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.

Based on ASA IFR Syllabus:

- Stage 2 / Module 3: GPS Approaches
- Stage 2 / Module 4: ILS Approaches
- Stage 2 / Module 5: RNAV Approaches

(60 minutes)

Overview

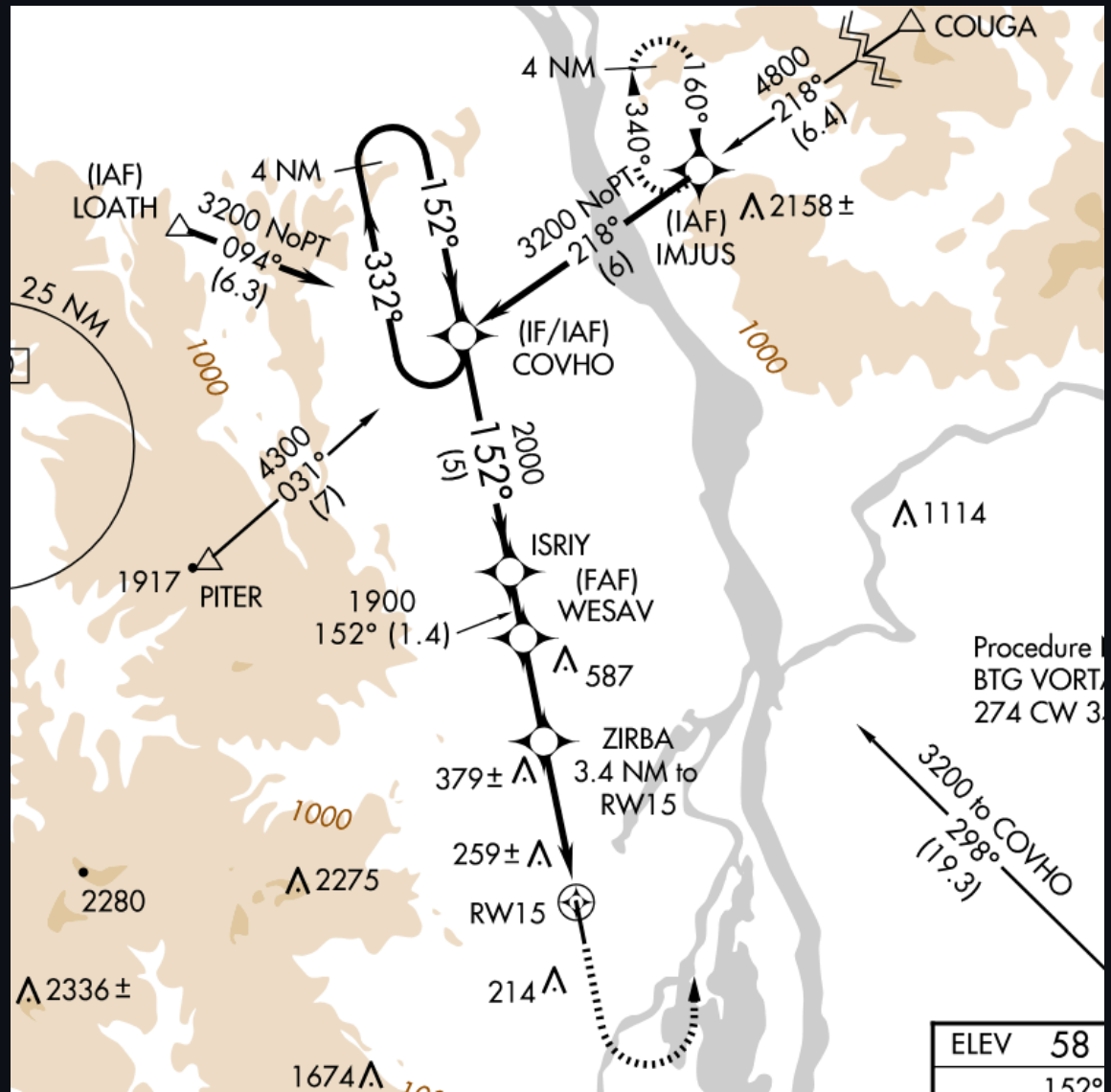
- Getting established on an approach
- Types of approaches
  - Precision (ILS)
  - Non-precision (VOR)
  - GPS approaches (LNAV, LPV)
- When can we land?
- Circle to land, sidesteps
- Other Approach Types
  - LDA Approaches
  - Backcourse Approaches
  - Visual and Contact Approaches
- Inoperative Equipment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

Getting Established on an Approach

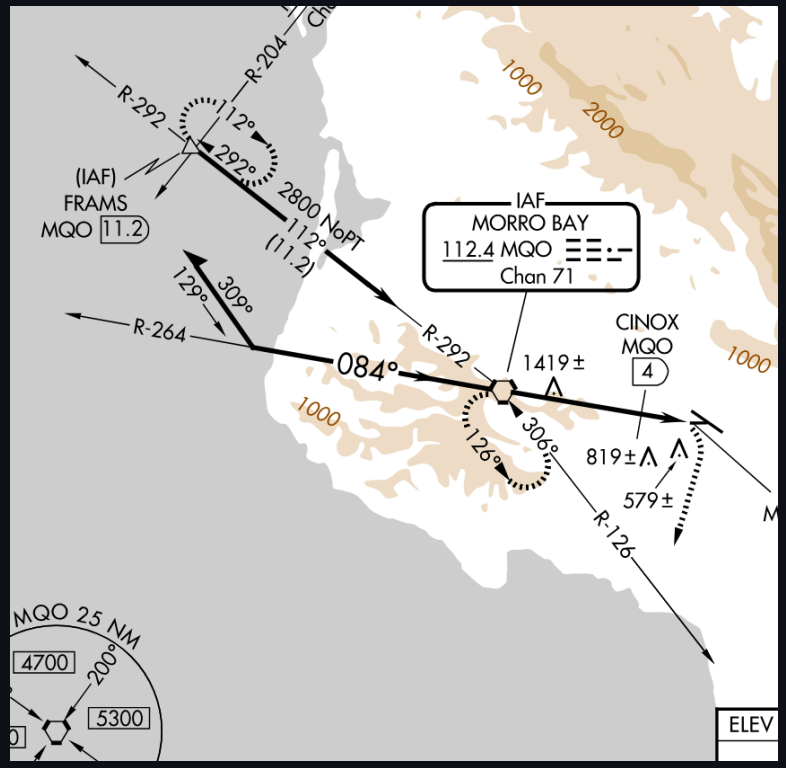
How do we get from the enroute phase to the final approach phase?

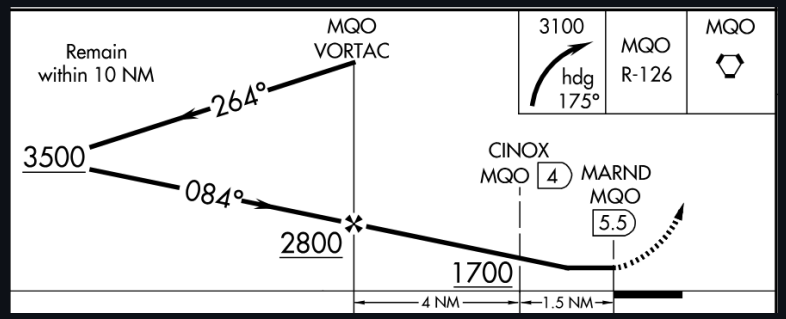
- **Direct to an IAF** (e.g. LOATH)
  - Or an IF if RNAV equipped
- **Via a feeder route** (e.g. COUGA)
- **Vectors to final**
  - ATC-assigned headings, intercept to the final approach course
  - Entry behind the FAF

AIM 5-4-6, IFH Ch 10



Procedure Turns



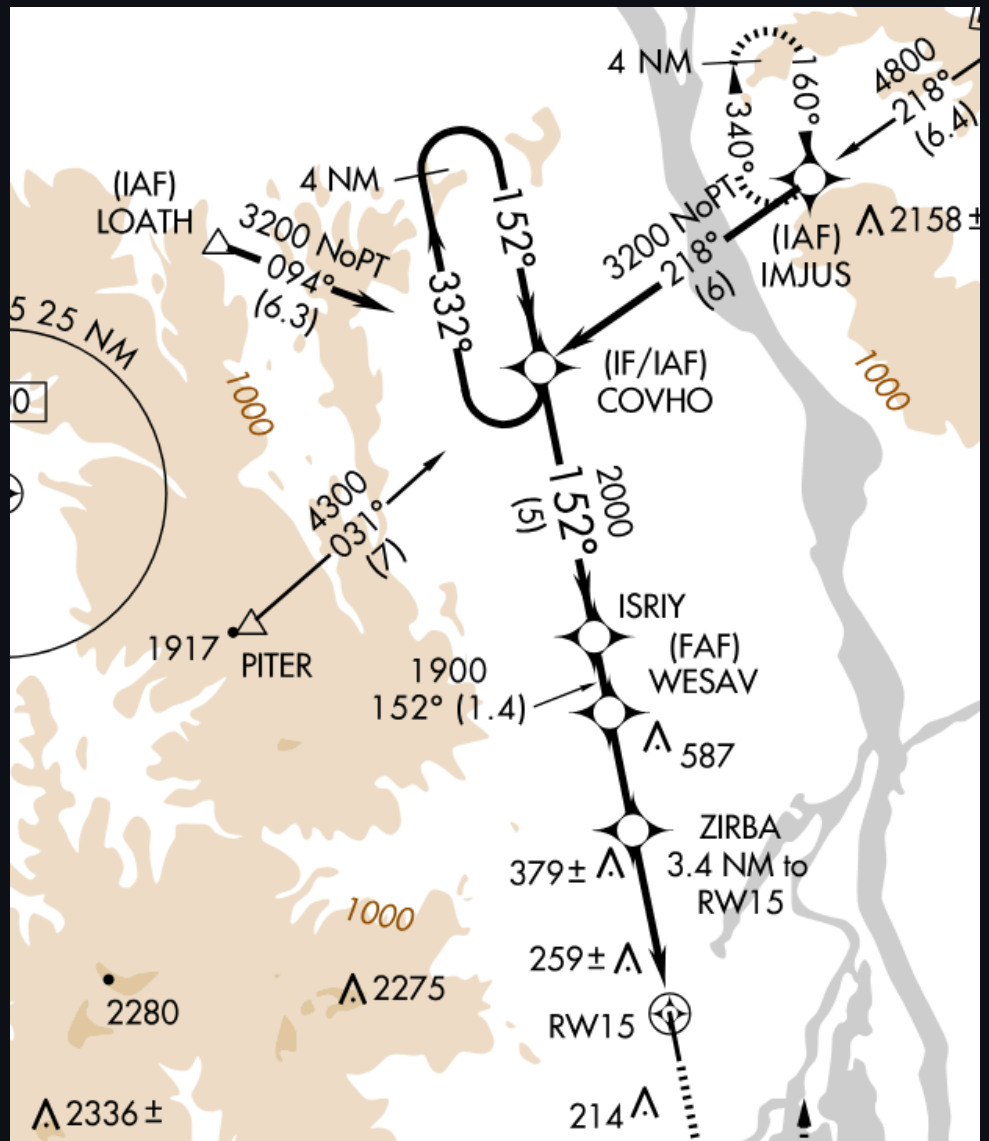


A published 180-degree turn to align you with the final approach course.

