UNITED VIRTUAL

Mastering the Art of Approaches

A Guide to Instrument Approach Procedures

Instrument Approach Procedures (IAPs)

What is an Instrument Approach?

Instrument approaches are navigationally aided approaches designed to allow pilots to fly in and land in non-visual conditions.

What can they be used for?

- Descending through Instrument Flight Conditions (IMC)
- Safely avoiding terrain and obstacles you may not be able to see
- Keeping you safe when you're eyes can't

Instrument Approaches

Types of Instrument Approaches

There are 8 types of Instrument Approach

We will be discussing

- ILS
- Localizer
- RNAV (GPS)
- RNAV (RNP)
- GLS/GBAS

We will NOT be discussing:

- NDB
- VOR
- TACAN
- SRA

What is ILS

ILS = Instrument Landing System

What's the Point?

- ILS provides aircraft with a lateral and vertical path to the runway
- Allows for safe operation in non-visual (IMC) conditions
- Provides very high accuracy through the use of a Localizer and Glideslope
- Most "basic" approach form, installed at thousands of airports worldwide

What is RNAV

RNAV = aRea NAVigation

What's the Point?

- Designed to give aircraft the ability to use GPS "fixes" to navigate the globe
- Provides moderate accuracy for approaches
- Lower minimums than VOR and NDB approaches, but higher than ILS/GLS
- Used in 2 different types of approaches: RNP and GPS

What is RNP

RNP = Required Navigation Performance

What's the Point?

- RNP uses onboard systems and satellites to verify position accuracy
- Can be programmed in the FMC/MCDU to ensure adherence
- Allows for lower minimums, but still higher mins than LPV, ILS and GLS
- Usually incorporates RF (Radius-to-Fix) which are curved path segments

What is GLS/GBAS

GBAS = Ground Based Augmentation System | GLS = GBAS Landing System

What's the Point?

- GLS Uses the GBAS system to provide higher accuracy in terminal areas
- Intended to eventually replace the conventional ILS system
- Provides ILS-like accuracy without the possibility of ground interference
- Eliminates the need for a localizer and glideslope antenna
- Only used at select airports in the world
  - US Airports which use GLS are: IAH, EWR and SFO. All of which are UAL Hubs…

Briefing Approaches

General Approach Briefings

Briefing Must-Haves:

- Approach navaid (as needed)
- Final Approach Course
- Approach specific minimums
- Crosscheck arrival plate with FMC and aircraft
- Re-verify all points if a runway or procedure change occurs

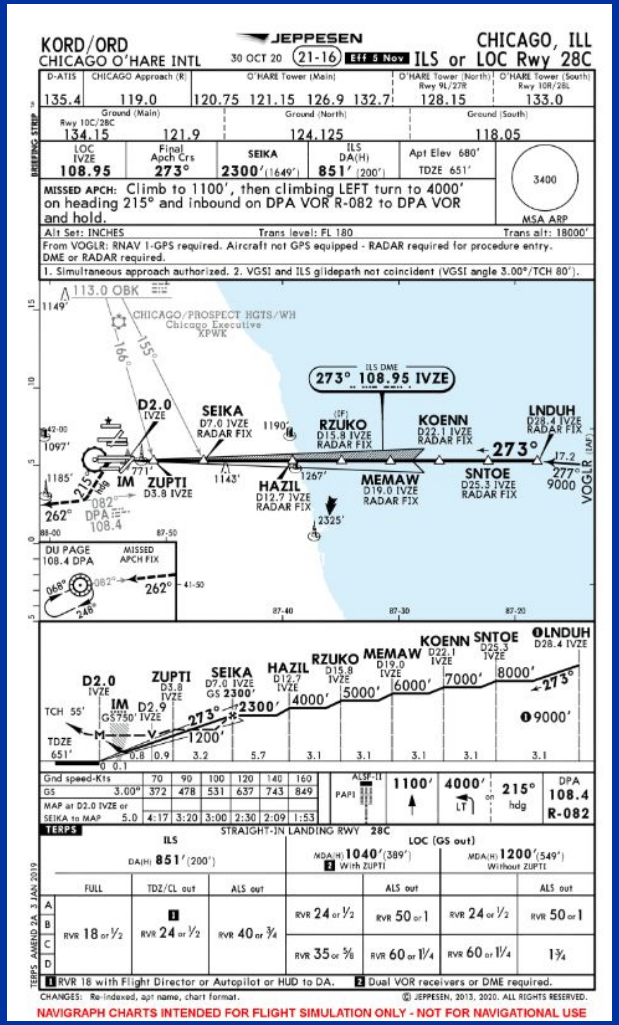
How to brief an ILS or Localizer Approach

Primary Differences:

- ILS = Lateral AND Vertical guidance using ground-based navaids
- LOC = Lateral ONLY guidance using ground-based navaids

Briefing Must-Haves

- Localizer frequency and final approach course
- Approach entry requirements (RNAV-1, DME/DME/IRU etc.)


