier lights (REILs)
- PAPI/VASI
- Touchdown markings/lights
- Runway or runway markings
- Runway lights

*The red terminating bars allow you to descend to 100' above TDZ (regardless of the approach)

14 CFR 91.175, AIM 5-4-5

Non-Precision Approaches

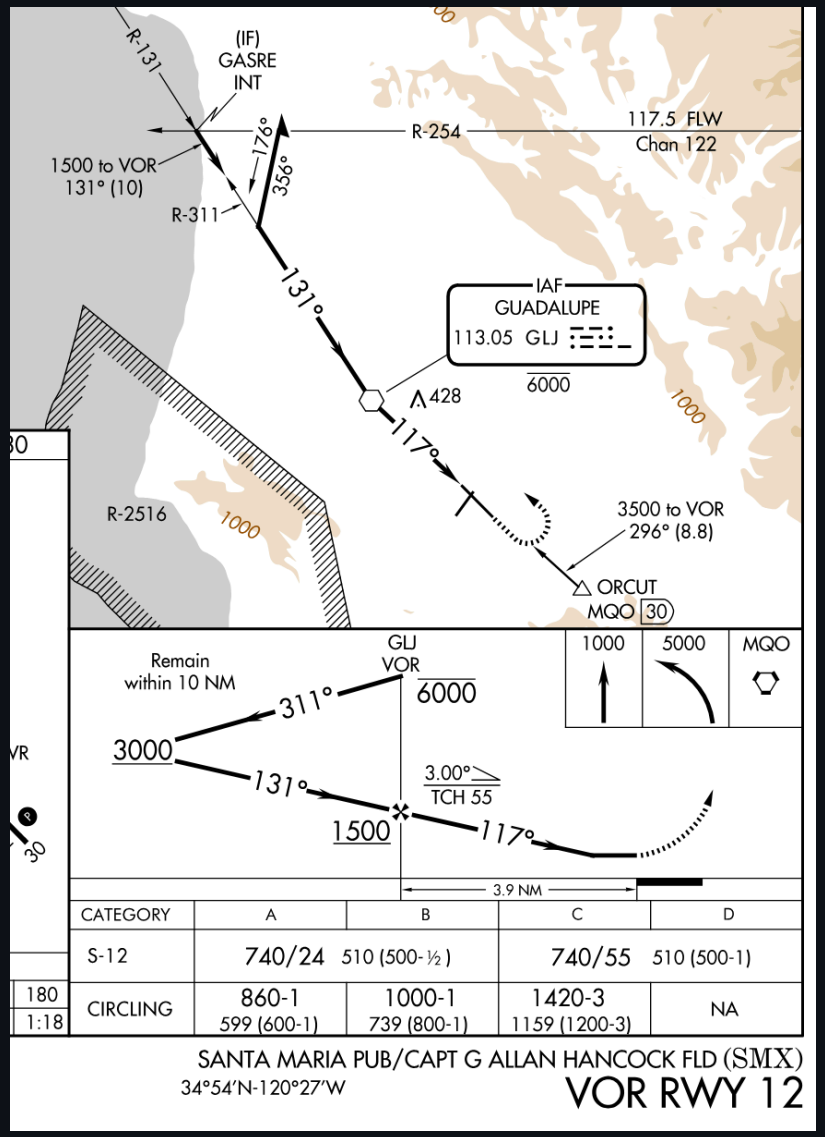
Non-precision approaches are characterized by **step-down fixes** and a **minimum descent altitude (MDA)** .

Types:

- **VOR** - VOR approach
- **TACAN** - TACAN approach
- **LOC** - Localizer approach
- **LDA** - Localizer directional aid
- **LOC BC** - Localizer back course approach
- **ASR** - Approach surveillance radar

AIM 5-4-5, IFH Ch 10

Flying a Non-Precision Approach



- Use the primary navaid for L/R guidance
- Descent to the lowest altitude for each segment based on the profile view
- After the final step-down fix, descend to the approariate MDA
- Fly at the MDA until
  - The runway is in sight and a landing can be made (91.175)
  - Or, the missed approach point and execute the missed procedure

Flying VOR Approaches with RNAV

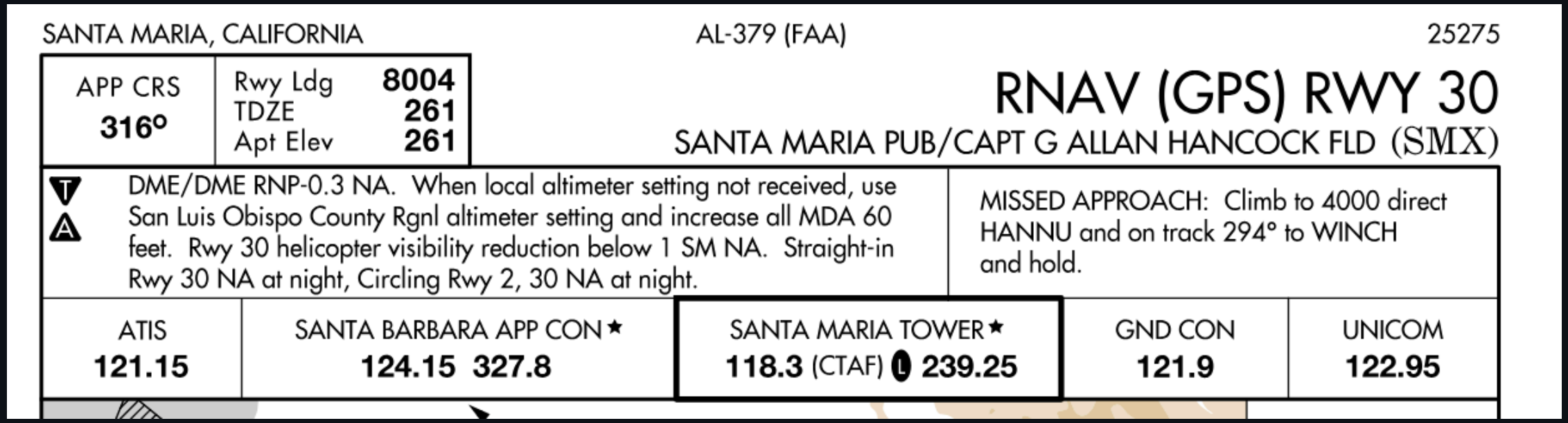
AIM 1-2-3: "Use of a suitable RNAV system as a means to navigate on the final approach segment of an instrument approach procedure based on VOR, TACAN or NDB signal is allowable."

