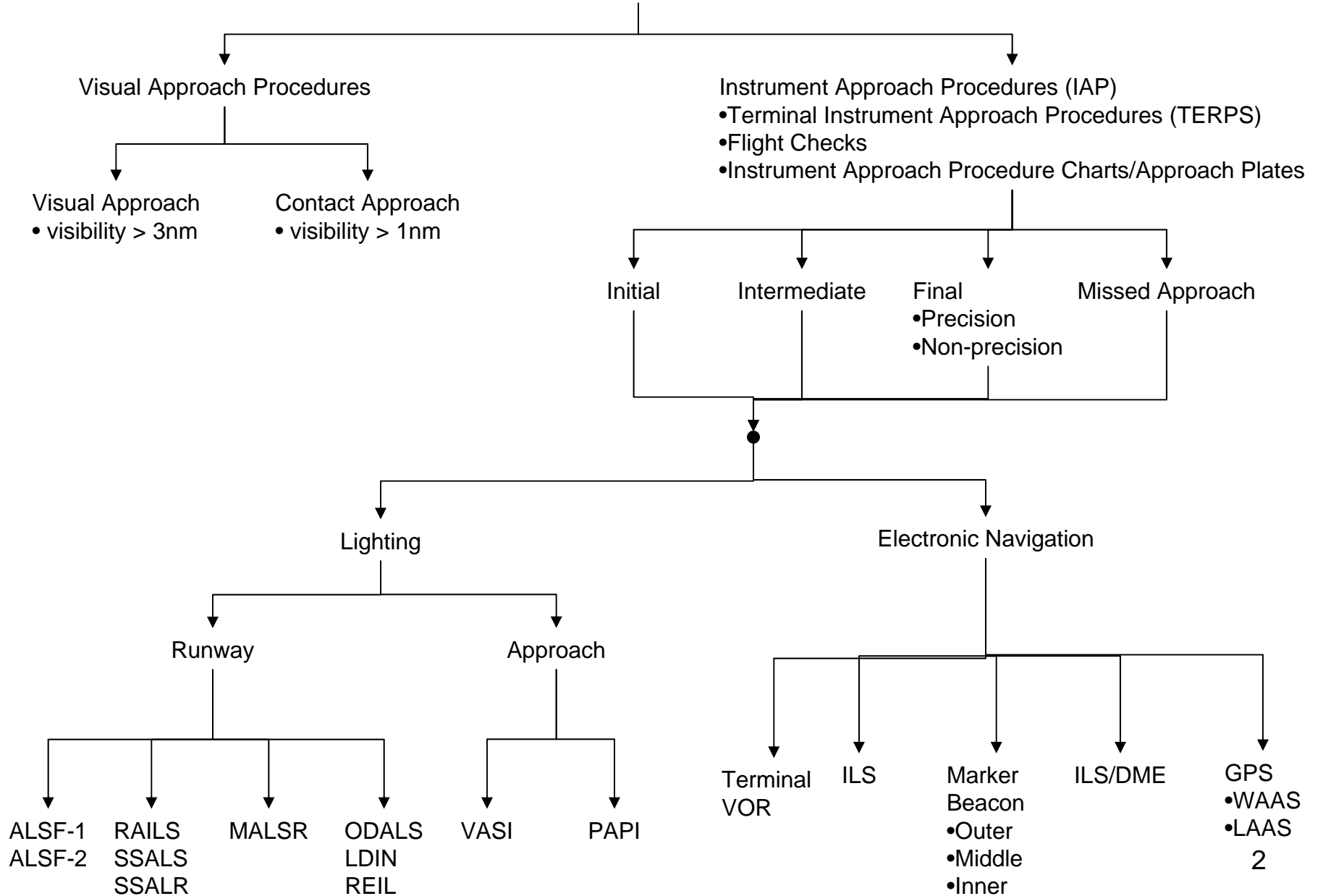


Navigation Systems - Approach

Nolan, Chap 2

Approach Navigation



Visual Approach Procedures

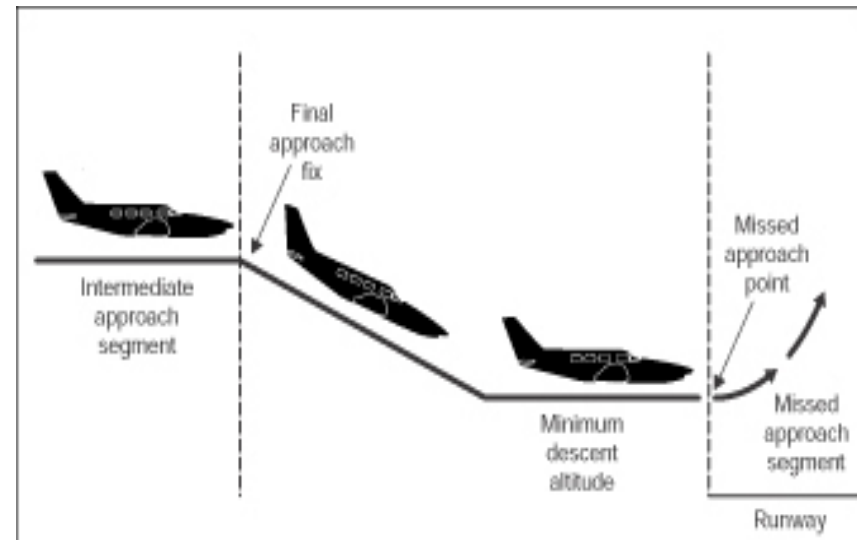
- Pilot accepts responsibility for navigation to the airport
 - Pilots under VFR
 - Pilots use “see-and-avoid”
- Two types of Visual Approach Procedures
 - Visual Approach
 - Initiated by pilot or ATCo
 - Visibility > 3nm
 - Contact Approach
 - Initiated by pilot
 - Visibility > 1nm