KORD/ORD
CHICAGO O'HARE INTL
JEPPESEN
30 OCT 20 (21-16) Eff 5 Nov
CHICAGO, ILL
ILS or LOC Rwy 28C
D-ATIS 135.4
CHICAGO Approach (R) 119.0
O'HARE Tower (Main) 120.75 121.15 126.9 132.7
O'HARE Tower (North) Rwy 9L/27R 128.15
O'HARE Tower (South) Rwy 10R/28L 133.0
Ground (Main) Rwy 10C/28C 134.15
Ground (North) 121.9
Ground (South) 124.125 118.05
LOC IVZE 108.95
Final Apch Crs 273°
SEIKA 2300' (1649')
ILS DA(H) 851' (200')
Apt Elev 680' TDZE 651'
MISSED APCH: Climb to 1100', then climbing LEFT turn to 4000' on heading 215° and inbound on DPA VOR R-082 to DPA VOR and hold.
3400 MSA ARP
Alt Set: INCHES
Trans level: FL 180
Trans alt: 18000'
From VOGLR: RNAV 1-GPS required. Aircraft not GPS equipped - RADAR required for procedure entry. DME or RADAR required.
1. Simultaneous approach authorized. 2. VGSI and ILS glidepath not coincident (VGSI angle 3.00°/TCH 80').
113.0 OBK
CHICAGO/PROSPECT HGTS/WH Chicago Executive KPWK
ILS DME
273° 108.95 IVZE
D2.0 IVZE
SEIKA D7.0 IVZE RADAR FIX
RZUKO D15.8 IVZE RADAR FIX
KOENN D22.1 IVZE RADAR FIX
LNDUH D28.4 IVZE RADAR FIX
IM ZUPTI D3.8 IVZE
HAZIL D12.7 IVZE RADAR FIX
MEMAW D19.0 IVZE RADAR FIX
SNTOE D25.3 IVZE RADAR FIX
VOGLR
DPA 108.4
DU PAGE 108.4 DPA
MISSED APCH FIX
D2.0 IVZE
ZUPTI D3.8 IVZE
SEIKA D7.0 IVZE GS 2300'
HAZIL D12.7 IVZE
RZUKO D15.8 IVZE
MEMAW D19.0 IVZE
KOENN D22.1 IVZE
SNTOE D25.3 IVZE
LNDUH D28.4 IVZE
IM D2.9 IVZE GS 750'
TCH 55'
TDZE 651'
2300'
4000'
5000'
6000'
7000'
8000'
9000'
273°
Gnd speed-Kts 70 90 100 120 140 160
GS 3.00° 372 478 531 637 743 849
MAP at D2.0 IVZE or SEIKA to MAP 5.0 4:17 3:20 3:00 2:30 2:09 1:53
ALSF-II PAPI
1100'
4000' LT
215° hdg
DPA 108.4 R-082
TERPS
STRAIGHT-IN LANDING RWY 28C
ILS DA(H) 851' (200')
LOC (GS out) MDA(H) 1040' (389') 2 With ZUPTI
MDA(H) 1200' (549') Without ZUPTI
FULL TDZ/CL out ALS out
RVR 18 or 1/2
1 RVR 24 or 1/2
RVR 40 or 3/4
RVR 24 or 1/2
RVR 50 or 1
RVR 35 or 5/8
RVR 60 or 1 1/4
RVR 24 or 1/2
RVR 50 or 1
RVR 60 or 1 1/4
1 3/4
TERPS AMEND 2A 3 JAN 2019