- 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)



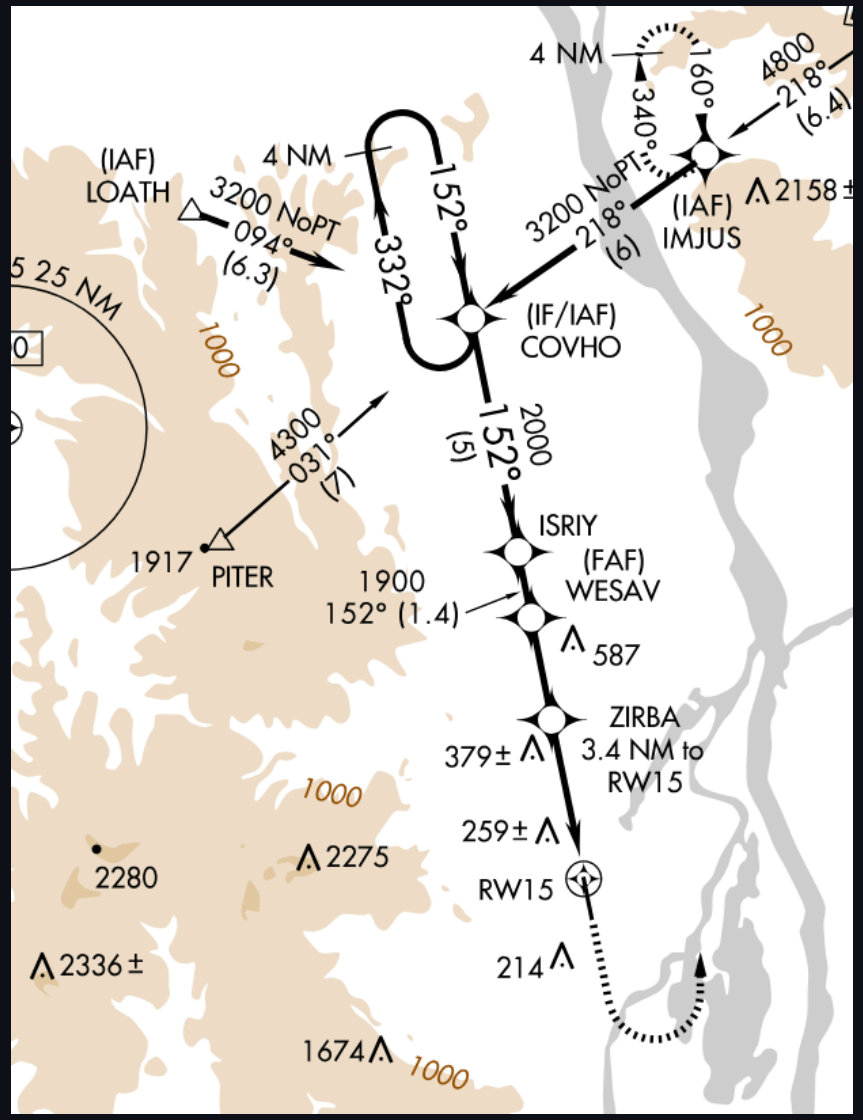
- Published hold used for getting you aligned with final approach course (e.g. PITER transition)
- Fly standard hold entry and begin the approach
- ATC will not expect you to make additional turns in the hold
- These are become more common than barbed PTs
- Tip: Always confirm with ATC if you're going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

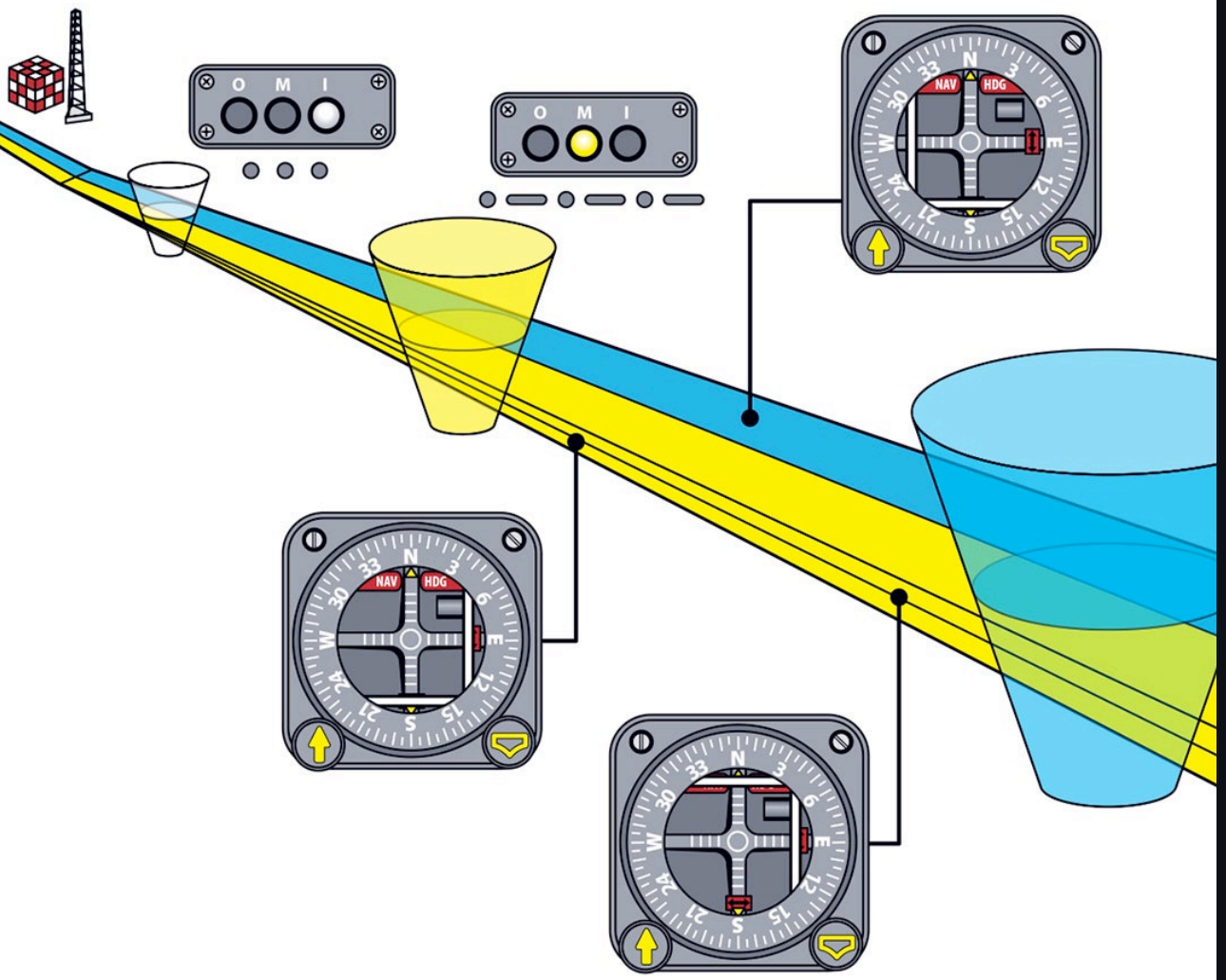
AIM 5-4-9, IFH Ch 10

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.

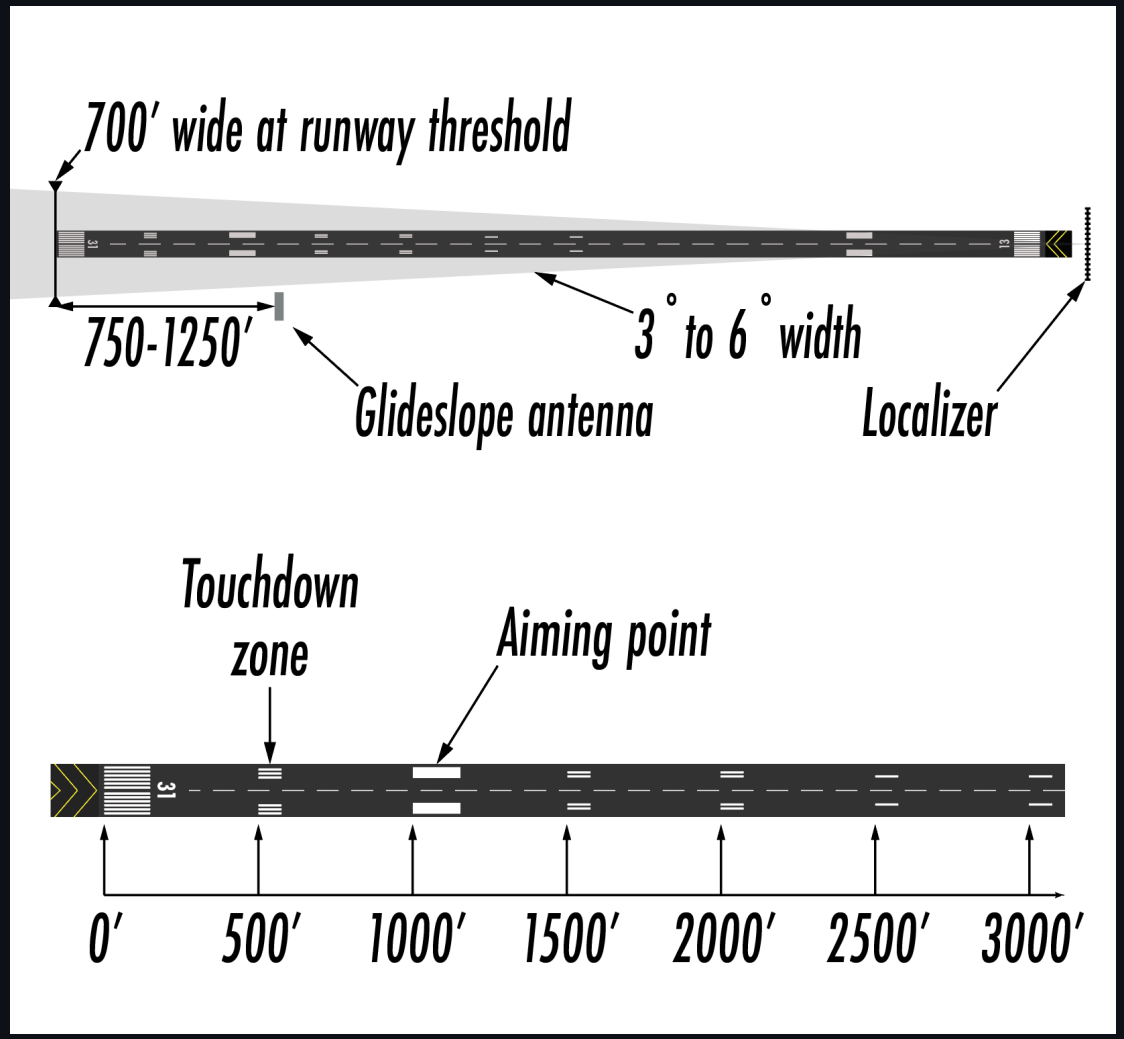
Type of precision approaches:

- **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

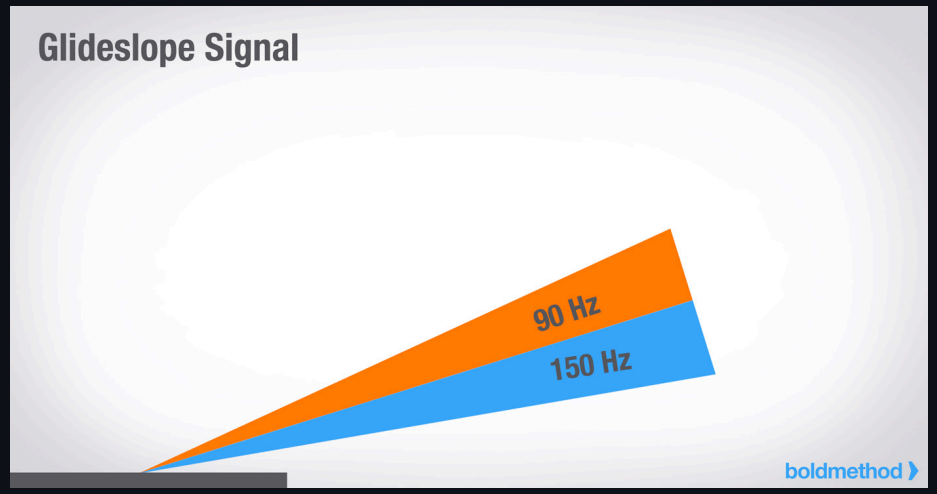


Localizer:

- Positioned at the end of the runway
- Angular width is 700' wide at the threshold
  - Two signals: 150HZ and 90HZ signals
- 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

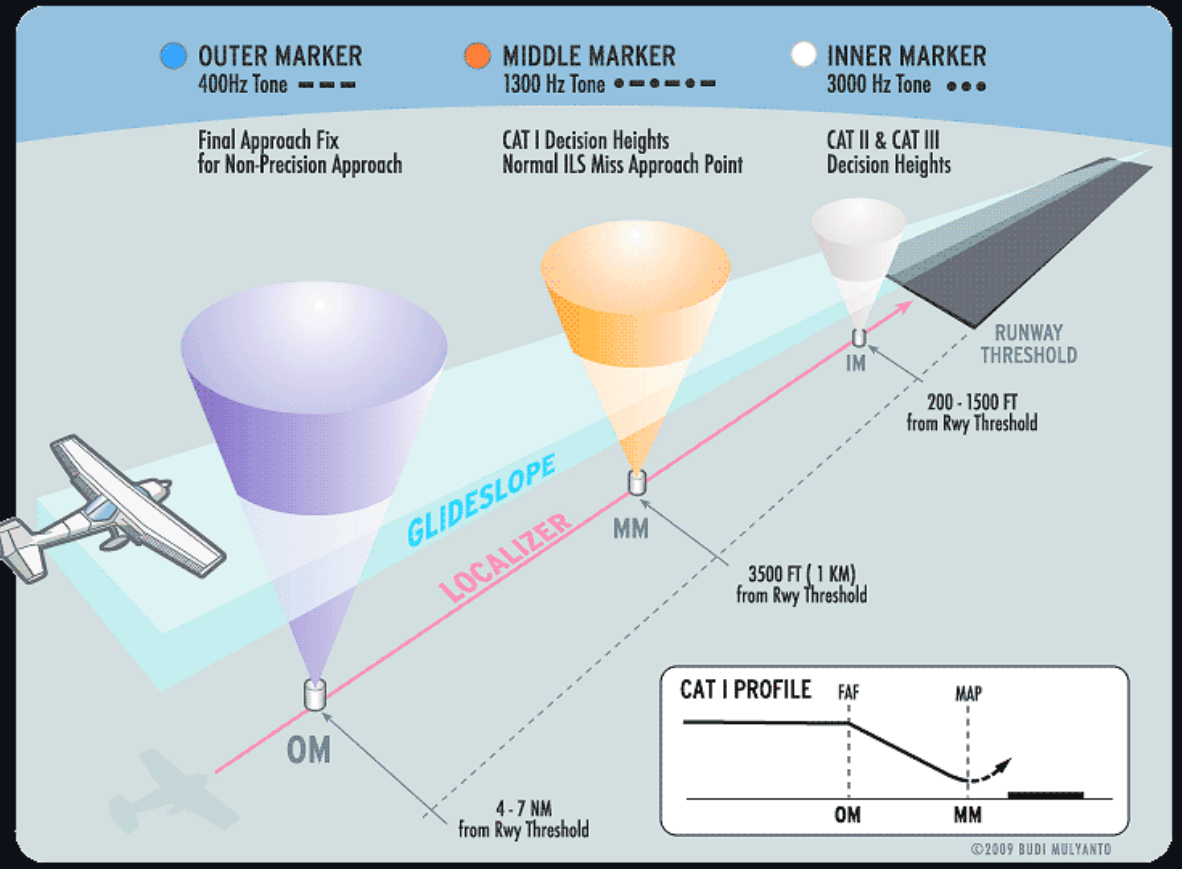
AIM 1-1-9

ILS Marker Beacons

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

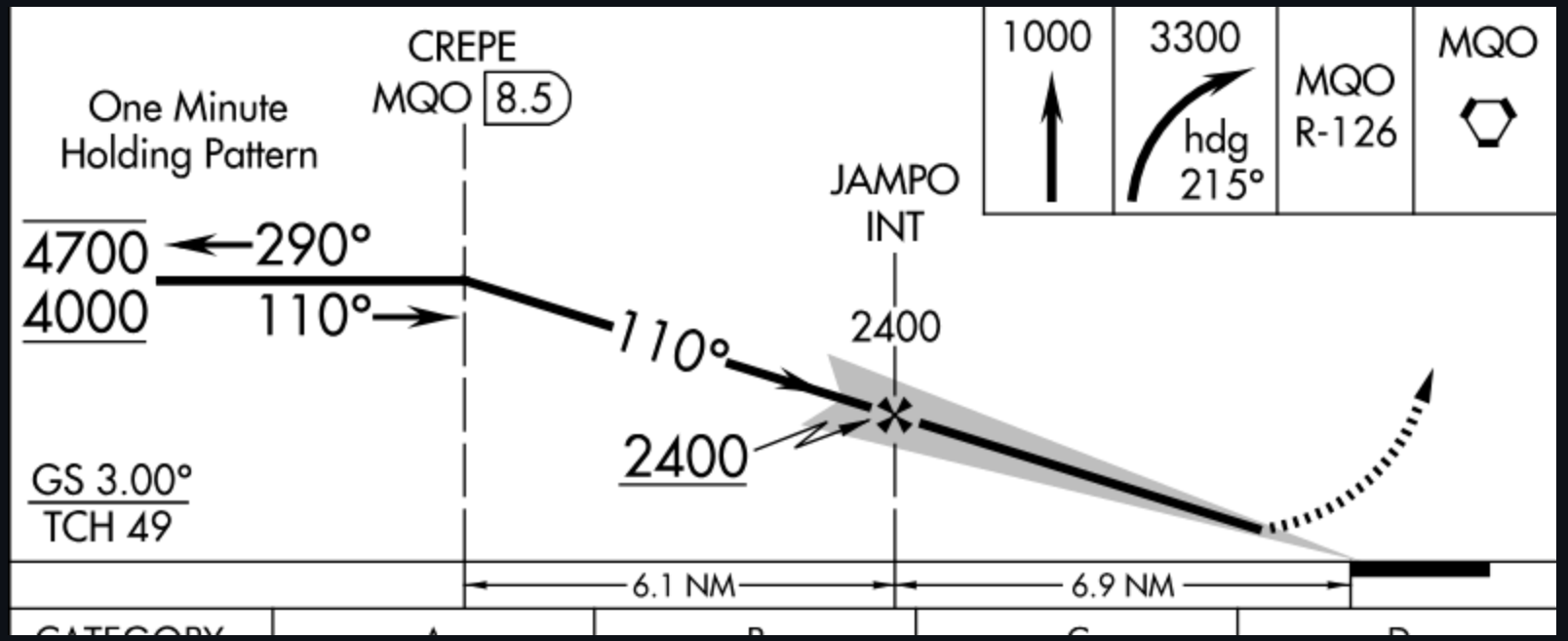
- **Outer marker:** FAF (tone)
- **Middle marker:** Standard minimums (tone)
- **Inner marker:** Used to identify lower minimums of CAT II or III ILS (tone)

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

SUPPLEMENTAL TABLES 25107

INSTRUMENT TAKEOFF AND APPROACH PROCEDURE CHARTS
RATE OF DESCENT TABLE
(ft per min)

The rate of descent table is provided for use in planning and executing descents with a known or approximate ground speed. The descent chart may also be used to calculate a constant rate of descent in the final segment on a non-precision approach. This rate of descent is advisory only. Rates of descent in ft per min are monitored with a vertical speed indicator (VSI). The use of a descent rate should not be used if it will exceed the aircraft's operational limitations.