Requirements:

- The underlying NAVAID must be operational
- The NAVAID must be monitored for the final approach course alignment
- Secondary CDI or bearing pointer should monitor the underlying NAVAID
- Guidance can be used from the GPS

AIM 1-2-3

RNAV (GPS) Approaches



SANTA MARIA, CALIFORNIA AL-379 (FAA) 25275

APP CRS	Rwy Ldg	8004
316°	TDZE	261
	Apt Elev	261

RNAV (GPS) RWY 30

SANTA MARIA PUB/CAPT G ALLAN HANCOCK FLD (SMX)

T A — DME/DME RNP-0.3 NA. When local altimeter setting not received, use San Luis Obispo County Rgnl altimeter setting and increase all MDA 60 feet. Rwy 30 helicopter visibility reduction below 1 SM NA. Straight-in Rwy 30 NA at night, Circling Rwy 2, 30 NA at night.

MISSED APPROACH: Climb to 4000 direct HANNU and on track 294° to WINCH and hold.

ATIS	SANTA BARBARA APP CON ★	SANTA MARIA TOWER ★	GND CON	UNICOM
121.15	124.15 327.8	118.3 (CTAF) (L) 239.25	121.9	122.95

Approaches with Vertical Guidance:

- **LPV**: Localizer Performance with Vertical guidance
- **LNAV/VNAV**: Lateral/vertical navigation

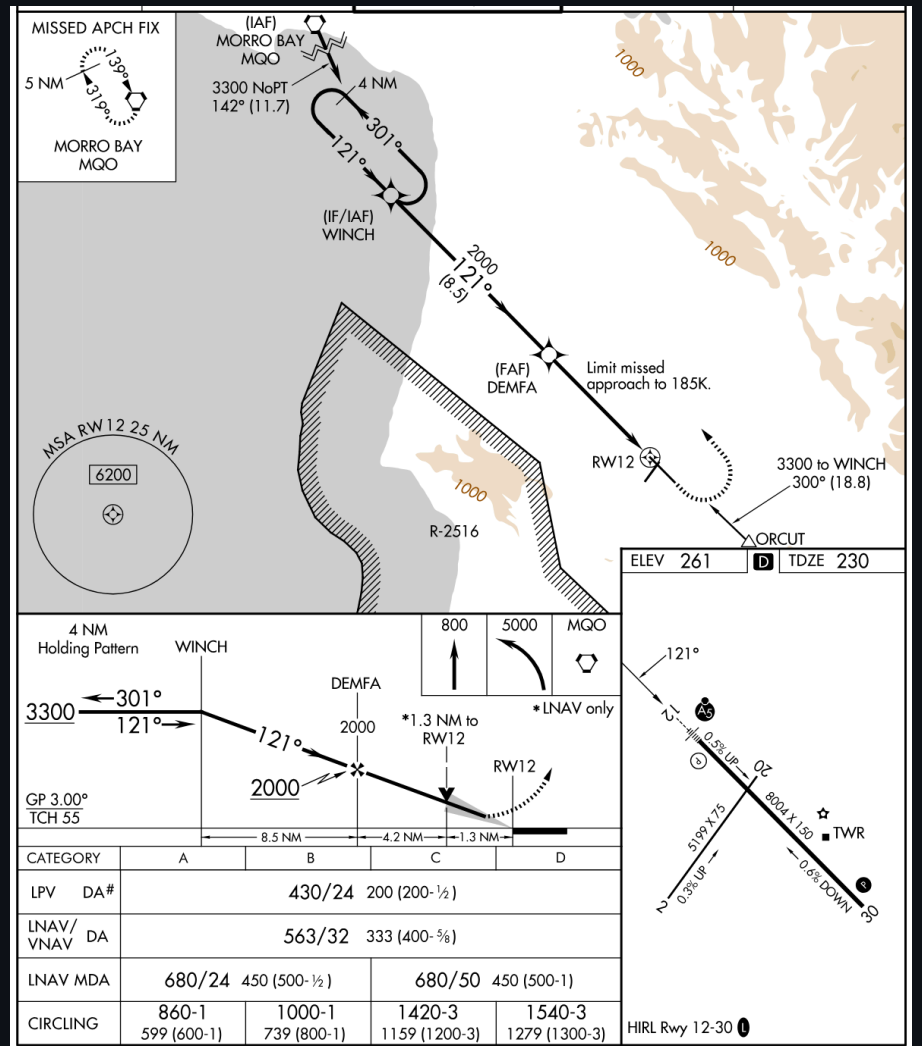
Without Vertical Guidance:

- **LP** - Akin to a LOC approach
- **LNAV** - Lateral guidance

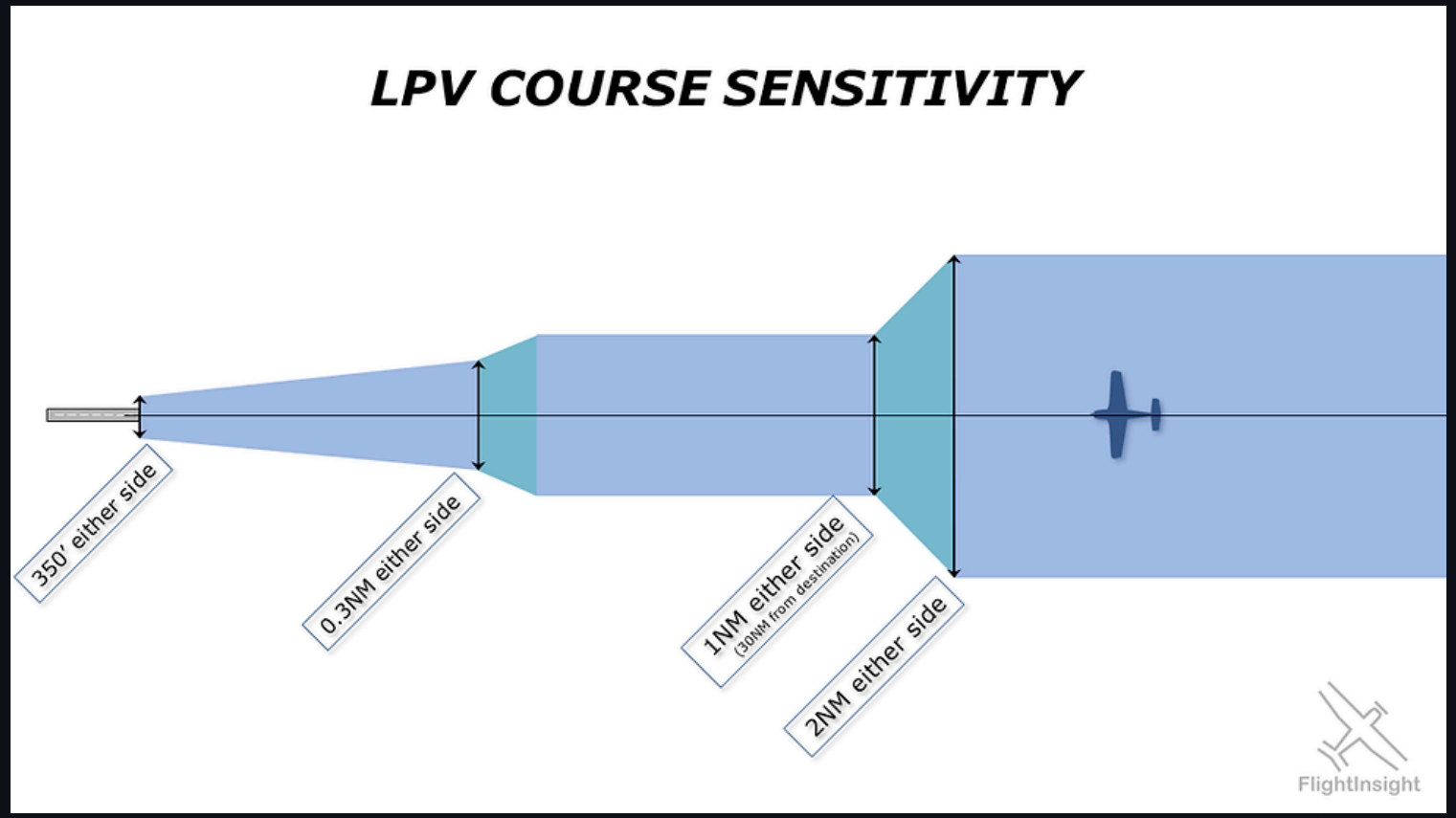
AIM 5-4-5, IFH Ch 10

LPV Approaches: Localizer Performance with Vertical Guidance

- **ILS-like minimums** (200' minima)
- Flown just like an ILS:
  - Intercept the "localizer"
  - Capture the glideslope from below
- Gives angular L/R guidance which gets more sensitive as you descend
- **Not technically a "precision approach"** (for the purposes of alternate planning)

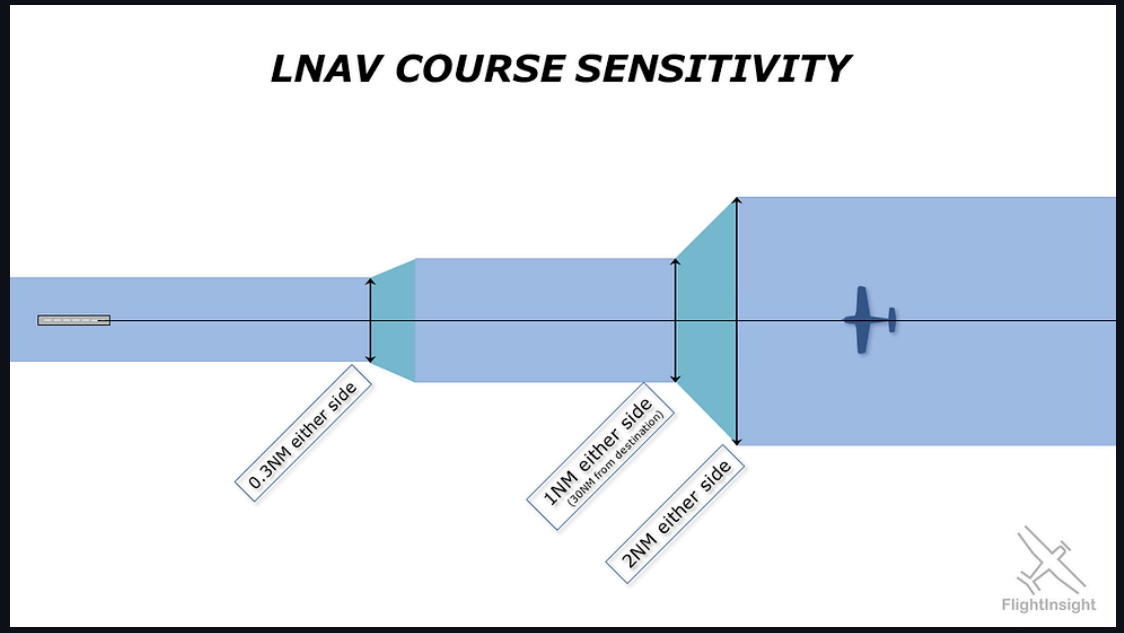


LPV Approach CDI Sensitivity



- CDI sensitivity becomes more accurate as you get closer to the runway
- Final segment has angular guidance like an ILS