1 RVR 18 with Flight Director or Autopilot or HUD to DA. 2 Dual VOR receivers or DME required.
CHANGES: Re-indexed, apt name, chart format.
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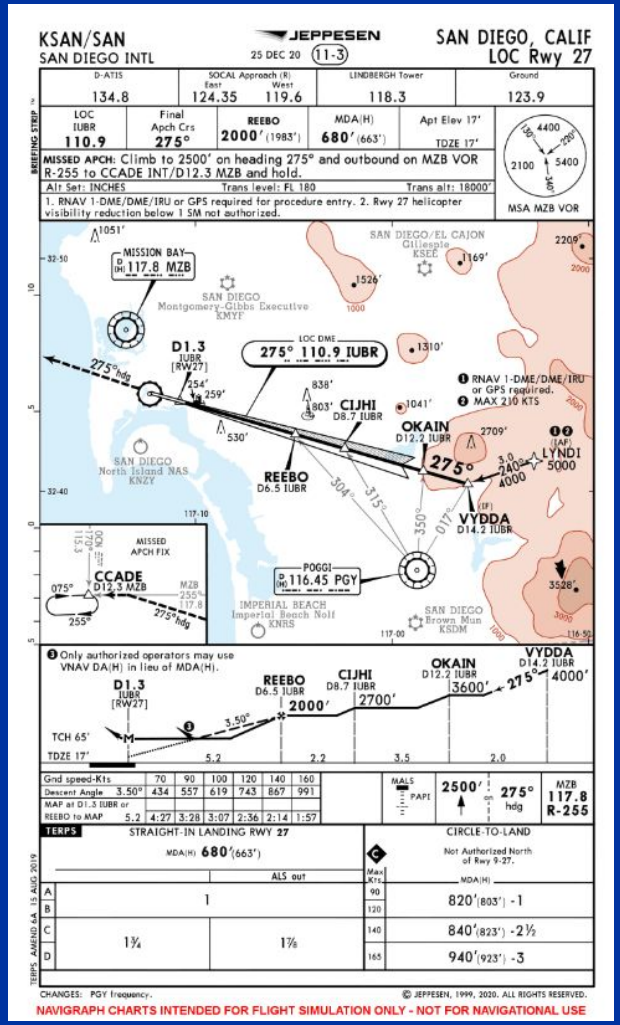
KSAN/SAN
SAN DIEGO INTL
JEPPESEN
25 DEC 20 (11-3)
SAN DIEGO, CALIF
LOC Rwy 27
D-ATIS 134.8
SOCAL Approach (R) East 124.35 West 119.6
LINDBERGH Tower 118.3
Ground 123.9
LOC IUBR 110.9
Final Apch Crs 275°
REEBO 2000' (1983')
MDA(H) 680' (663')
Apt Elev 17' TDZE 17'
MISSED APCH: Climb to 2500' on heading 275° and outbound on MZB VOR R-255 to CCADE INT/D12.3 MZB and hold.
MSA MZB VOR
Alt Set: INCHES
Trans level: FL 180
Trans alt: 18000'
1. RNAV 1-DME/DME/IRU or GPS required for procedure entry. 2. Rwy 27 helicopter visibility reduction below 1 SM not authorized.
MISSION BAY D (H) 117.8 MZB
SAN DIEGO/EL CAJON Gillespie KSEE
SAN DIEGO Montgomery-Gibbs Executive KMYF
LOC DME
275° 110.9 IUBR
D1.3 IUBR [RW27]
REEBO D6.5 IUBR
CIJHI D8.7 IUBR
OKAIN D12.2 IUBR
LYNDI (IAF) 5000
VYDDA (IF) D14.2 IUBR
SAN DIEGO North Island NAS KNZY
MISSED APCH FIX
CCADE D12.3 MZB
POGGI D (H) 116.45 PGY
IMPERIAL BEACH Imperial Beach Noll KNRS
SAN DIEGO Brown Mun KSDM
1 RNAV 1-DME/DME/IRU or GPS required. 2 MAX 210 KTS
3 Only authorized operators may use VNAV DA(H) in lieu of MDA(H).
D1.3 IUBR [RW27]
REEBO D6.5 IUBR
CIJHI D8.7 IUBR
OKAIN D12.2 IUBR
VYDDA D14.2 IUBR
TCH 65'
TDZE 17'
2000'
2700'
3600'
4000'
3.50°
Gnd speed-Kts 70 90 100 120 140 160
Descent Angle 3.50° 434 557 619 743 867 991
MAP at D1.3 IUBR or REEBO to MAP 5.2 4:27 3:28 3:07 2:36 2:14 1:57
MALS PAPI
2500'
275° hdg
MZB 117.8 R-255
TERPS
STRAIGHT-IN LANDING RWY 27
MDA(H) 680' (663')
ALS out
CIRCLE-TO-LAND
Not Authorized North of Rwy 9-27.
Max Kts
MDA(H)
A B 90 820' (803') - 1
C 120 840' (823') - 2 1/2
D 140 940' (923') - 3
1
1 3/4
1 7/8
TERPS AMEND 6A 15 AUG 2019
CHANGES: PGY frequency.
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NAVIGRAPH CHARTS INTENDED FOR FLIGHT SIMULATION ONLY - NOT FOR NAVIGATIONAL USE