ANGLE	ft/NM	GROUND SPEED (knots)										
		60	90	120	150	180	210	240	270	300	330	360
2.0	212	212	318	424	530	637	743	849	955	1061	1167	1273
2.5	265	265	398	531	663	796	929	1061	1194	1326	1459	1592
2.6	276	276	414	552	690	828	966	1104	1242	1380	1518	1655
2.7	287	287	430	573	716	860	1003	1146	1289	1433	1576	1719
2.8	297	297	446	594	743	892	1040	1189	1337	1486	1634	1783
2.9	308	308	462	616	770	923	1077	1231	1385	1539	1693	1847
3.0	318	318	478	637	796	955	1115	1274	1433	1592	1751	1911
3.1	329	329	494	658	823	987	1152	1316	1481	1645	1810	1974
3.2	340	340	510	679	849	1019	1189	1359	1529	1699	1868	2038
3.3	350	350	526	701	876	1051	1226	1401	1577	1752	1927	2102
3.4	361	361	541	722	902	1083	1263	1444	1624	1805	1985	2166
3.5	372	372	557	743	929	1115	1301	1487	1672	1858	2044	2230
3.6	382	382	573	765	956	1147	1338	1529	1720	1911	2103	2294
3.7	393	393	589	786	982	1179	1375	1572	1768	1965	2161	2358
3.8	404	404	605	807	1009	1211	1413	1614	1816	2018	2220	2421
3.9	414	414	621	828	1036	1243	1450	1657	1864	2071	2278	2485

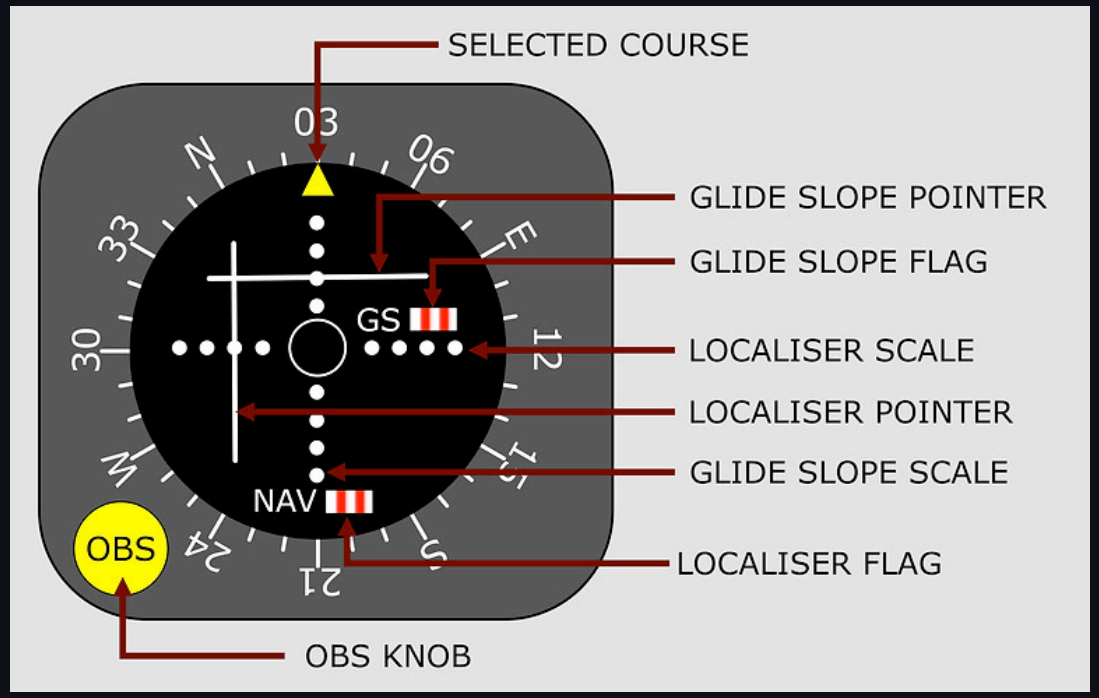
Rule of Thumb for a 3° Descent

Descent rate = (Ground speed in knots) / 2 * 10

90 knots / 2 * 10 = 450 fpm

How would wind affect our descent rate?

Flying an ILS



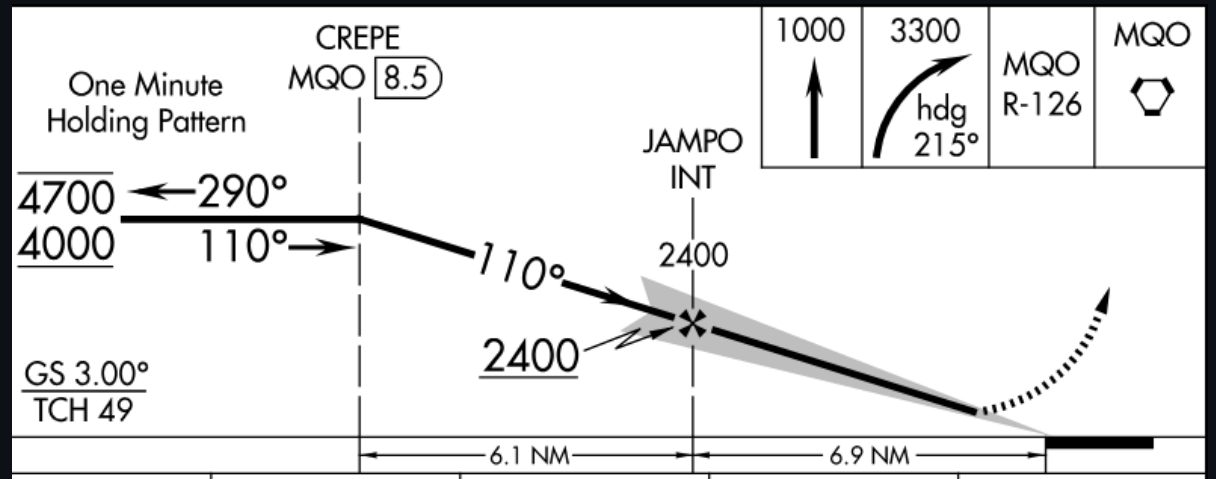
Fly to keep the needles centered

- 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

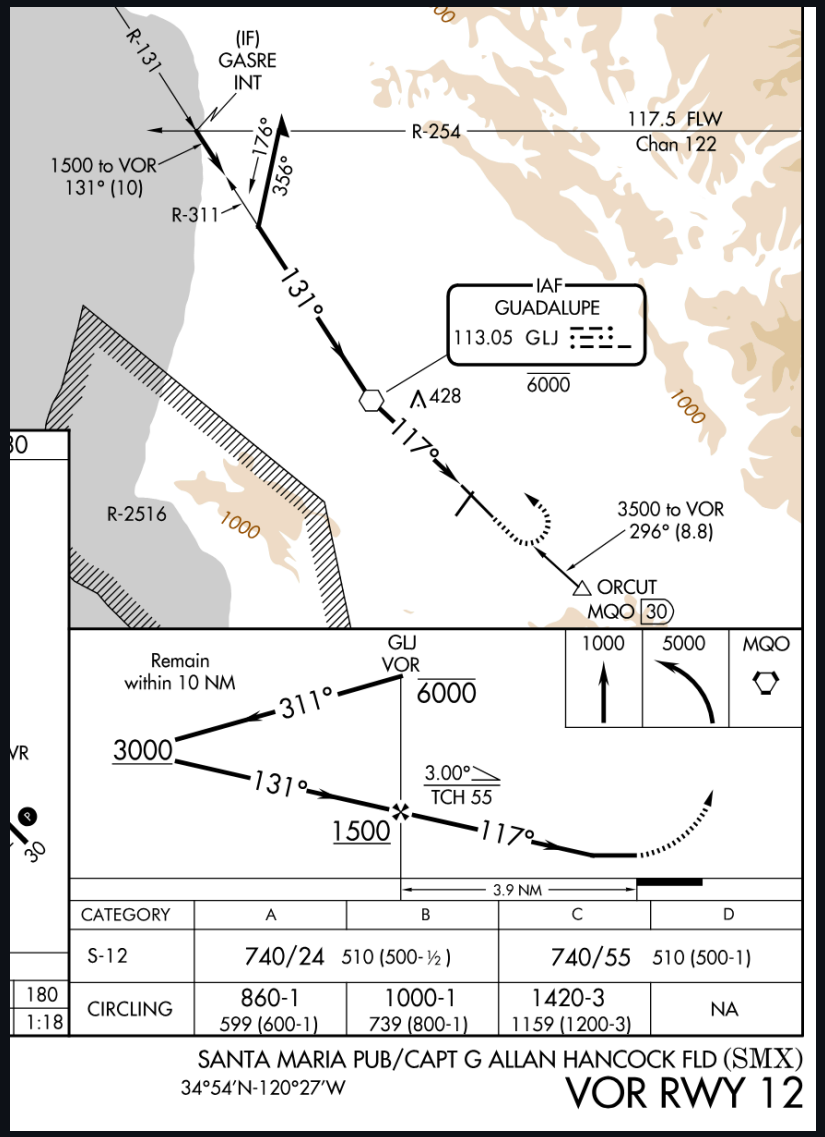
Non-precision approaches are characterized by **step-down fixes** and a **minimum descent altitude (MDA)** .

Types:

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

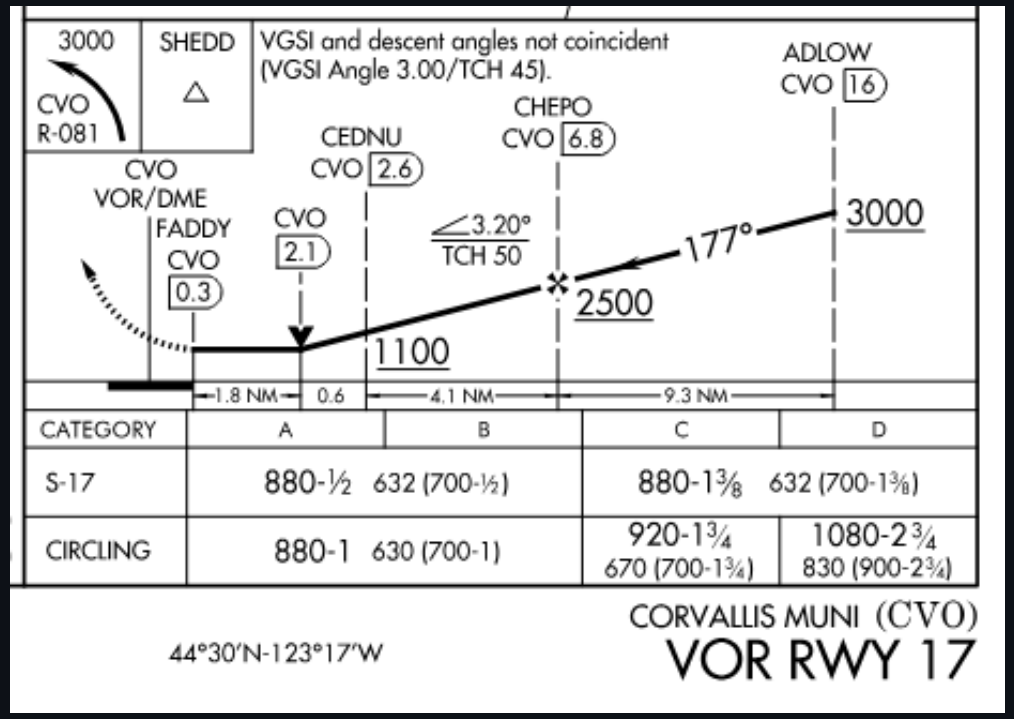
AIM 5-4-5, IFH Ch 10

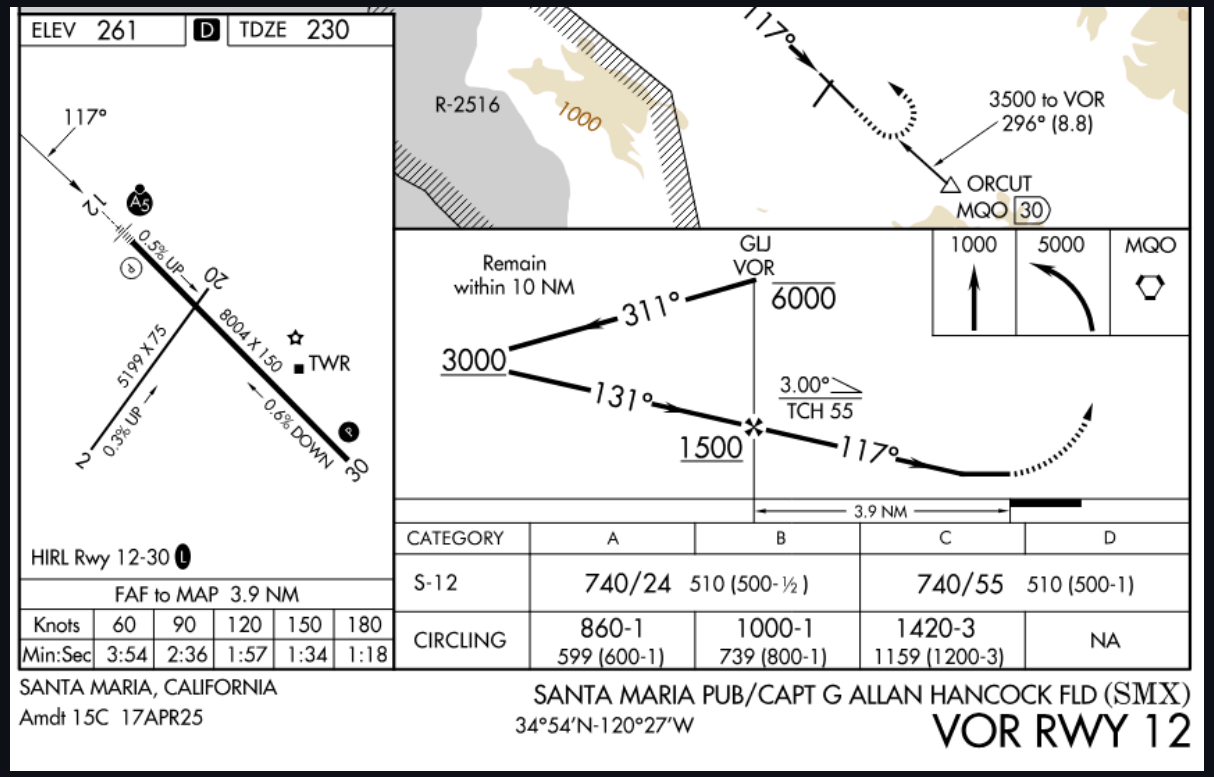
Flying a Non-Precision Approach



- 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

Going Missed on a Non-Precision Approach





Flying VOR Approaches with RNAV

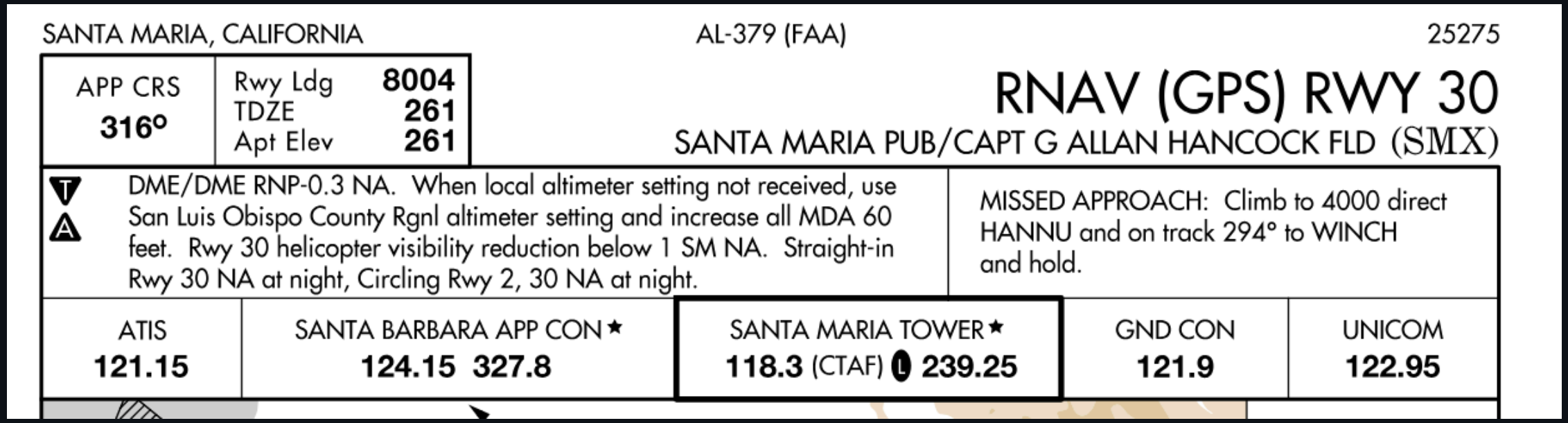
AIM 1-2-3: "Use of a suitable RNAV system as a means to navigate on the final approach segment of an instrument approach procedure based on VOR, TACAN or NDB signal is allowable."

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

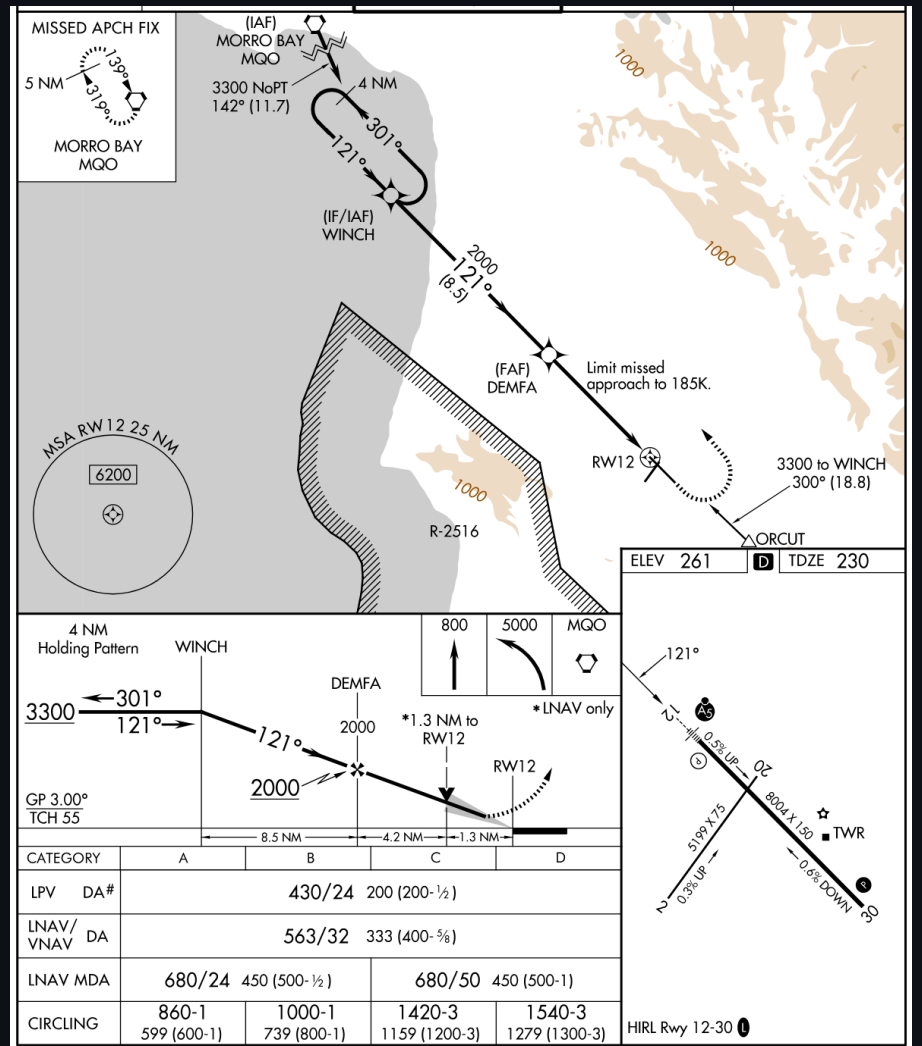
Without Vertical Guidance:

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

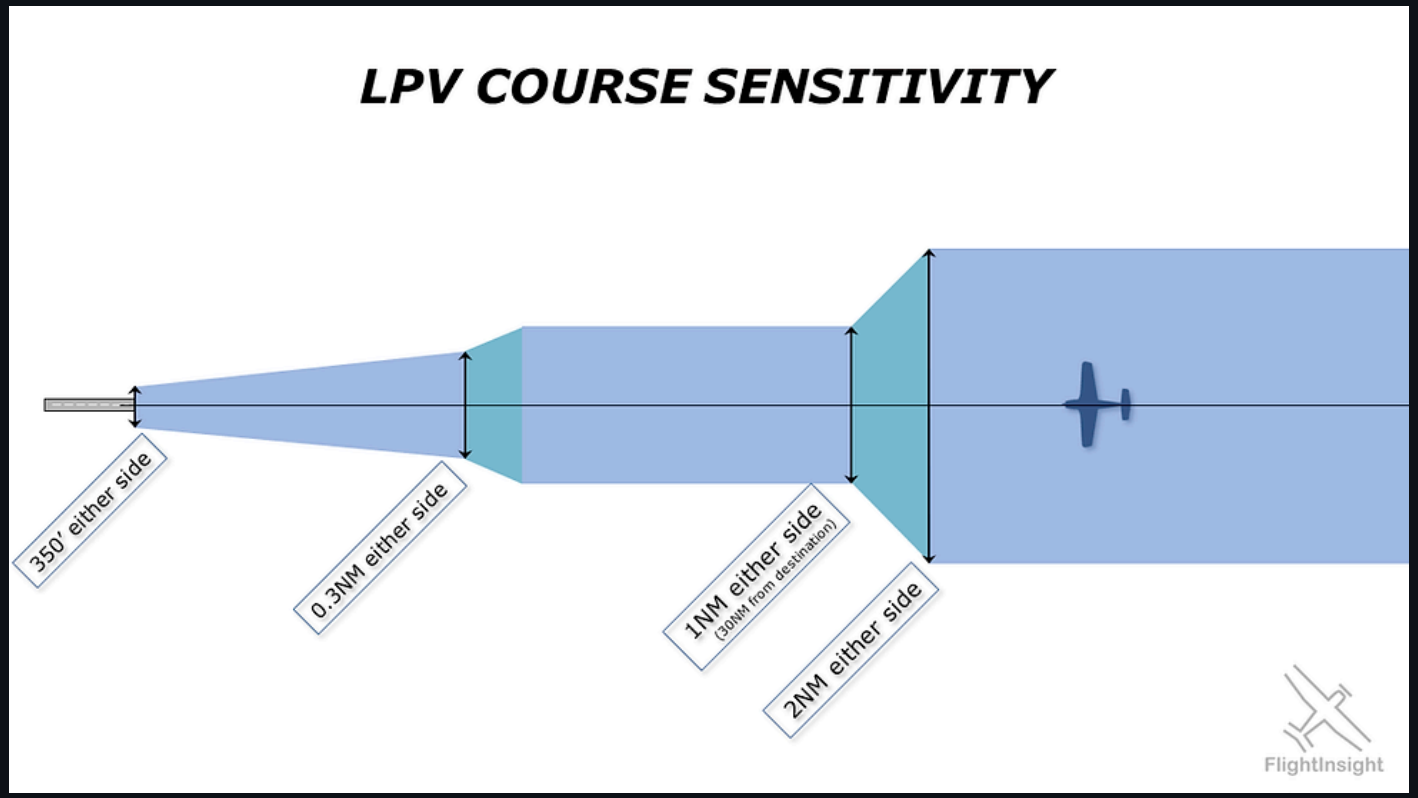
AIM 5-4-5, IFH Ch 10

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)