LNAV/VNAV Lateral/vertical Approaches

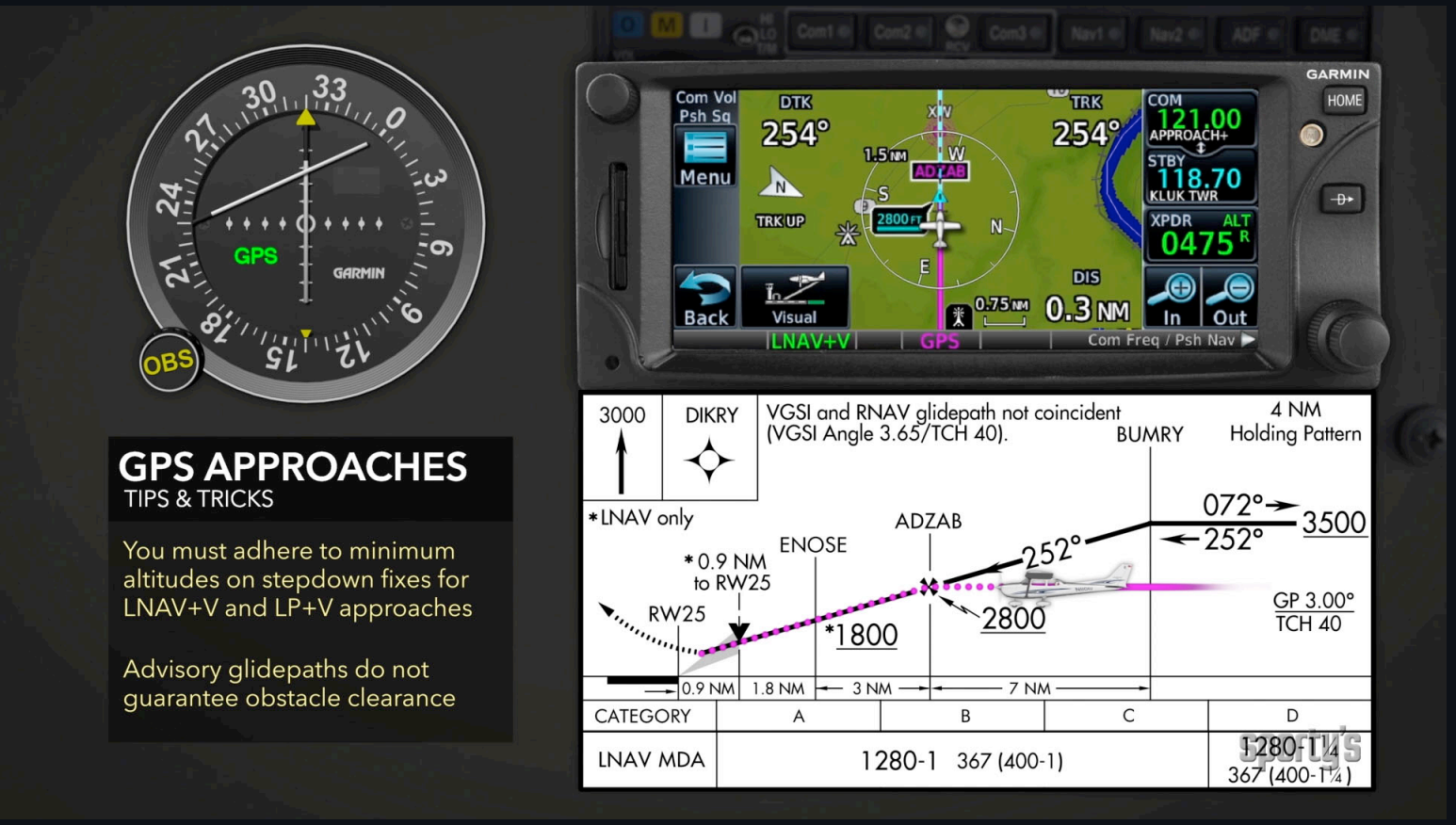


- Final approach has **fixed 0.3NM sensitivity** (not angular like LPV)
- Doesn't require a WAAS-based navigator
- These were initially designed for baro-aided FMS systems
- Garmin annunciation: Garmin L/VNAV

AIM 5-4-5, IFH Ch 10

GPS Mode Annunications

- **ENR**: Enroute
- **TERM**: Terminal
- **LNAV**: Lateral navigation
- **LNAV +V**: Lateral navigation w/ advisory vertical guidance
- **LP**: Localizer performance
- **LP +V**: Localizer performance w/ advisory vertical guidance



Advisory Vertical Guidance

LP+V, LNAV+V

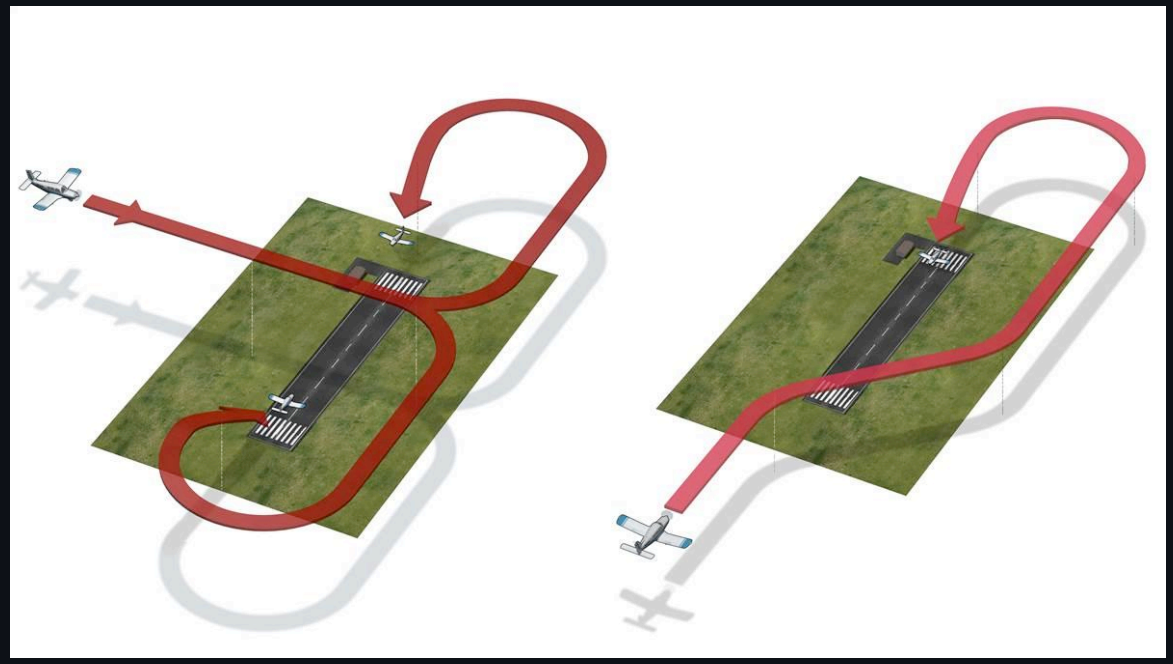
A glideslope generated the navigator which meets the crossing requirements of the step-down fixes of a non-precision approach.

Follow the guidance to the **MDA** (not a DA).

IFH Ch 10

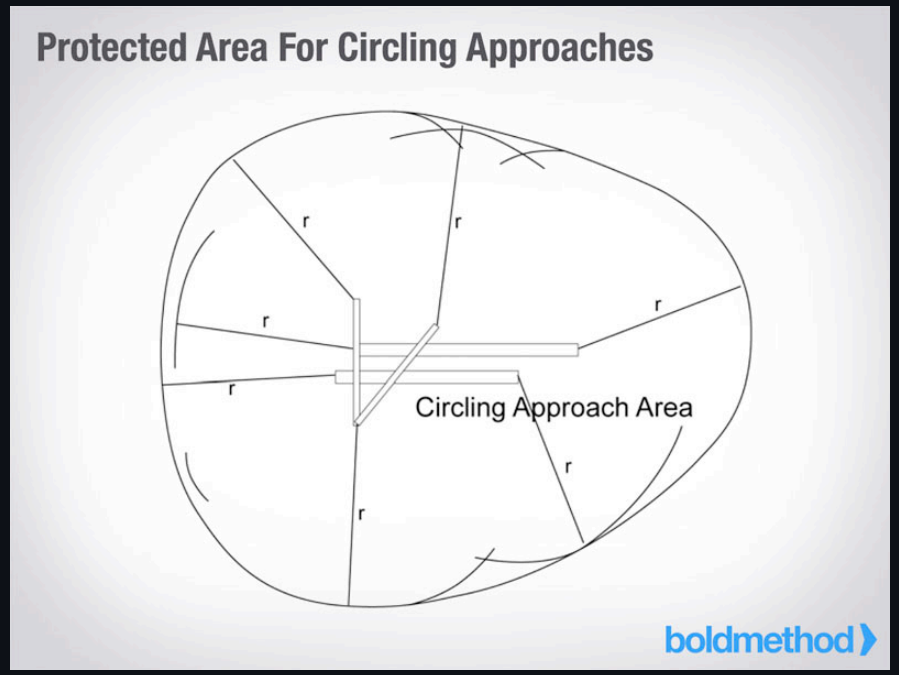
Circling Approaches

Allow you to fly an approach to one runway, but "circle" to land on a different runway