How to brief a GLS (GBAS) Approach

Primary Differences:

- GLS = GBAS Landing System
  - GBAS = Ground Based Augmentation System
- GPS-Dependent alternative to ILS, uses satellites to draw LOC/GS instead of ground based LOC and GS antenna

Briefing Must-Haves

- GBAS RPI (Reference Path Indicator) code, frequency, and FAC
- Approach entry requirements (RNAV-1, DME/DME/IRU etc.)

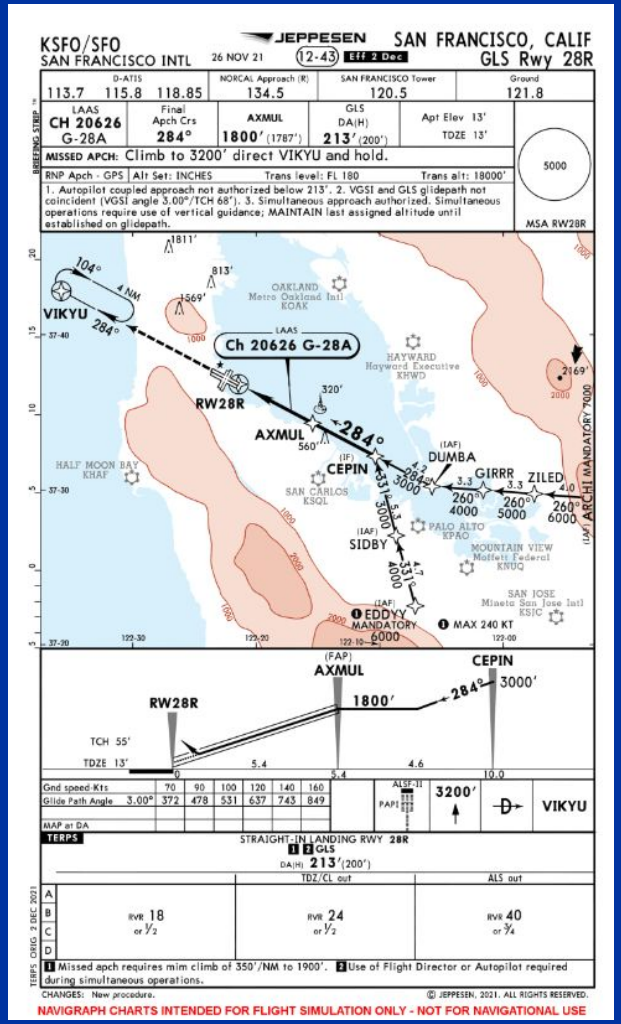
How to brief a GLS (GBAS) Approach

Important Requirements:

- MUST have Multi-Mode Receiver (MMR) equipped on board (Boeing only)
- MUST request the “GLS xx” runway with Approach Control

Things to note:

- GLS often uses the same fixes and transitions as the ILS
- GLS usually matches standard ILS minimums
- Typically only flown by Boeing acft though some newer Airbus are capable



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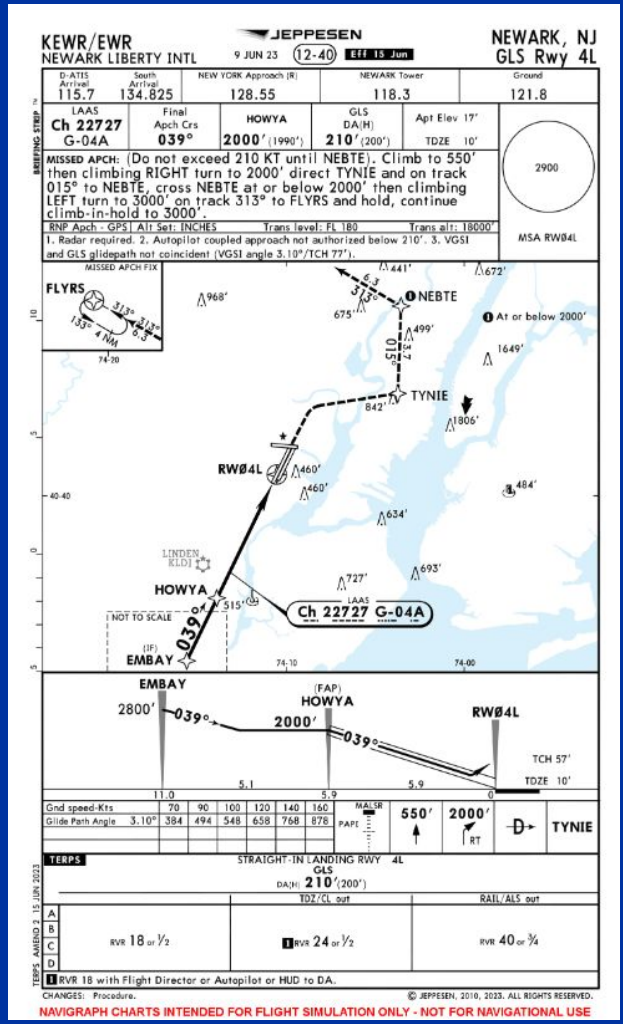

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How to brief an RNAV (GPS) Approach

Primary Differences:

- Most are straight-in though some are offset
- GPS approaches offer LPV on some, which can get near-ILS minimums

Briefing Must-Haves:

- Carefully select minimums (LNAV, LNAV/VNAV, or LPV)
- Take note of any offset FAC or necessary turns to final