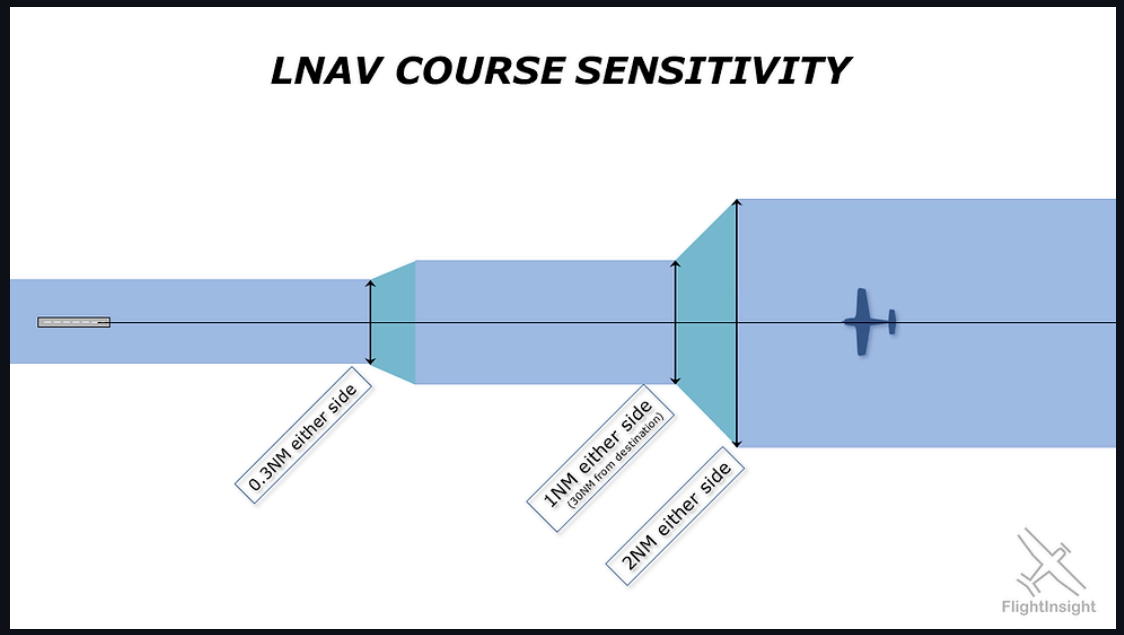


LPV Approach CDI Sensitivity



- 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

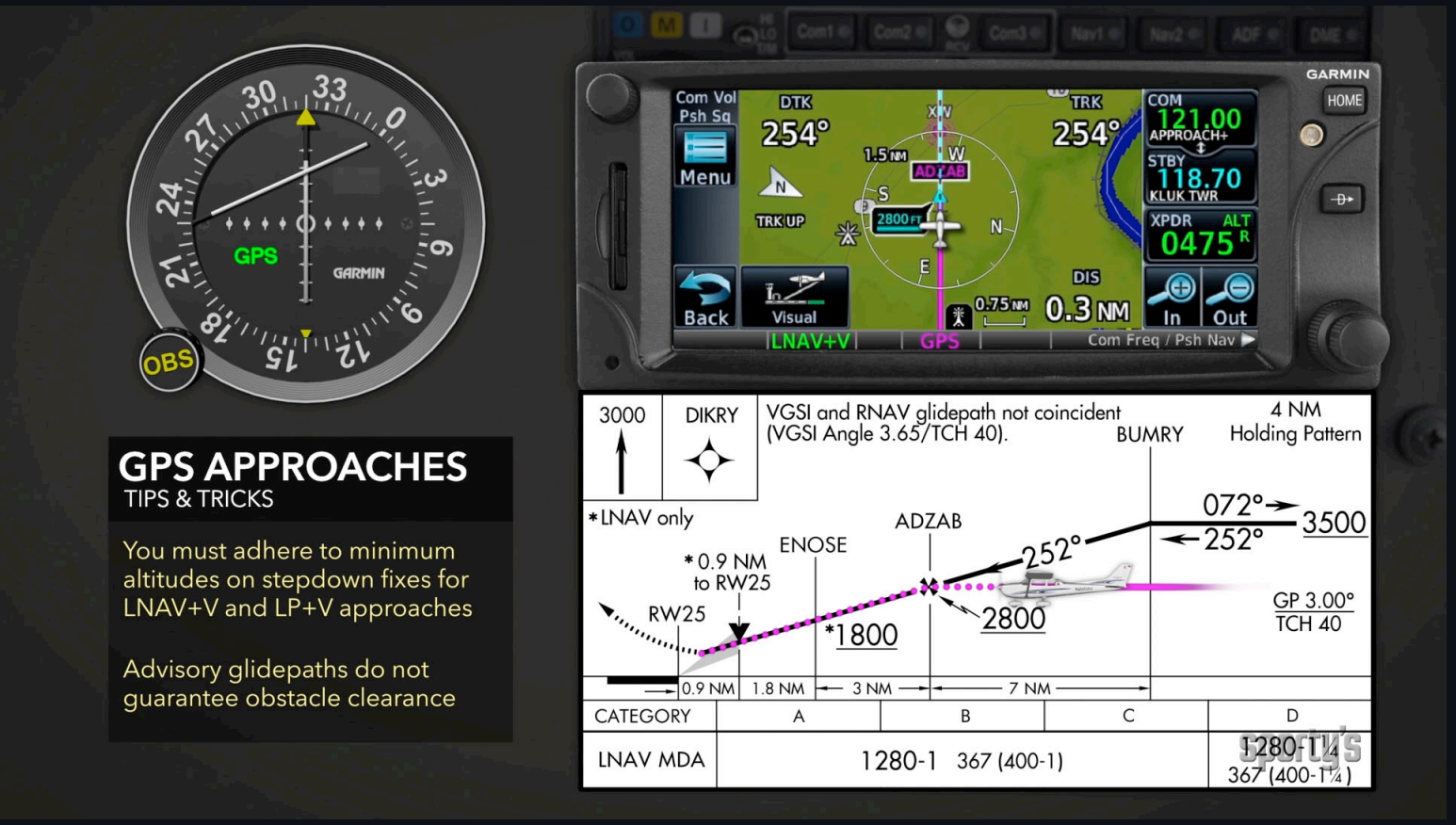


- Final approach has **fixed 0.3NM sensitivity** (not angular like LPV)
- Doesn't require a WAAS-based navigator
- These were initially designed for baro-aided FMS systems
- Garmin annunciation: Garmin L/VNAV

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

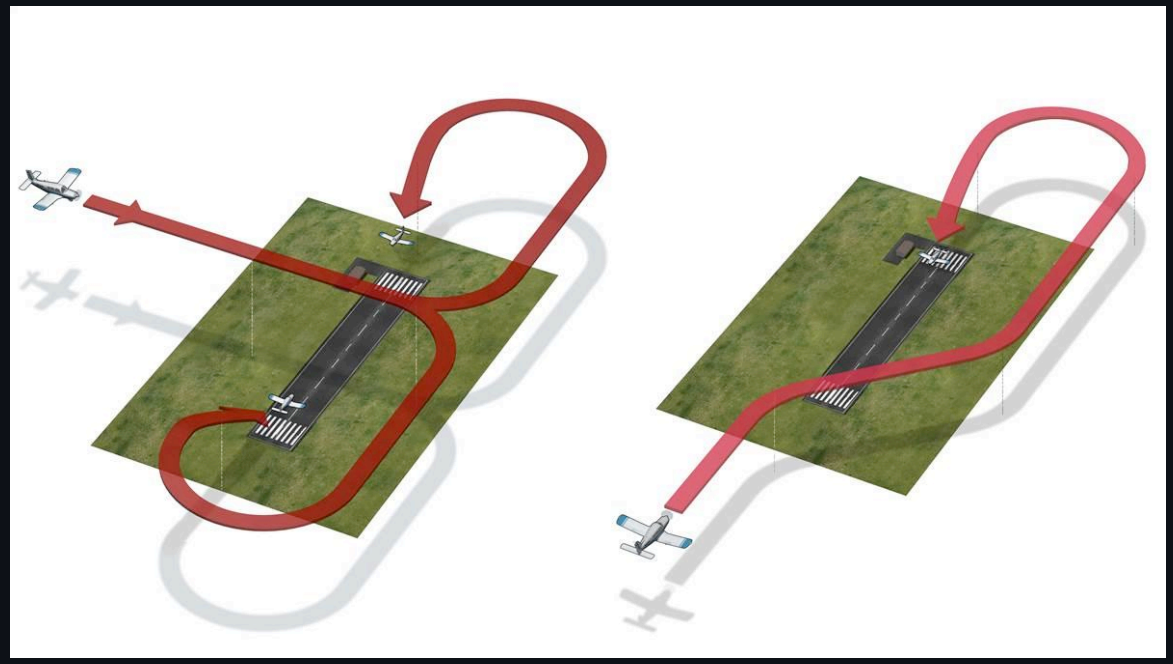
A glideslope generated the navigator which meets the crossing requirements of the step-down fixes of a non-precision approach.