Instrument Approach Procedures

- Pilot follows a published Instrument Approach Procedures (IAP)
 - Provides guidance, obstacle clearance to airport
- IAP designed by FAA
 - Terminal Instrument Approach Procedures (TERPS)
 - Flight Checks
 - IAP Charts (also known as Approach Plates)

Segments of IAP

1. Initial Approach Segment
2. Intermediate Approach Segment
3. Final Approach Segment
 - Non-precision Approach
 - Precision Approach
4. Missed Approach



Initial Approach Segment

- Objective:
 - Ground-track to transition aircraft from en-route airway to intermediate approach segment
- Start/Termination
 - Starts at Initial Approach Fix (IAF)
 - Located on airway
 - Ends at Intermediate Approach Segment
- Defined by:
 - Defined by Heading or Radial from IAF
 - Minimum allowable altitude

Intermediate Approach Segment

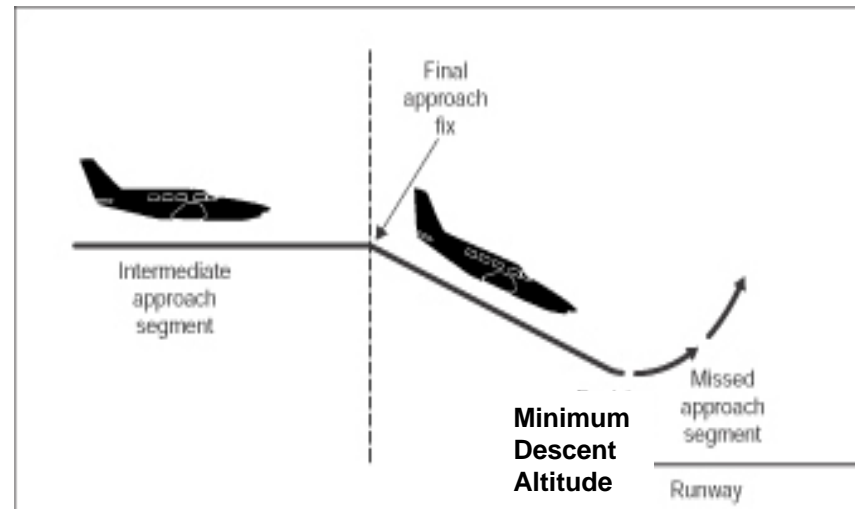
- Objective:
 - Permit pilot to:
 - descend to intermediate altitude
 - Align aircraft to runway course
 - Start/Termination
 - Start at end of Initial Approach Segment
 - End at Final Approach Fix (FAF)
 - Defined by:
 - Course to Final Approach Fix (FAF)
 - Part of Procedure Turn

Final Approach Segment

- Objective:
 - Navigate to runway using navigation aid (located at or nearby runway)
- Start/Terminate:
 - Start at FAF
 - End at Missed Approach Point (MAP)
- Defined by:
 - Runway center-line course
 - Descent on 3° to runway

Final Approach – Nonprecision

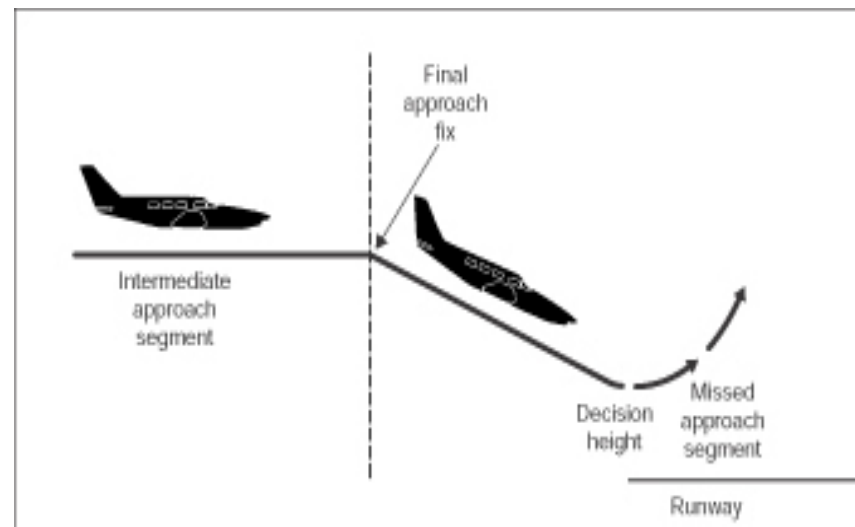
- Lateral guidance only
 - Navaids:
 - VOR (Terminal)
 - VOR/DME
 - NDB
- Aircraft descends from FAF to Minimum Descent Altitude (MDA)
- Pilot maintains MDA on runway center-line to Missed Approach Point (MAP)
- If runway in sight at MAP, then land
- If runway not in sight at MAP, then Missed Approach Segment



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Final Approach - Precision

- Lateral AND Vertical Guidance
- Aircraft descends from FAF down Glideslope to Decision Height (DH)
 - Glideslope provides 3° descent
 - Decision Height lower than MDA
- If runway in sight at DH, then land
- If runway not in sight at DH, then Missed Approach Segment