LNAV vs LNAV/VNAV vs LPV vs LP

Primary Differences:

- LPV = Localizer Performance with Vertical Guidance, GPS version of an ILS approach
- LP = Localizer Performance, essentially the GPS version of a LOC approach
- LNAV/VNAV = Vertical guidance down to minima, but less accuracy = higher mins
- LNAV = Lateral Guidance ONLY -> step-down or calculated DA required (mins+50)

Briefing Must-Haves

- Minima revision if flying LNAV only
- Review if minimums are DA or MDA
- Review step-downs for non-vertical guidance procedures (LNAV and LP)

How to brief an RNAV (RNP) Approach

Primary Differences:

- RNP means more requirements
- GPS monitoring MUST be installed onboard

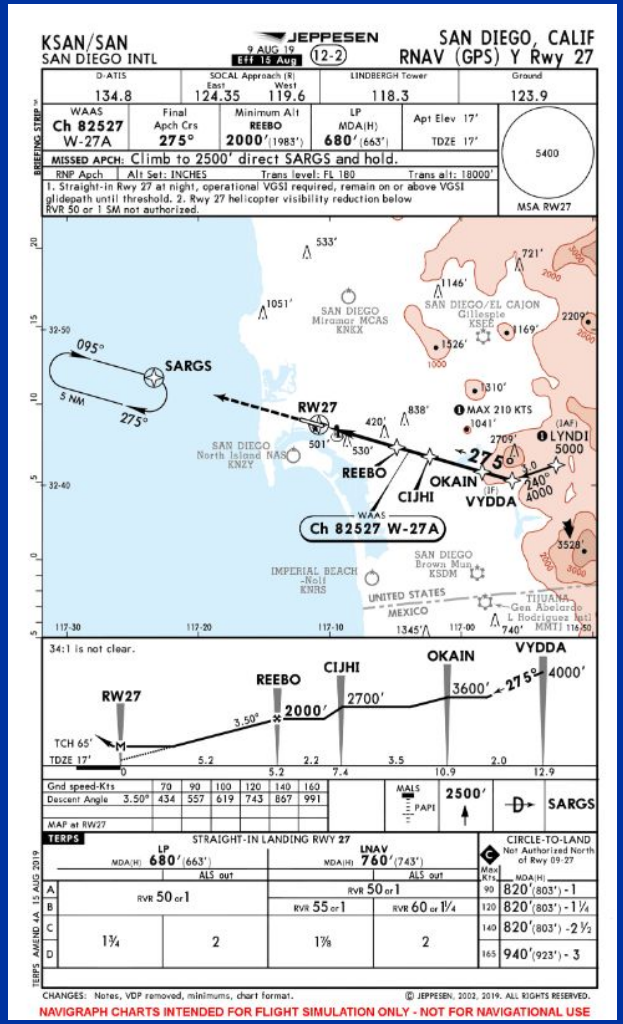
Briefing Must-Haves

- RF Leg point outs and leg MEA checks
- Use LNAV/VNAV minimums 99% of time, unless VNAV is unreliable

What's the difference?
RNAV (GPS) and RNAV (RNP)

Primary Differences:

- RNP approaches have stricter requirements
- RNP requires GPS accuracy monitoring, GPS does not
- RNP Approaches usually get you lower approach minimums, unless using LPV
- Only GPS approaches give the option for LPV, which has lower mins than RNP