- This requires **higher minimums** to ensure obstacle clearance
- Should maneuver to the "shortest path to the base or downwind leg"
- **Missed approach procedure:**
  - Climbing turn towards the runway, the execute missed turn procedure
  - Additional turns in the protected area may be required

Circling Approach Minimums

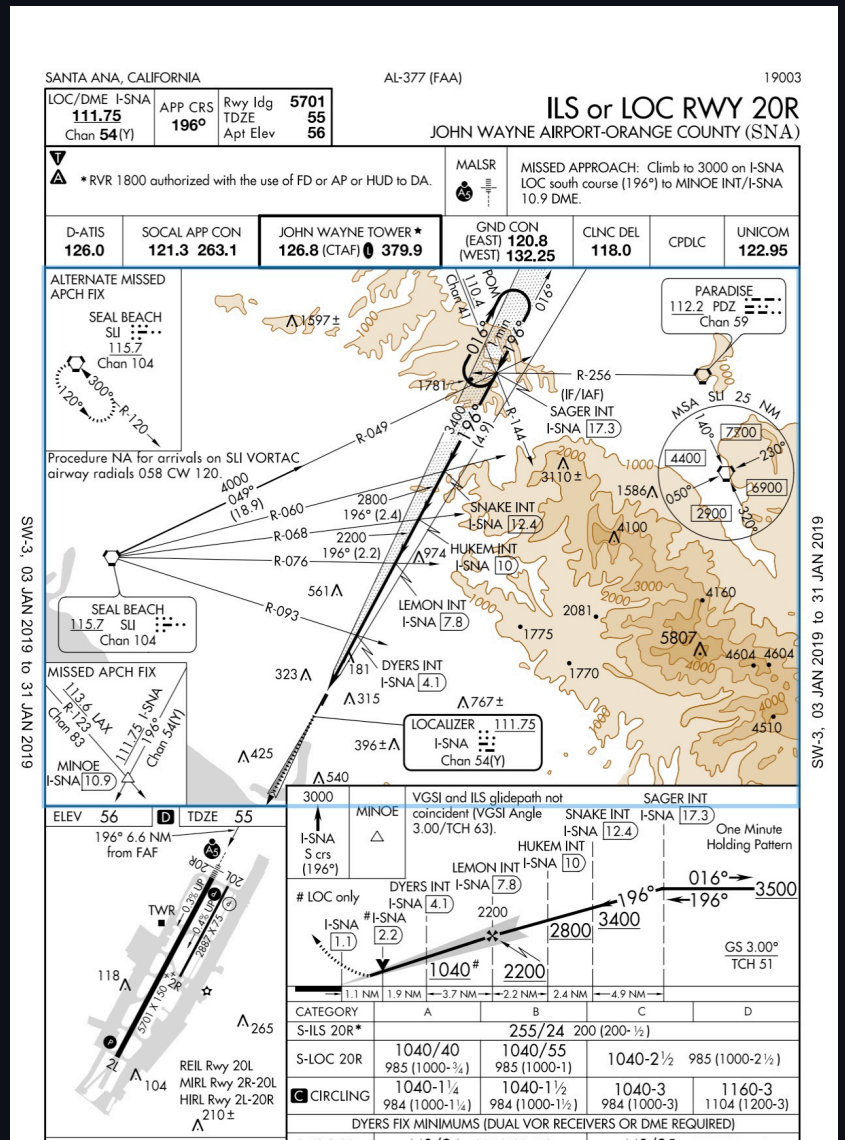


CATEGORY	A	B	C	D
LPV DA#	430/24 200 (200-½)			
LNAV/ VNAV DA	563/32 333 (400-⅝)			
LNAV MDA	680/24 450 (500-½)		680/50 450 (500-1)	
CIRCLING	860-1 599 (600-1)	1000-1 739 (800-1)	1420-3 1159 (1200-3)	1540-3 1279 (1300-3)

CATEGORY	A	B	C	D	E
S-ILS 10L	293/24 263 (300-½)				
S-LOC 10L	420/24 390 (400-½)		420/35 390 (400-⅝)		
C CIRCLING	720-1 689 (700-1)	760-1 729 (800-1)	1060-3 1029 (1100-3)		1140-3 1109 (1200-3)

Expanded circling protections: Introduced in 2012, indicated by negative C on minima line

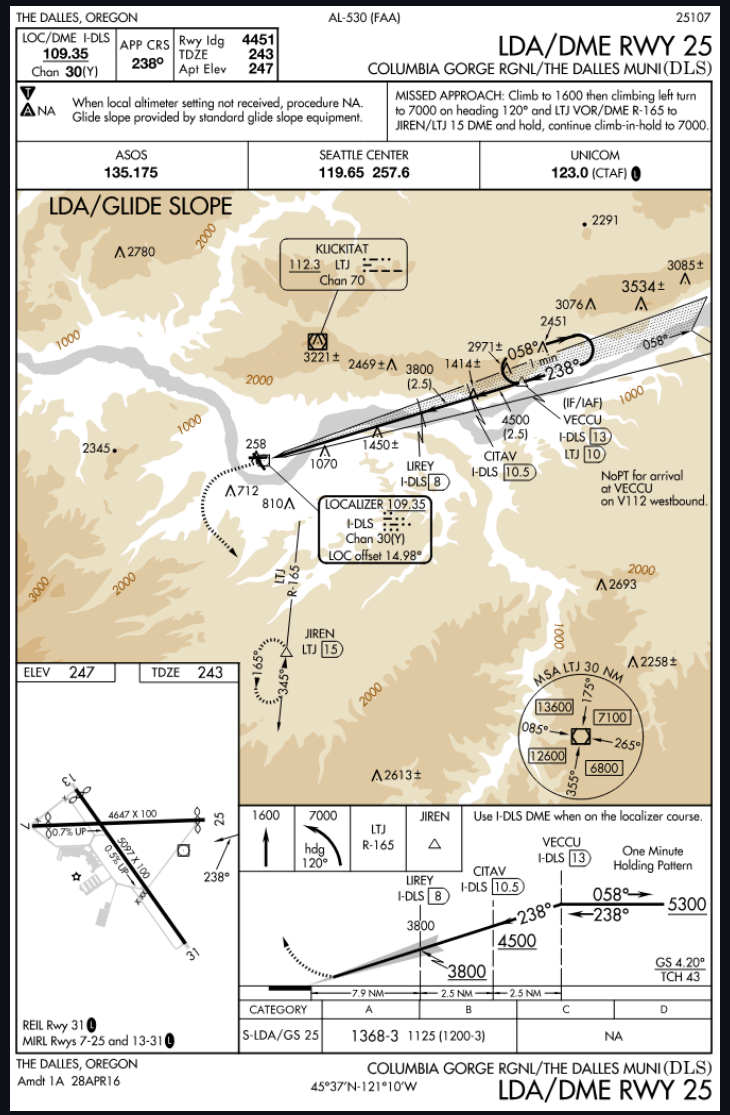
Sidestep Maneuver



- Parallel runways less than 1200 ft. apart
- ATC can say "cleared ILS runway 20R approach, side-step runway 20L"
- **Commence the side-step maneuver as soon as possible** after the runway or runway environment is in sight