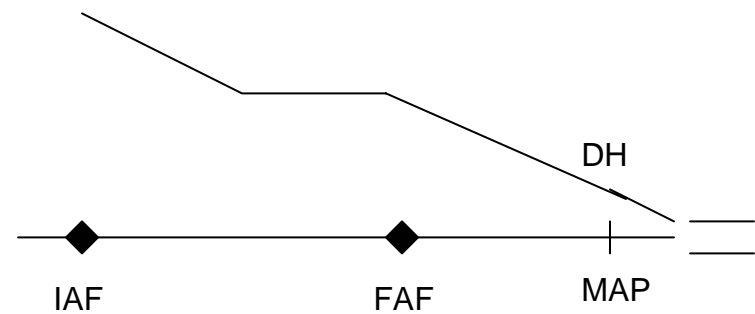
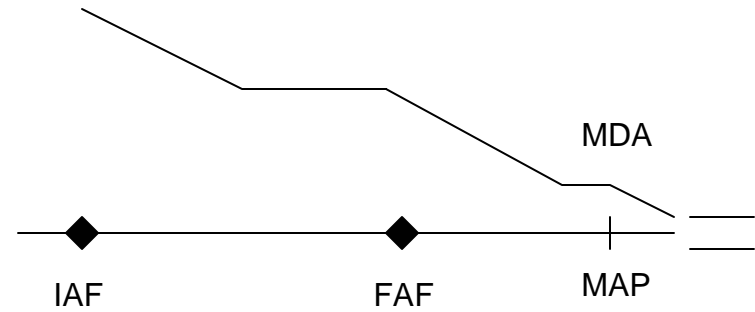
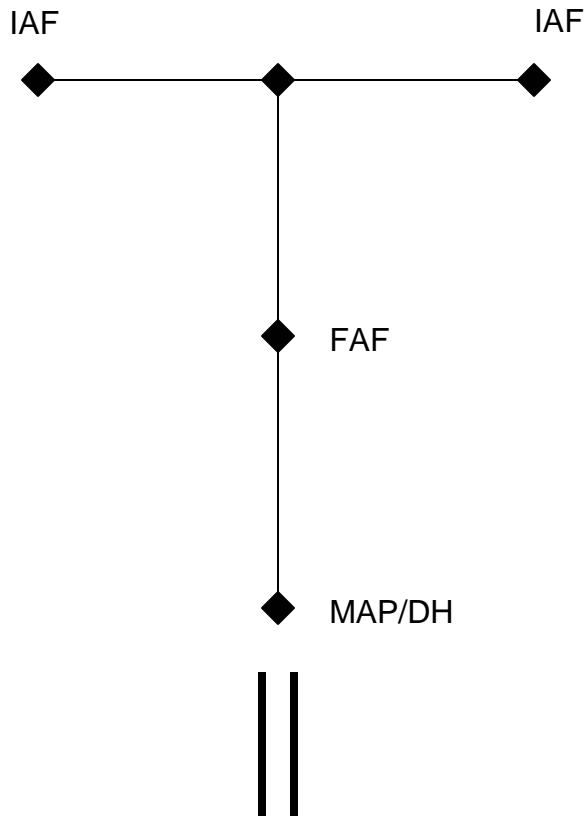


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Missed Approach Segment

- Objective:
 - To guide aircraft above obstacles away from traffic to safe location, prior to entering the queue for the approach again
 - Navigation Aids:
 - Instrument Landing System (ILS)
- Start/Terminate:
 - Start at MP or DH
 - Terminate at Exit Hold
- Defined by:
 - Climb to safe altitude
 - Hold at published location

Instrument Approach Procedure

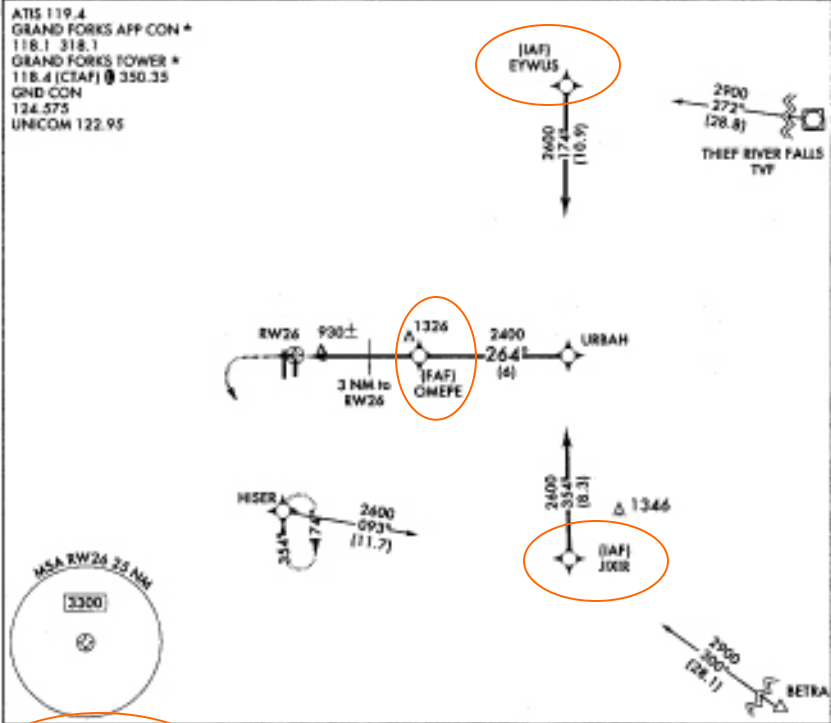


Orig 8 02108

GPS RWY 26

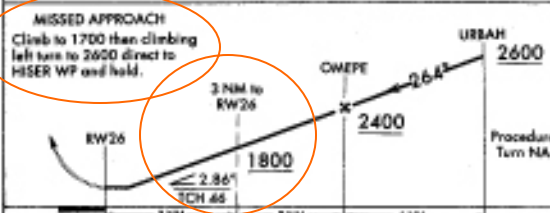
AL-5187 (FAA)