KSAN/SAN
SAN DIEGO INTL
JEPPESEN
9 AUG 19
Eff 15 Aug
(12-2)
SAN DIEGO, CALIF
RNAV (GPS) Y Rwy 27
D-ATIS 134.8
SOCAL Approach (R) East 124.35 West 119.6
LINDBERGH Tower 118.3
Ground 123.9
WAAS Ch 82527 W-27A
Final Apch Crs 275°
Minimum Alt REEBO 2000'(1983')
LP MDA(H) 680'/663'
Apt Elev 17'
TDZE 17'
MISSED APCH: Climb to 2500' direct SARGS and hold.
RNP Apch
Alt Set: INCHES
Trans level: FL 180
Trans alt: 18000'
1. Straight-in Rwy 27 at night, operational VGSI required, remain on or above VGSI glidepath until threshold. 2. Rwy 27 helicopter visibility reduction below RVR 50 or 1 SM not authorized.
5400
MSA RW27
SARGS
095°
5 NM
275°
RW27
REEBO
CIJHI
OKAIN
VYDDA
275°
MAX 210 KTS
LYNDI
5000
240°
4000
Ch 82527 W-27A
SAN DIEGO Miramar MCAS KNKX
SAN DIEGO/EL CAJON Gillespie KSEE
SAN DIEGO North Island NAS KNZY
SAN DIEGO Brown Mun KSDM
IMPERIAL BEACH -Nolf KNRS
UNITED STATES
MEXICO
TIJUANA Gen Abelardo L Rodriguez Intl MMTJ
34:1 is not clear.
TCH 65'
TDZE 17'
3.50°
2000'
2700'
3600'
4000'
Gnd speed-Kts 70 90 100 120 140 160
Descent Angle 3.50° 434 557 619 743 867 991
MALS
PAPI
2500'
SARGS
MAP at RW27
TERPS
STRAIGHT-IN LANDING RWY 27
LP MDA(H) 680'/663' ALS out
LNAV MDA(H) 760'/743' ALS out
CIRCLE-TO-LAND Not Authorized North of Rwy 09-27
A RVR 50 or 1
B RVR 50 or 1
C RVR 55 or 1 RVR 60 or 1¼
D 1¾ 2 1⅞ 2
Max Kts MDA(H)
90 820'/803' - 1
120 820'/803' - 1¼
140 820'/803' - 2½
165 940'/923' - 3
TERPS AMEND 4A 15 AUG 2019
CHANGES: Notes, VDP removed, minimums, chart format.
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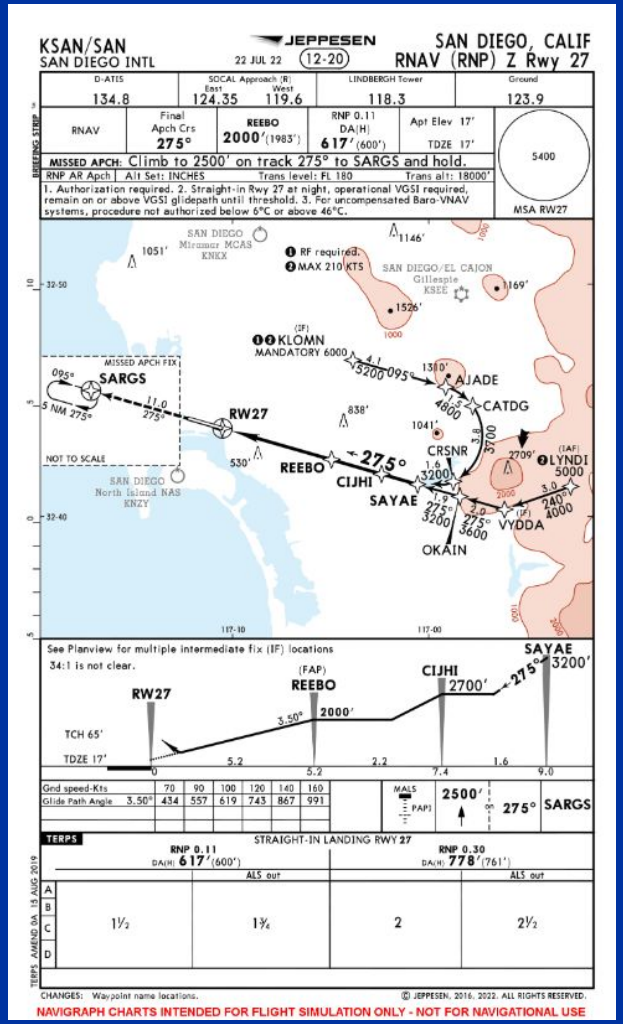
KSAN/SAN
SAN DIEGO INTL
JEPPESEN
22 JUL 22
(12-20)
SAN DIEGO, CALIF
RNAV (RNP) Z Rwy 27
D-ATIS 134.8
SOCAL Approach (R) East 124.35 West 119.6
LINDBERGH Tower 118.3
Ground 123.9
RNAV
Final Apch Crs 275°
REEBO 2000'(1983')
RNP 0.11 DA(H) 617'(600')
Apt Elev 17'
TDZE 17'
MISSED APCH: Climb to 2500' on track 275° to SARGS and hold.
RNP AR Apch
Alt Set: INCHES
Trans level: FL 180
Trans alt: 18000'
1. Authorization required. 2. Straight-in Rwy 27 at night, operational VGSI required, remain on or above VGSI glidepath until threshold. 3. For uncompensated Baro-VNAV systems, procedure not authorized below 6°C or above 46°C.
5400
MSA RW27
SAN DIEGO Miramar MCAS KNKX
RF required.
MAX 210 KTS
SAN DIEGO/EL CAJON Gillespie KSEE
KLOMN
MANDATORY 6000
MISSED APCH FIX
SARGS
095°
5 NM
275°
RW27
REEBO
CIJHI
SAYAE
OKAIN
VYDDA
AJADE
CATDG
CRSNR
LYNDI
5000
240°
4000
NOT TO SCALE
SAN DIEGO North Island NAS KNZY
See Planview for multiple intermediate fix (IF) locations
34:1 is not clear.
(FAP)
TCH 65'
TDZE 17'
3.50°
2000'
2700'
3200'
Gnd speed-Kts 70 90 100 120 140 160
Glide Path Angle 3.50° 434 557 619 743 867 991
MALS
PAPI
2500'
275°
SARGS
TERPS
STRAIGHT-IN LANDING RWY 27
RNP 0.11 DA(H) 617'(600') ALS out
RNP 0.30 DA(H) 778'(761') ALS out
A 1½ 1¾ 2 2½
B
C
D
TERPS AMEND 0A 15 AUG 2019
CHANGES: Waypoint name locations.
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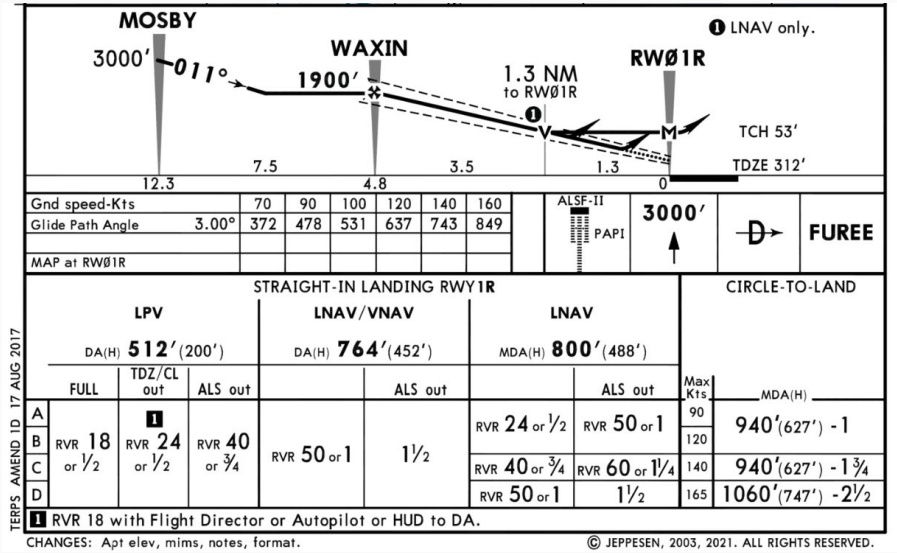
Minima Selection