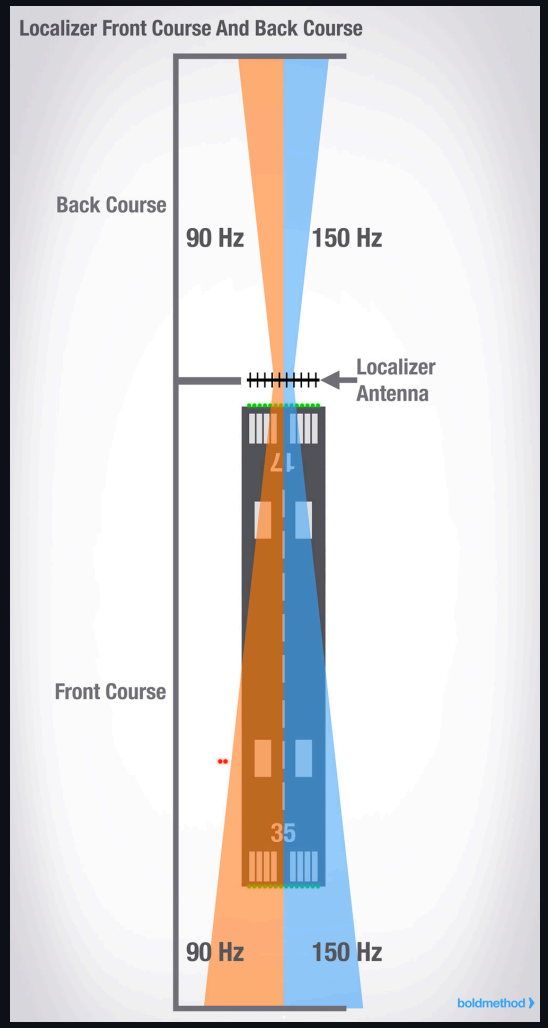
AIM 5-4-19

LDA - Localizer Directional Aid Approaches



- Localizer (and sometimes glideslope) which provide approach guidance **not aligned with a runway**
- Example: KDLS LDA/DME RWY 25
- They are **non-precision approaches**, even if they had a glideslope
- **S-LDA minimums are treated as an MDA**

Localizer Backcourse Approaches - LOC BC

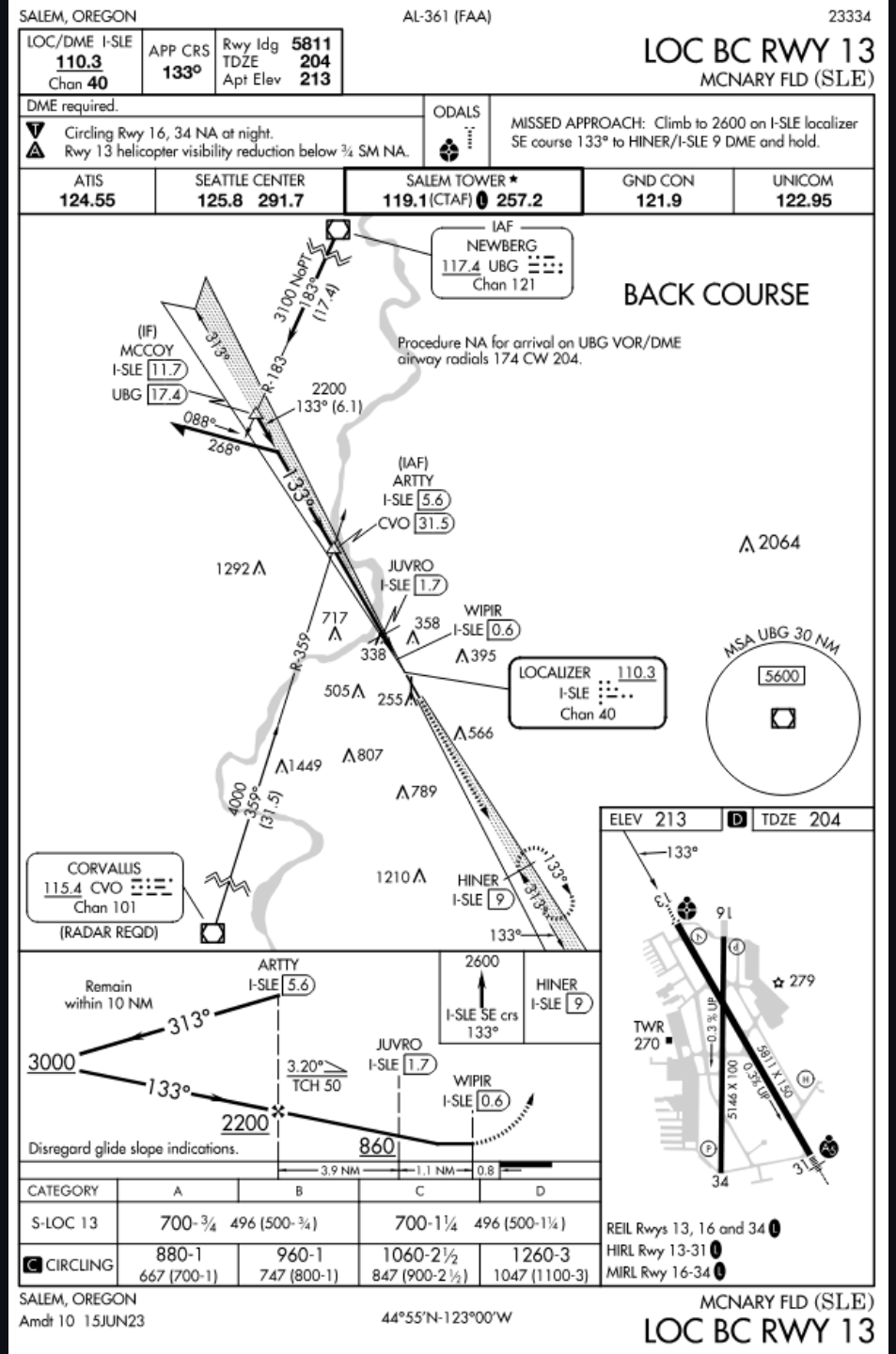


The signal from a localizer also extends behind the primary runway, and can be used to guidance to the opposing runway.