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

IFH Ch 10

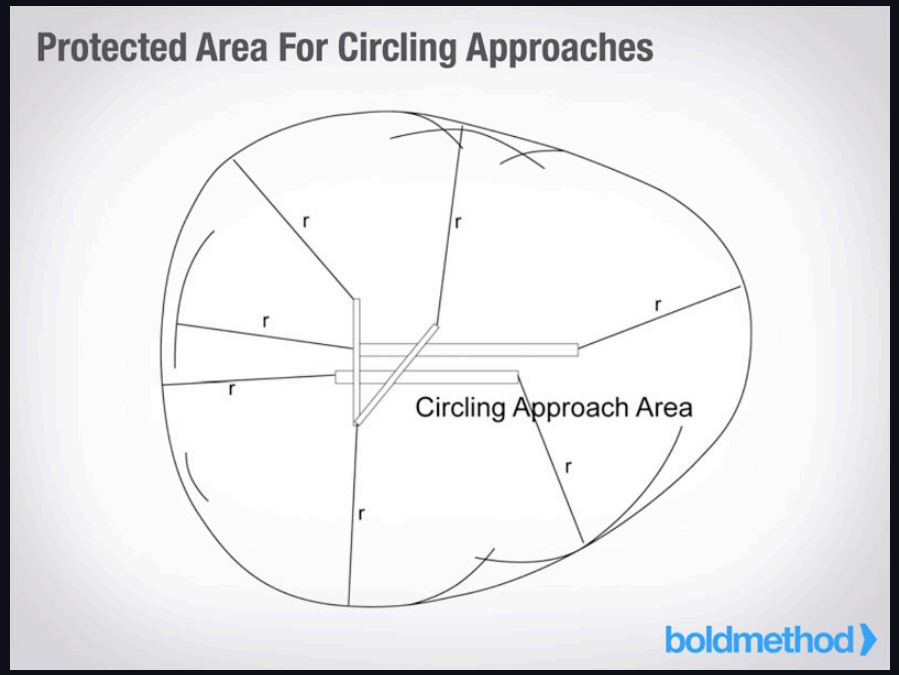
Circling Approaches

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

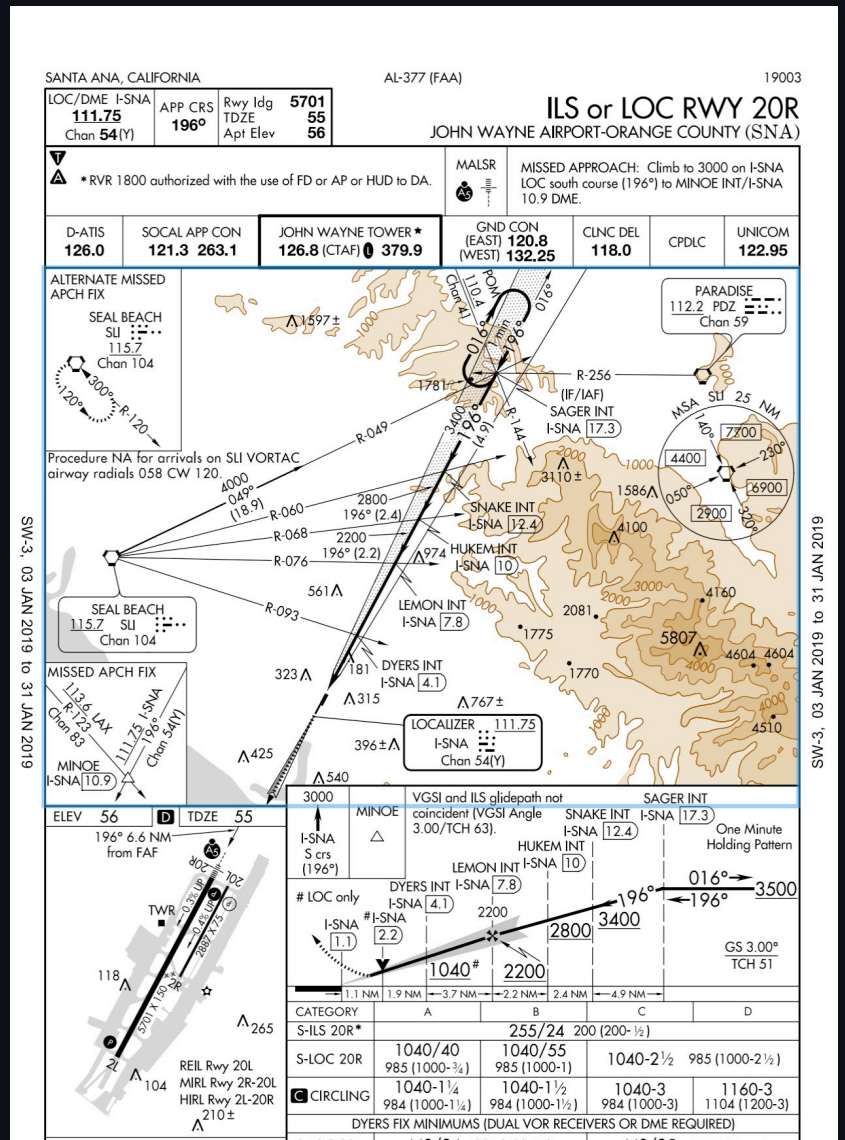


CATEGORY	A	B	C	D
LPV DA#	430/24 200 (200-½)			
LNAV/ VNAV DA	563/32 333 (400-⅝)			
LNAV MDA	680/24 450 (500-½)		680/50 450 (500-1)	
CIRCLING	860-1 599 (600-1)	1000-1 739 (800-1)	1420-3 1159 (1200-3)	1540-3 1279 (1300-3)