Minima Selection

Take a look at the minimums section:

- Several are listed, but you must choose wisely.
- Select the minimums based off YOUR AIRCRAFT and its capability

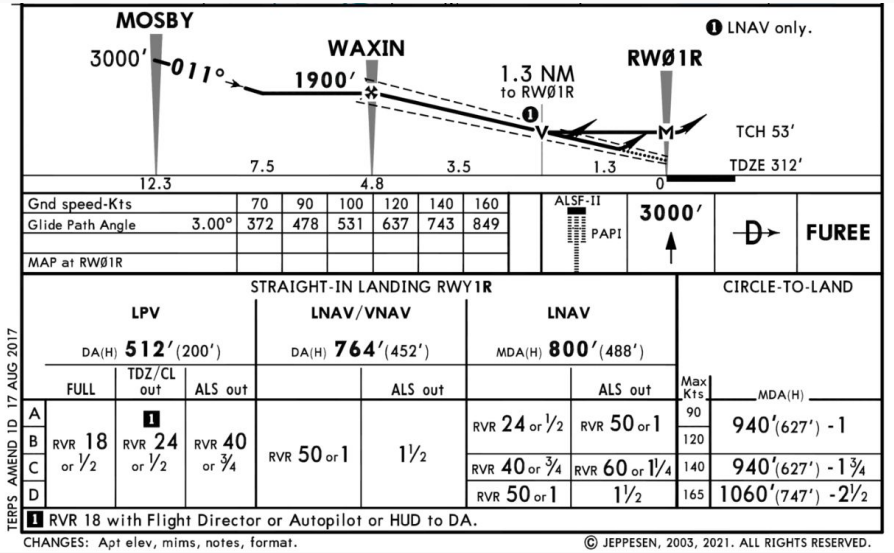


Minima Selection, cont’d

Let’s say you’re flying a 737-900ER.

You’re using the VNAV function to descend along the RNAV glidepath.

Which minimums should you select?