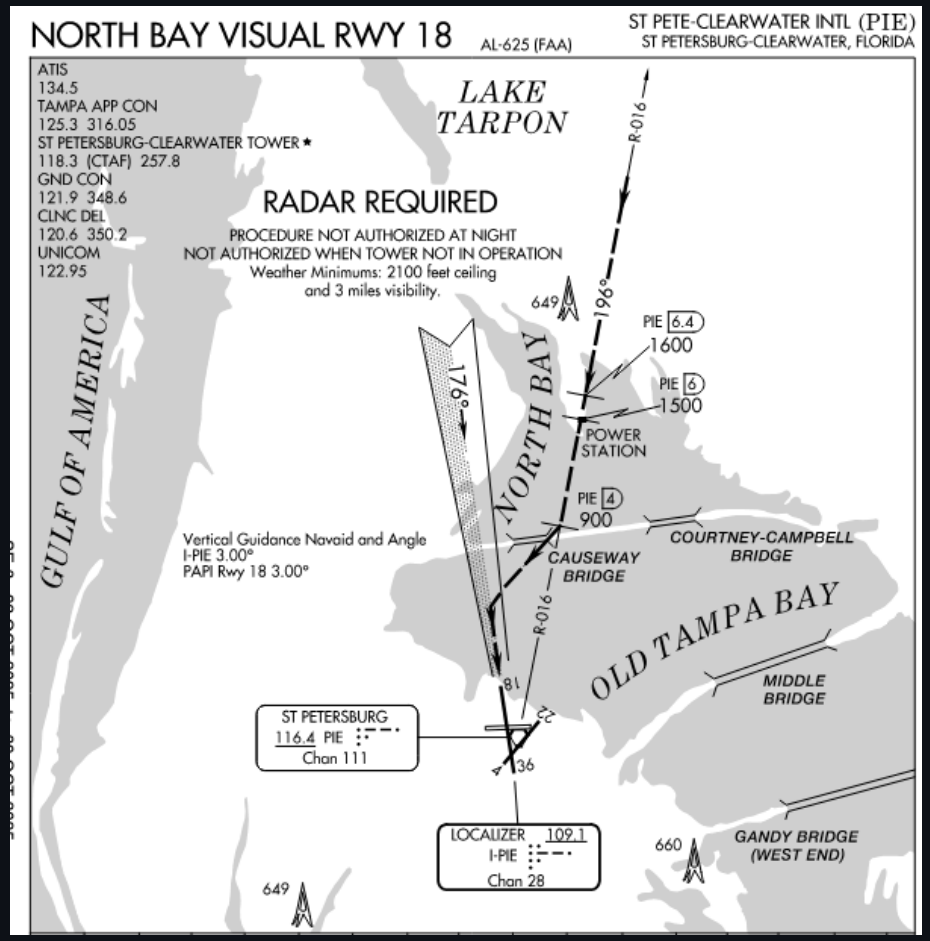
- Disregard any glideslope indication
- A standard CDI will be read L/R backwards
  - Fly away from the needle instead of towards it
  - "You are the needle"
- With an HSI, set the **inbound/front course** into your OBS
  - Then the green needles will read correctly (since the needles are flipped upside down)

AIM 5-4-5, IFH Ch 10

Example LOC BC Approach - KSLE LOC BC RWY 13



Visual and Contact Approaches



Visual Approaches:

- If the airport has VFR weather (1000 + 3), controllers can assign a visual approach
- We're still IFR, so VFR cloud clearance rules (91.255) don't apply
- Expectation that we land visually, traffic + terrain clearance is our responsbility

Charted Visual Procedures:

- These are uncommon
- Often used for noise-abatement

AIM 5-5-11, 5-4-23

Contact Approaches

- Gives us permission to descend to and land visually
- Need flight visibility of >1 s.m. and need to remain clear of clouds
- **Pilot needs to ask for a contact approach**

Note that these would only be used if the conditions are less than VFR at the airport, so we'd be maneuver at low altitude for the airport in <3 s.m. conditions

AIM 4-4-12, IFH Ch 10

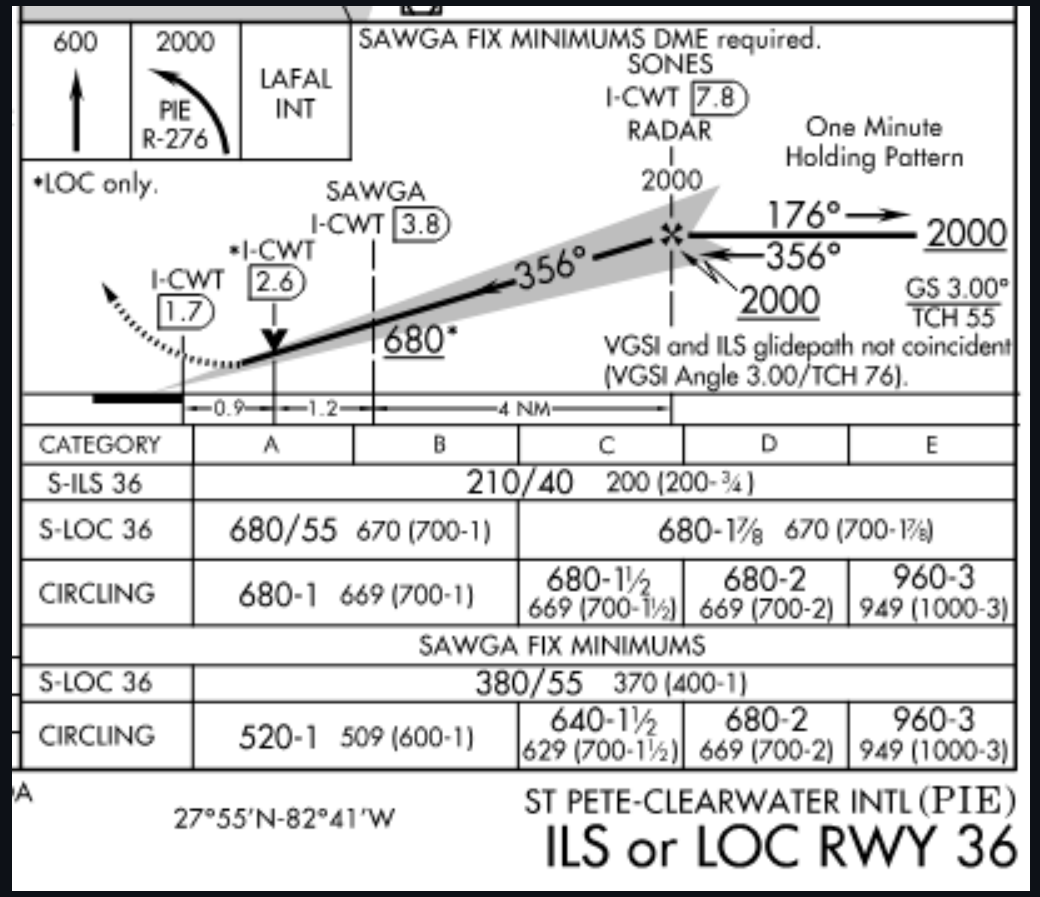
Inoperative Equipment - Navigation

Primary navaid failure (VOR, LOC):