GRAND FORKS INTL (GFK) GRAND FORKS, NORTH DAKOTA



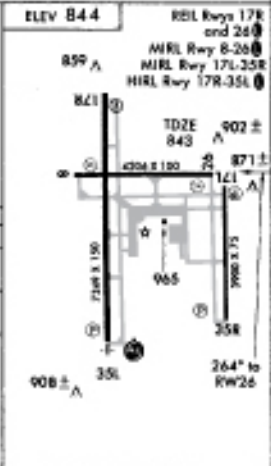
NC-1, 03 OCT 2000

NC-1, 03 OCT 2000



CATEGORY	A	B	C	D
S-26	1360-1 517 (600-1)		1360-1 1/2 517 (600-1 1/2)	1360-1 3/4 517 (600-1 3/4)
CIRCLING	1400-1 556 (600-1)		1400-1 1/2 556 (600-1 1/2)	1400-2 556 (600-2)

Δ NA



GPS RWY 26

Orig 8 02108

47°57'N-97°11'W

GRAND FORKS, NORTH DAKOTA
GRAND FORKS INTL (GFK)

Grand Forks – GPS RWY 26

- Initial Approach Segment:
 - EYWUS (IAF), 174° to URBAH. Cross URBAH at 2600'
 - JIXIR (IAF), 354° to URBAH, Cross URBAH at 2600'
- Intermediate Approach Segment:
 - Descend from URBAH, on 264° to OMEPE (FAF). Cross OMEPE at 2400'
 - URBAH to OMEPE is 6nm.
- Final Approach Segment:
 - FAF (OMEPE), 264° to MAP
 - OMEPE to MAP is 5nm (3+2)
 - Descend from OMEPE on 2.86° Flight Path Angle
 - Cross 3nm from Runway at 1800'
- Missed Approach Segment
 - Climb to 1700', then left turn to 2600', direct to HISER waypoint, Right Hold at Hiser on 354°
 - Return to IAF JIXIR on course 093° at 2600'

Terminal VOR

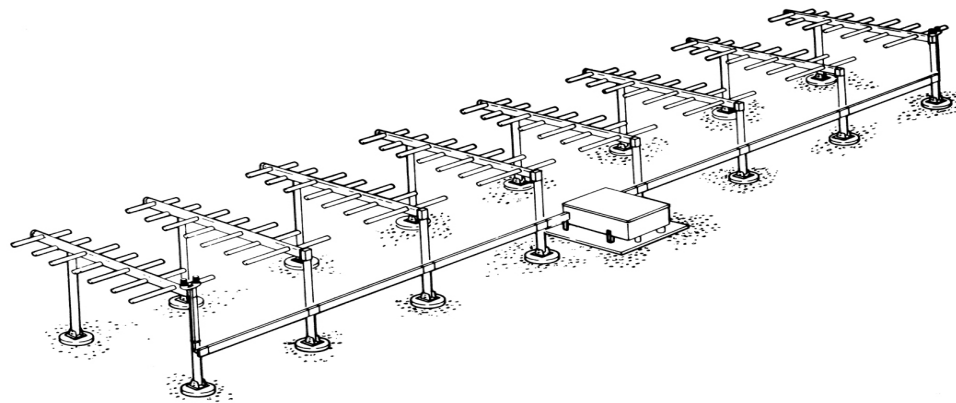
- Provides lateral guidance (course) to runway for airport needing instrument approach
- Low-powered VOR upto 25nm

Instrument Landing System

- ILS provides pilot with lateral and vertical approach path to runway centerline
- ILS is equipped with three types of transmitters:
 - Localizer
 - Glideslope
 - Marker Beacons (2 or 3)

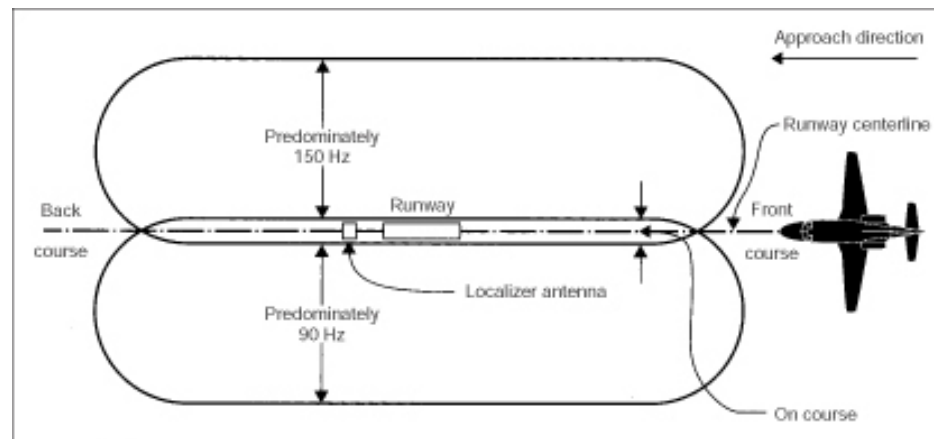
Localizer - Components

- 3 components:
 - Transmitter building
 - 300' to side of localizer antenna
 - Localizer antenna
 - 1000' beyond the opposite end of the arrival runway
 - Monitoring equipment
 - Part of antenna system