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

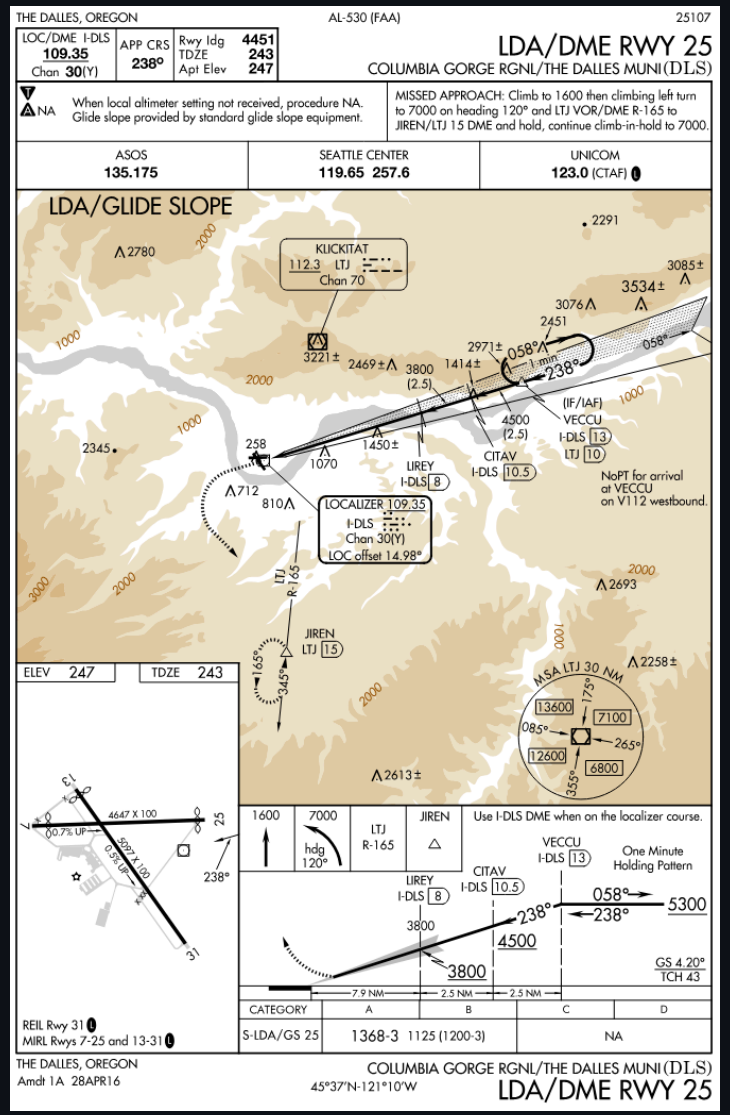
Sidestep Maneuver



- 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

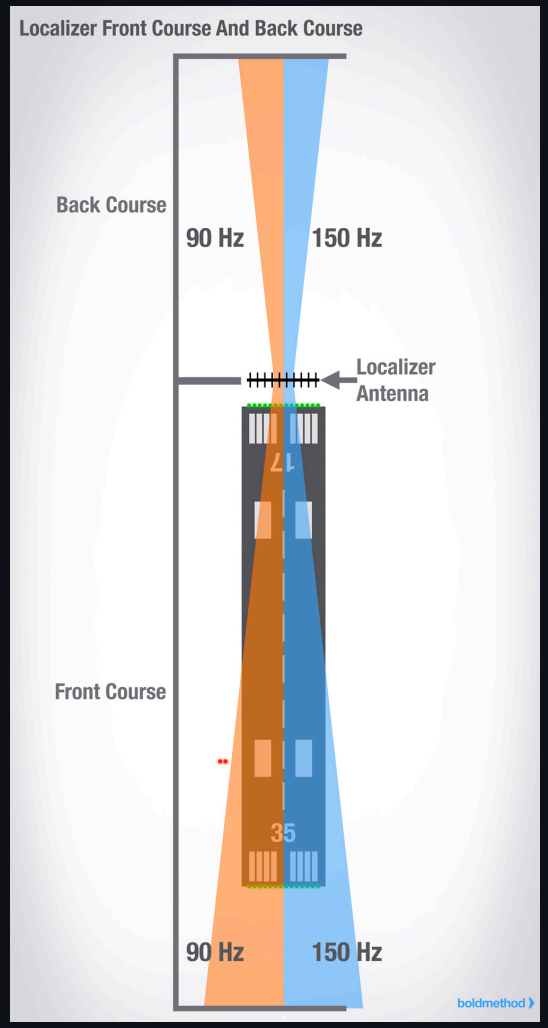
AIM 5-4-19

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

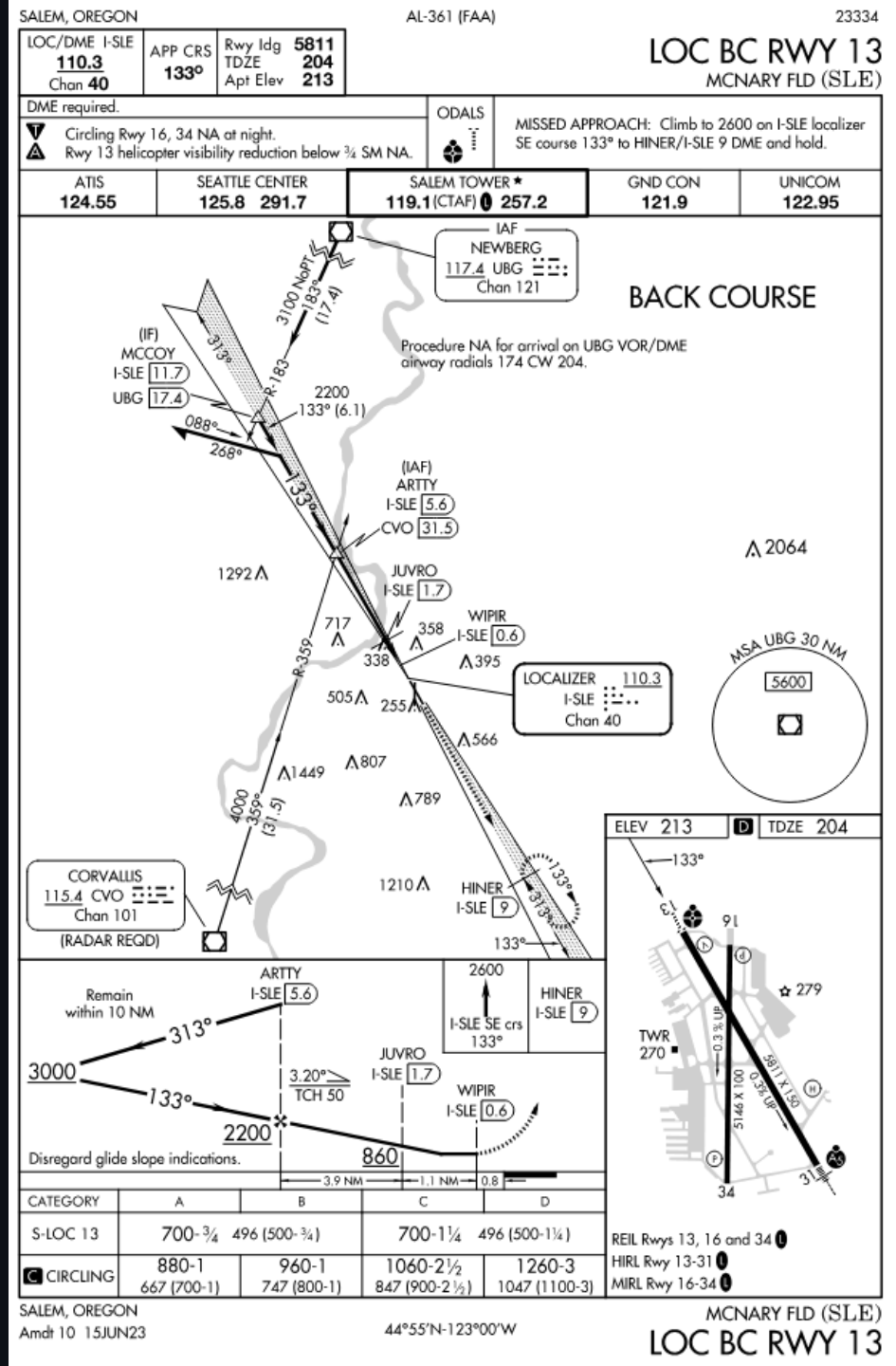


The signal from a localizer also extends behind the primary runway, and can be used to guidance to the opposing runway.

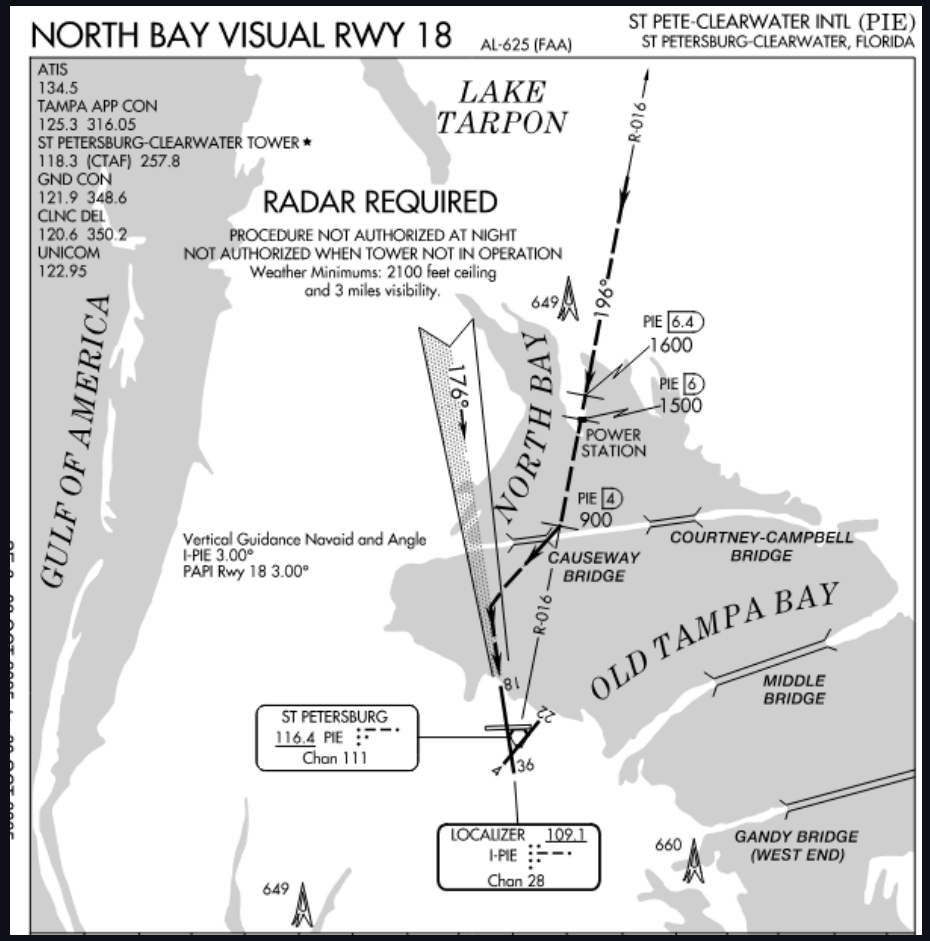
- Disregard any glideslope indication
- A standard CDI will be read L/R backwards
  - Fly away from the needle instead of towards it
  - "You are the needle"
- With an HSI, set the **inbound/front course** into your OBS
  - Then the green needles will read correctly (since the needles are flipped upside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

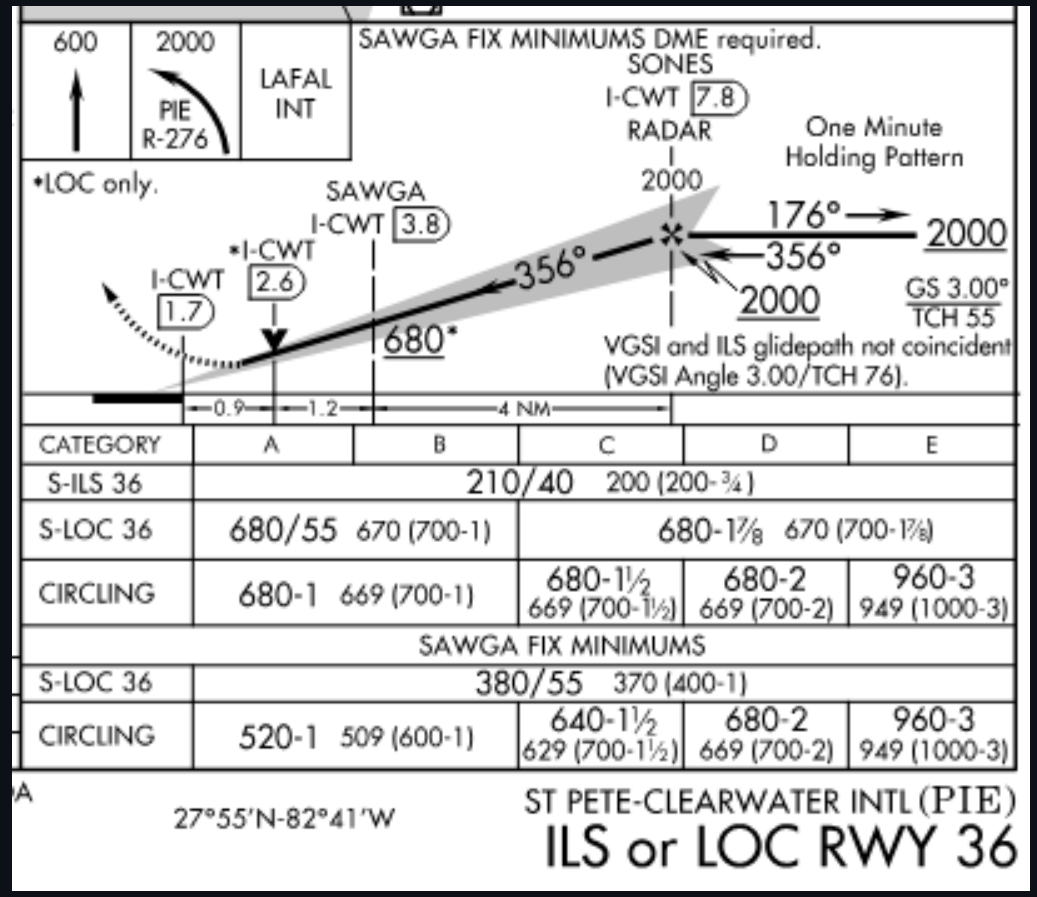
Inoperative Equipment - Navigation

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

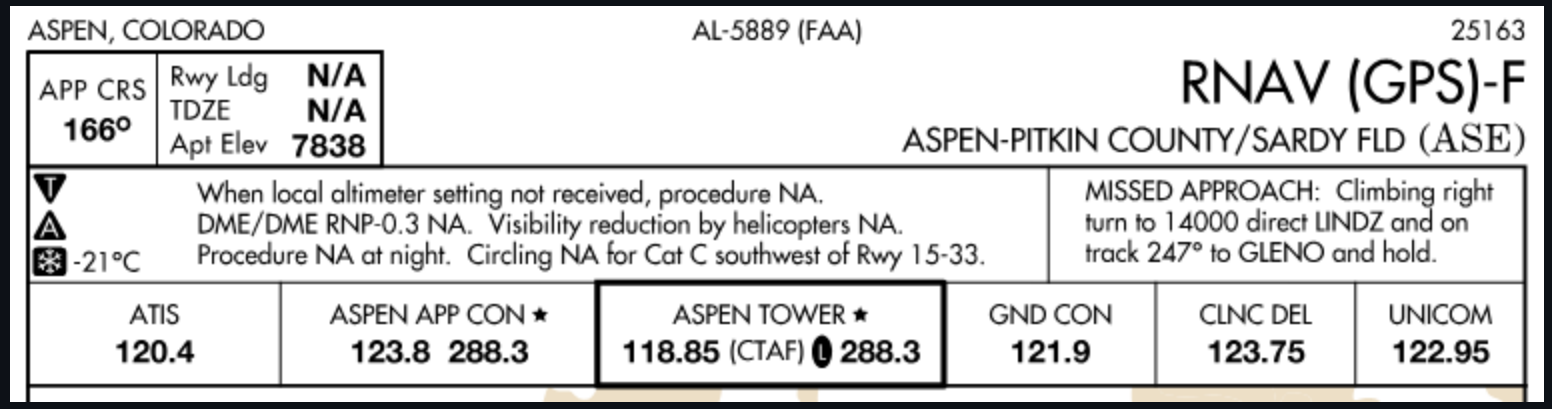
Inoperative Component or Visual Aid	Increase Visibility
ODALS (CAT A-B)	¼ mile
ODALS (CAT C-D)	⅛ mile

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?

Knowledge Check

While circling to land to the opposing runway you lose sight of the airfield. You're currently at 600 feet AGL and abeam the mid point of the runway. How should initiate the missed approach procedure?

Knowledge Check

You're approaching an airport to land and you notice that the VOR navaid on the field is out-of-service. You were hoping to fly the VOR-16 approach to land. You have a WAAS-based GPS system installed in your airplane. Can you fly the approach?

References

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