- Before the FAF: Notify ATC and choose a different approach, or divert
- After the FAF: Execute missed approach procedure

Glideslope failure:

- **Outside the FAF:** Inform ATC, ask for the localizer approach
- **Inside the FAF:** "Fail-down" to the LOC approach, follow LOC guidance and climb/descend to the MDA



AIM 1-1-9

Inoperative Equipment - Visual Aids

(1) ILS, PAR, LPV, GLS minima

Inoperative Component or Visual Aid	Increase Visibility
All ALS types (except ODALS)	¼ mile

(2) ILS, LPV, GLS with visibility minima of RVR 1800†/2000*/2200*

Inoperative Component or Visual Aid	Increase Visibility
ALSF 1 & 2, MALSR, SSALR	To RVR 4000† To RVR 4500*
TDZL or RCLS	To RVR 2400#
RVR	To ½ mile

#For ILS, LPV, GLS procedures with a 200 foot HAT, RVR 1800 authorized with use of FD or AP or HUD to DA. For ILS procedures with a 200 foot HAT with a restriction on autopilot usage, RVR 1800 authorized with use of FD or HUD to DA.

(3) All Approach Types and all lines of minima other than (1) & (2) above

Inoperative Component or Visual Aid	Increase Visibility
ALSF 1 & 2, MALSR, SSALR	½ mile
MALSF, MALS, SSALF, SSALS, SALSF, SALS	¼ mile

(4) Sidestep minima (CAT C-D)

Inoperative Component or Visual Aid to Sidestep Runway	Increase Visibility
ALSF 1 & 2, MALSR, SSALR	½ mile

(5) All Approach Types, All lines of minima

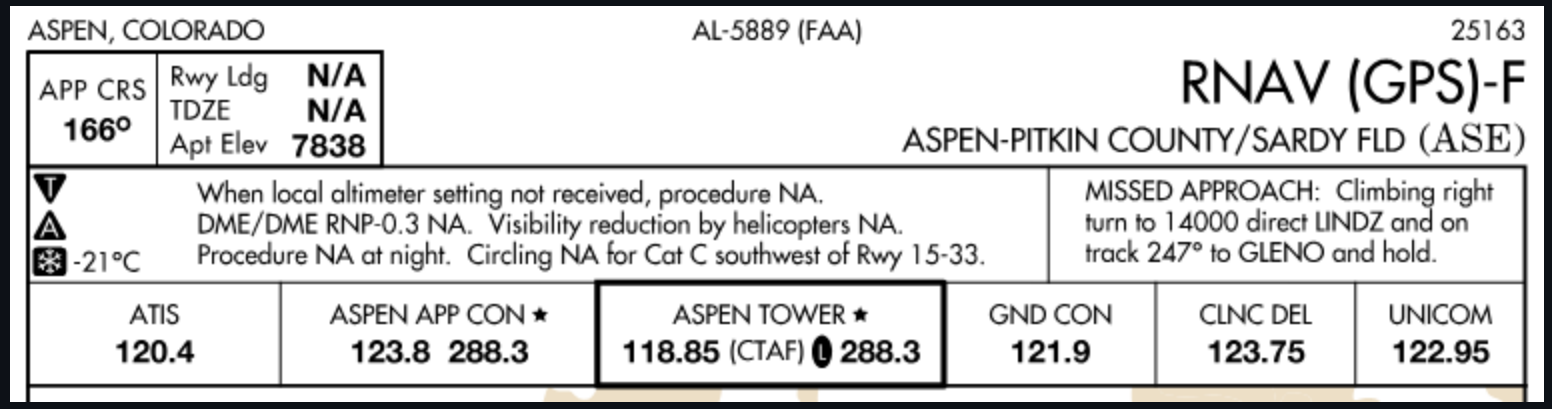
Inoperative Component or Visual Aid	Increase Visibility
ODALS (CAT A-B)	¼ mile
ODALS (CAT C-D)	⅛ mile

Approach lighting system inoperative:

- **Higher minimums are required** with inoperative ALS
- If more than one component is inoperative, each minimum is raised to the **highest minimum** required by any single inoperative component
- See **Inoperative Components or Visual Aids Table**

AIM 5-4-5, JEH Ch 10

Cold Weather Operations



ASPEN, COLORADO — AL-5889 (FAA) — 25163

RNAV (GPS)-F

ASPEN-PITKIN COUNTY/SARDY FLD (ASE)

APP CRS	Rwy Ldg	N/A
166°	TDZE	N/A
	Apt Elev	7838

T
A
-21°C

When local altimeter setting not received, procedure NA.
DME/DME RNP-0.3 NA. Visibility reduction by helicopters NA.
Procedure NA at night. Circling NA for Cat C southwest of Rwy 15-33.

MISSED APPROACH: Climbing right turn to 14000 direct LINDZ and on track 247° to GLENO and hold.

ATIS	ASPEN APP CON ★	ASPEN TOWER ★	GND CON	CLNC DEL	UNICOM
120.4	123.8 288.3	118.85 (CTAF) 288.3	121.9	123.75	122.95

- The snowflake symbol on an approach indicates cold-weather corrections are required when the reported temperature is at or below the given value
- Raise any cross-altitude restrictions and minimum altitude by the amount in the cold-weather correction chart in the TPP

COLD TEMPERATURE ERROR TABLE

HEIGHT ABOVE AIRPORT IN FEET

REPORTED TEMP °C	200	300	400	500	600	700	800	900	1000	1500	2000	3000	4000	5000
+10	10	10	10	10	20	20	20	20	20	30	40	60	80	90
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
-10	20	30	40	50	60	70	80	90	100	150	200	290	390	490
-20	30	50	60	70	90	100	120	130	140	210	280	420	570	710
-30	40	60	80	100	120	140	150	170	190	280	380	570	760	950

Summary

Approach Types:

- **Precision:** ILS (200' minimums, DA)
- **Non-Precision:** VOR, LOC, LDA (step-down fixes, MDA)
- **GPS:**
  - LPV, LNAV/VNAV (vertical guidance)
  - LP, LNAV (no vertical guidance)

Entry Methods:

- IAF, transitions, vectors to final
- Procedure turns, HILPT, SNoRT exceptions

Special Procedures:

- Circling approaches, sidestep maneuvers
- LDA, LOC BC, visual/contact approaches

Operational:

- Equipment failures
- Cold weather corrections
- Visual references (91.175)

Knowledge Check

While breifing an approach chart you come across a symbol on the airport sketch that you don't recognize. Where can you find its meaning?

Knowledge Check

When flying a localizer back-course approach you notice the glideslope needle falling. What should you do?

References

- AIM Chapter 1
- AIM Chapter 5
- Looking for the Lights
- 14 CFR 91.175
- Sporty's RNAV/GPS Approach Video