Localizer - Signals

- VHF Band – 108.1 to 111.9f mHZ
- Antennae radiates signal aligned with runway center-line
 - Modulated with 2 tones
 - 90Hz (left of runway) and 150Hz (right of runway)



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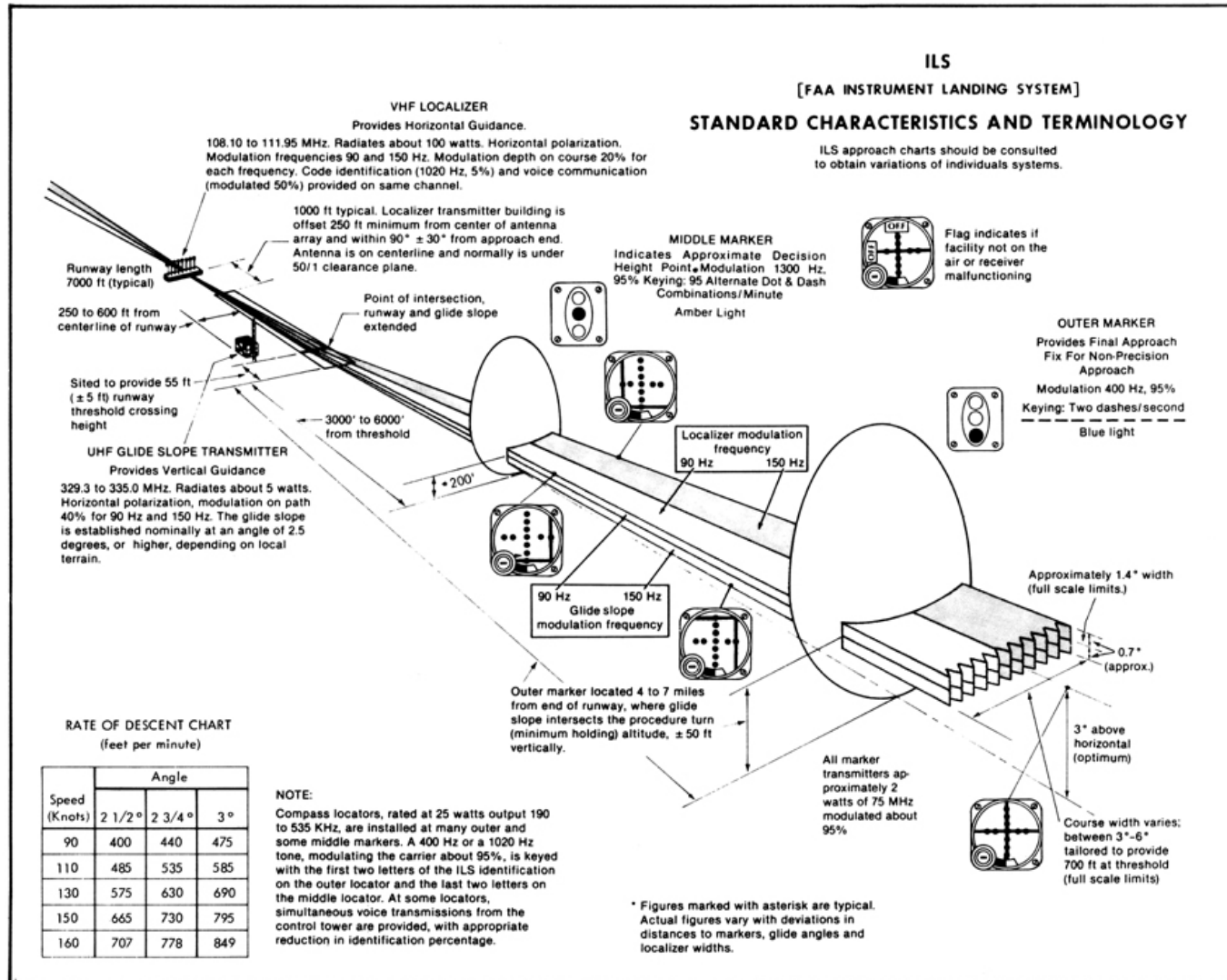
Localizer – Signal Geometry

- Localizer signal is transmitted;
 - along a narrow path extending 35° to the left and right of the centerline
 - Approx 7° high
- Transmitted to a distance of 10nm
 - Between 10nm and 25nm from runway accurate only within 10° of center-line
- Localizer Directional Aid (LDA)
 - Scalloping, degraded navaid

Localizer – On Aircraft

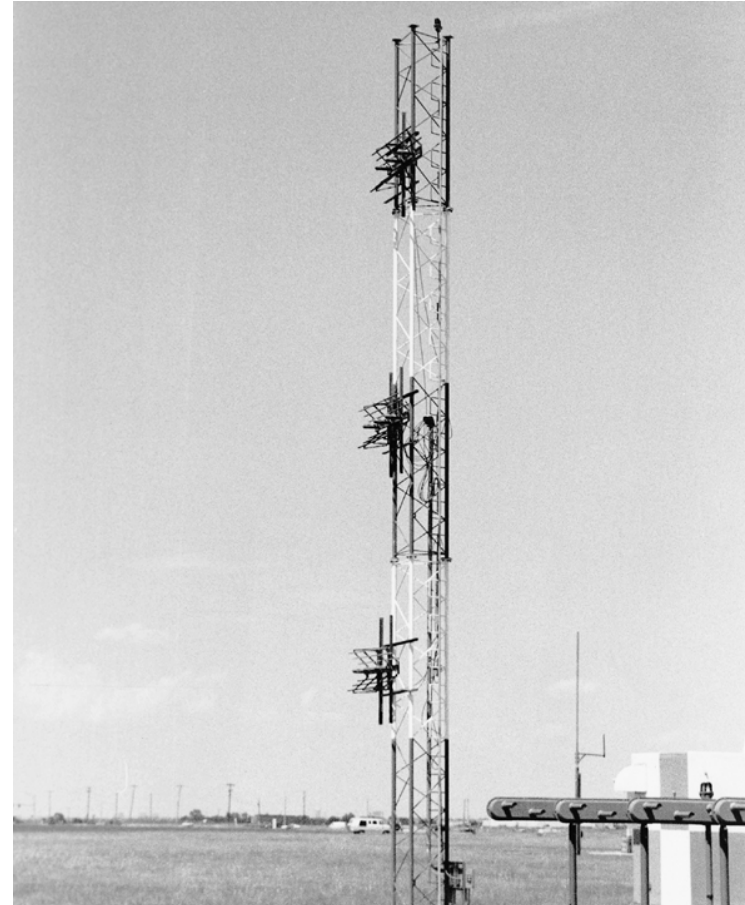
- Full-scale deflection 3° “off course”
- On-course narrows as approach antennae
 - Ten miles from runway, full-scale deflection, aircraft ½ mile off course
 - Approach end of runway, full scale deflection, aircraft is 300 ft off course

Localizer - Review



Glideslope - Components

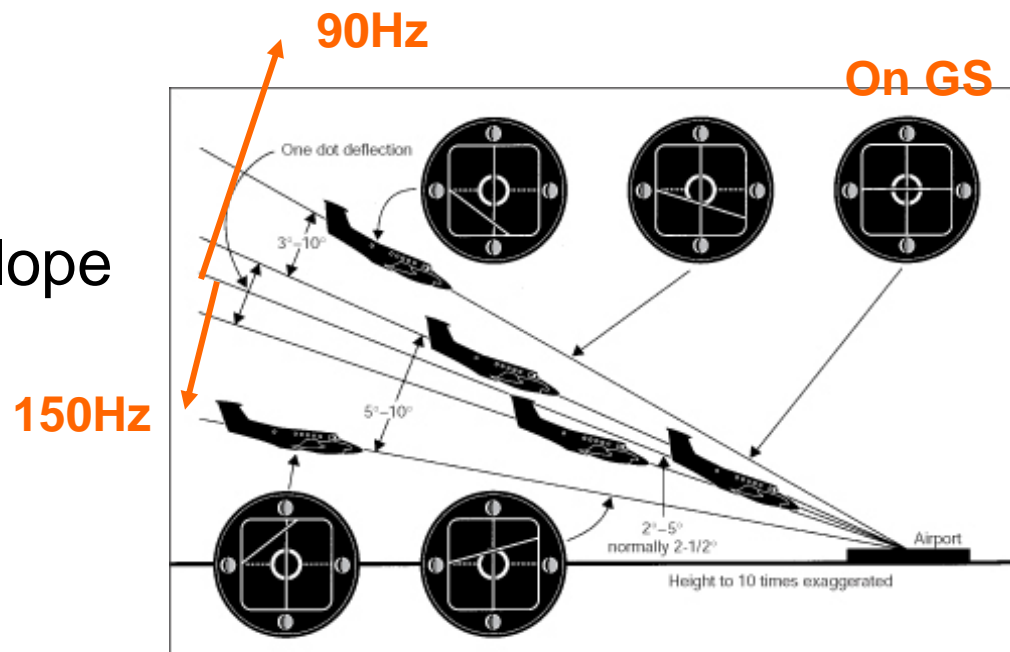
- Glideslope components
 - Antenna (30 ft)
 - 500 ft from runway center-line
 - 1000 ft from approach end of runway
 - transmitter building
 - 500 ft from runway center-line
 - 1000 ft from approach end of runway
 - Monitoring antenna
 - Clear zone
 - Glideslope reflecting area



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Glideslope - Signals

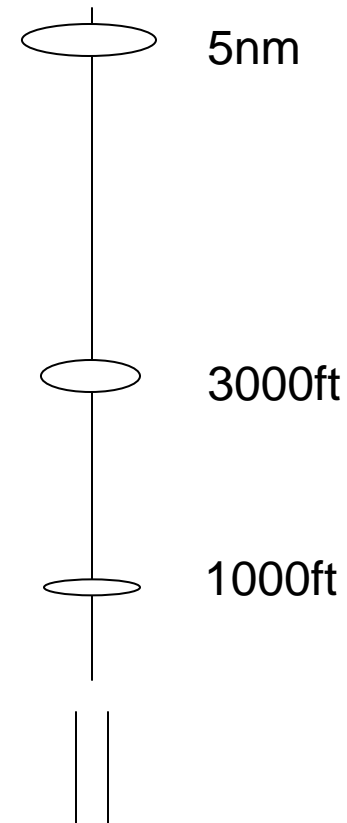
- UHF band 329mHz to 335mHz
- GS transmits
 - 90Hz above glideslope (+3°)
 - 150Hz below glideslope (-3°)



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Marker Beacons

- Located at known distance along final approach course
 - Outer Marker
 - 5nm from approach end of runway
 - Blue light, 400Hz beeps
 - Middle Marker
 - 3000 ft (1/2 mile) from approach end of runway
 - Amber light, 1300Hz beeps
 - Aircraft 200 ft AGL = Decision Height
 - Inner Marker
 - 1000ft from approach end of runway
 - White light, 3000Hz beeps
 - Aircraft 100 ft AGL
- Transmit cone shaped signal upwards

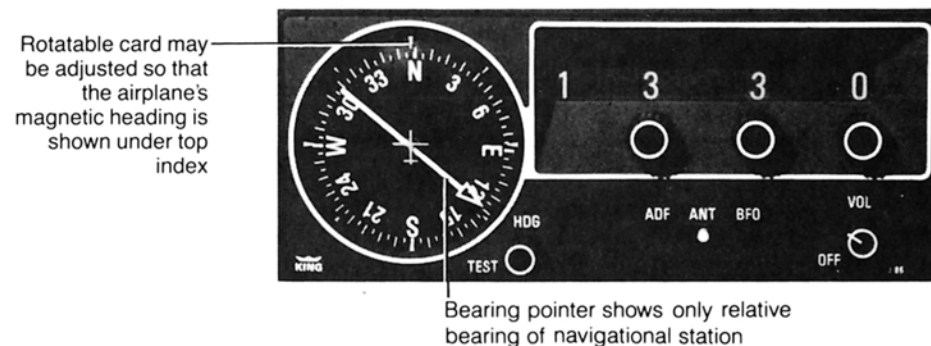


Compass Locators/Non-Directional Beacons

- Non-directional Beacons
 - Known as Compass Locators
 - Co-located at Outer or Middle Marker
- Locator Outer Marker (LOM)
 - NDB at OM
 - Available where no radar coverage
- Locator Middle Marker (LMM)
 - NDB at MM
 - Very few left, being decommissioned

Non-Directional Beacons

- NDB transmits radio signal
 - Omni-directional signal
 - Low-medium frequency (190 – 540 kHz)
- Automatic Direction Finder (ADF) on aircraft
 - Displays (relative) bearing to the NDB
 - 0° NDB is straightahead, 90° NDB to the right, ...
- Nowadays, located at smaller airports as instrument approach aids



ILS/DME

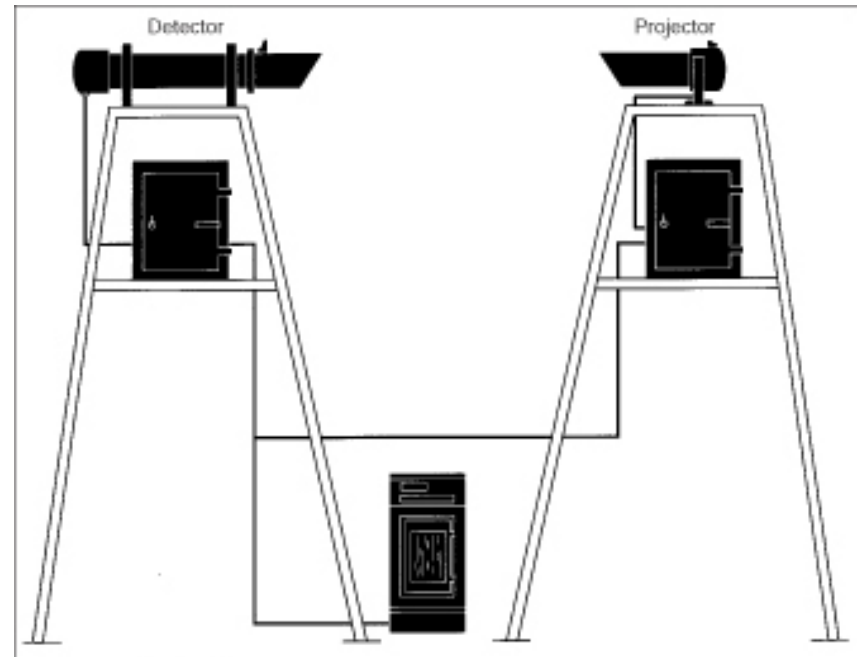
- DME co-located with Localizer
- Used when terrain prevents installation of Outer Marker and/or Middle Markers
- DME is tuned on same frequency as ILS

ILS Categories

- 3 Categories
 - Determined by:
 - Decision Height
 - Runway Visual Range (i.e. Visibility)
- Cat I
 - DH - 200' RVR - ½ mile or 2400'
- Cat II
 - DH - 100' RVR – 1,200 (Runway RVR equipped)
- Cat III
 - DH – 0'
 - RVR – 700' Cat III-a (Runway RVR equipped)
 - RVR – 150' Cat III-b (Runway RVR equipped)
 - RVR – 0' Cat III-c (aircraft equipped with Automatic Landing System)

Runway Visual Range Equipment

- Measures visibility along runway
 - Rain, smoke, haze, fog
- Used for Instrument Approaches
- Components
 - Projector
 - Located to side of runway
 - Upto 3 locations on touchdown, midpoint, rollout
 - 500' from Detector
 - Detector
 - Data Convertor
 - Takes into account time of day, location of sun
 - Remote Digital Display



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CHICAGO, ILLINOIS

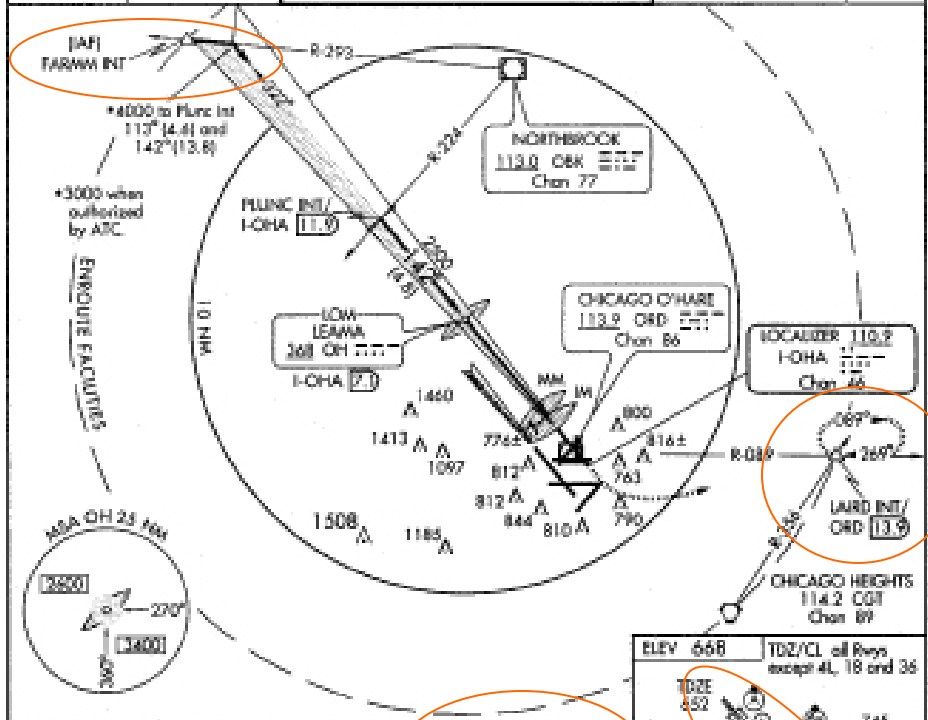
AL-146 (FAA)

LOC/DWE I-CHA 110.0 Chan 46	APP CRS 142°	Rwy Idg TDZE Agt Elev 10003 652 660
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ILS RWY 14L (CAT III)
CHICAGO-O'HARE INTL (ORD)

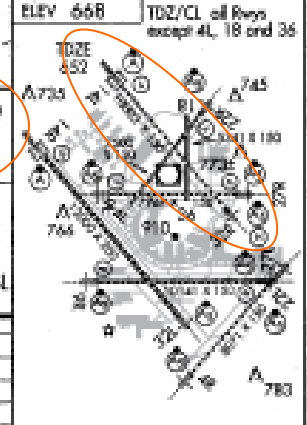
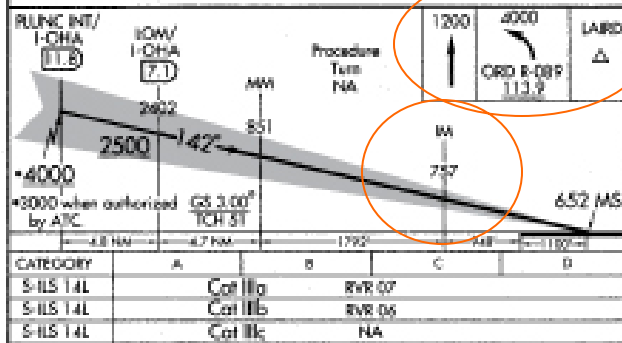
Simultaneous approach authorized with Rwy 14R. **ALSF-2**
MISSED APPROACH: Climb to 1200, then climbing left turn to 4000 via ORD R-089 to LAIRD Int and hold.

ATS 135.4 269.9	CHICAGO APP CON 119.0 393.1	O'HARE TOWER 120.75(S) 126.9(N) 127.825 132.7 390.9	GND CON 121.75 121.9 348.6	CLNC DEL 121.6
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EC-3-03 OCT 2002

EC-3-03 OCT 2002



CATEGORY	A	B	C	D
S-ILS 14L	Cat IIIa	RVR 00'		
S-ILS 14L	Cat IIIb	RVR 05'		
S-ILS 14L	Cat IIIc	NA		

CATEGORY III ILS - SPECIAL AIRCREW & AIRCRAFT CERTIFICATION REQUIRED

LDIN Rwy 4L
MIRL Rwy 18-36
HIRL all Rwy's except 18-36

ORD – ILS RWY 14L

- Initial Approach Segment:
 - FARMM Intercept (IAF), located on radial 293° from NORTHBROOK (OBK) VOR
 - Cross FARMM at 4000', descend on Glideslope of 3° PLUNC Intercept
 - PLUNC Intercept is located on 293° from NORTHBROOK (OBK) VOR
 - 4.8 nm to 2500' at Locator Outer Marker (LOM)
- Intermediate Approach Segment:
 - Descend from LOM, on 142° to BESSE(FAF).
- Final Approach Segment:
 - FAF 142° to DH
 - Descend on Glideslope

 - TDZE (Touchdown Zone Elevation) – 652'
 - Airport Elevation – 668'
- Missed Approach Segment
 - Climb to 1200'
 - then climbing left turn to 4000' via ORD R-089 (radial) to LAIRD Intercept
 - LAIRD Intercept is ORD R-089 and CGT R356
 - Hold
- Misc.
 - Simultaneous approach authorized on RWY 14R

Homework

- Prepare for quiz
 - Name components of Localizer, Glideslope, Runway Visual Range Equip?
 - What are the 3 categories of ILS approaches?
 - Where are Non-directional beacons located?
 - What signal do Marker Beacons provide pilot?
 - Where is localizer equipment located (relative to runway)?
 - What is range of Terminal VOR?
 - What are segments of approach?
 - What is difference between Precision, non-Precision Approach?
 - Describe 2 types of visual approach?