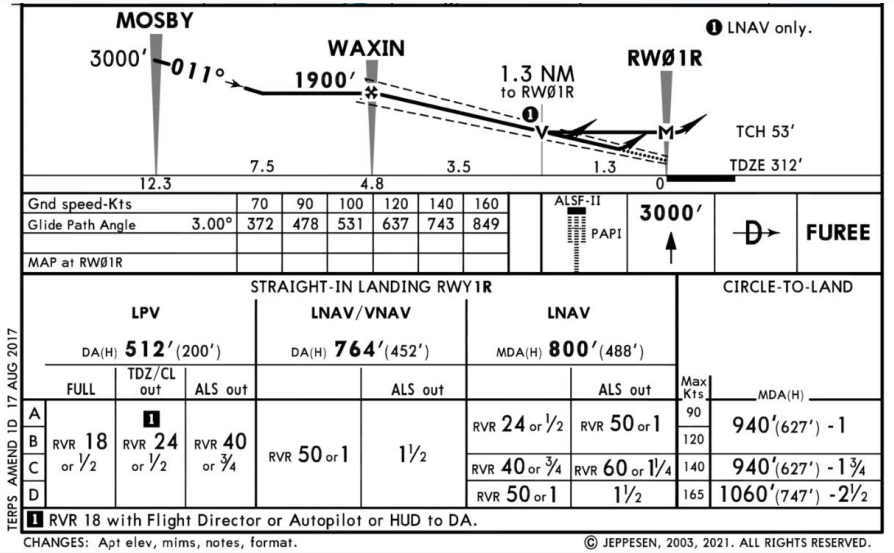


Minima Selection, cont’d

Now let’s say you’re in an SR-22

You’re using the LPV GP function to descend along the RNAV glidepath

Which minimums should you select?

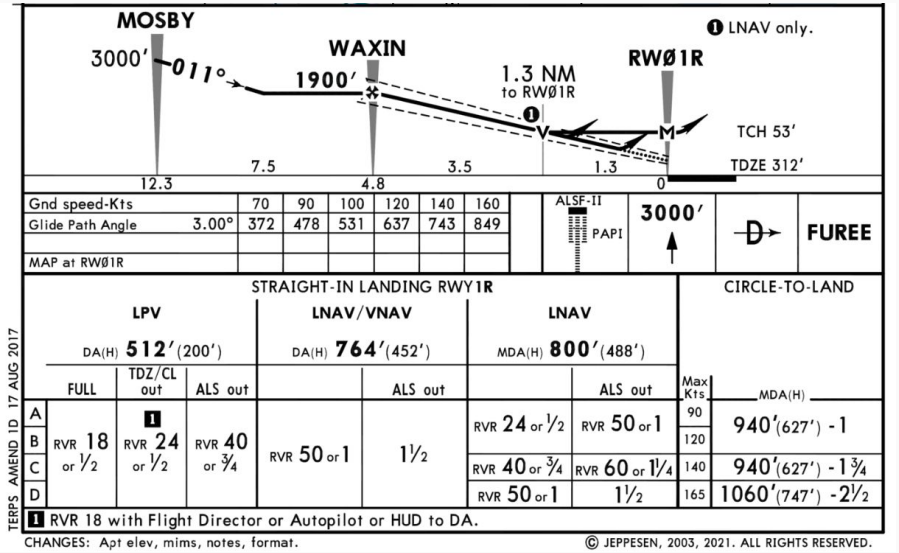


Minima Selection, cont’d

Let’s go back to the 737-900ER

You are using the RNAV approach to line up with Runway 1R then circle-to-land on Runway 30.

Which minimums should you select?



Approach Stability

What is a “stable” approach

ICAO defines a “stable approach” as:

“An approach is considered to be stable when all of the following conditions are met: All briefings and checklists have been actioned. The aircraft is in the planned landing configuration, [and] The aircraft is on the correct flight path.”

How to create a “stable approach” environment

- Complete all briefings well prior to conducting the approach
  - Usually about 10-20 minutes BEFORE you expect to be cleared for the approach
- Confirm all your aircraft’s weights and landing speeds
- Make minimal adjustments to pitch and power to the max extent possible
- FOCUS and RELAX. A tense mindset will cause knee jerk reactions
- The plane is first and foremost. Avoid distractions and other things

IF YOU BECOME UNSTABLE: GO AROUND!! DON’T BE A HERO

Follow Ken Davis' words: You Can Always Go Around

Stable Approach Visual Cues

Visual aids can also cue you in as to whether your approach is stable

- Acceleration/Deceleration indication on your PFD?
- Excessive rate of descent?
- No more than 1 deviation from Glidepath/LOC?
- Use the HGS if the airplane has it!


FD
LOC1
G/S
IMC
5
5
3.2
09
10
5.50
-5
-5
5.50
146
360
560 B
GS
147
DME 0.0
-10
-10
-1400 VS
HDG 093
MDA 0

Flare, Touchdown, and Rollout

Glidepath to Flare: Understanding timing

Transitioning from the glide to the flare can be very tricky. Here are some tips

- Once the RA callouts hits about 50 ft, look at the opposite end of the runway instead of focusing on the aiming point
- As you flare, pull gently back on the yoke to aim for 3-5° nose up
- Once in your flare, hold the pitch angle and allow the plane to naturally land
- Avoid reintroducing nose down pressure and simply hold the flare pitch

The Flare: When to Reduce Power

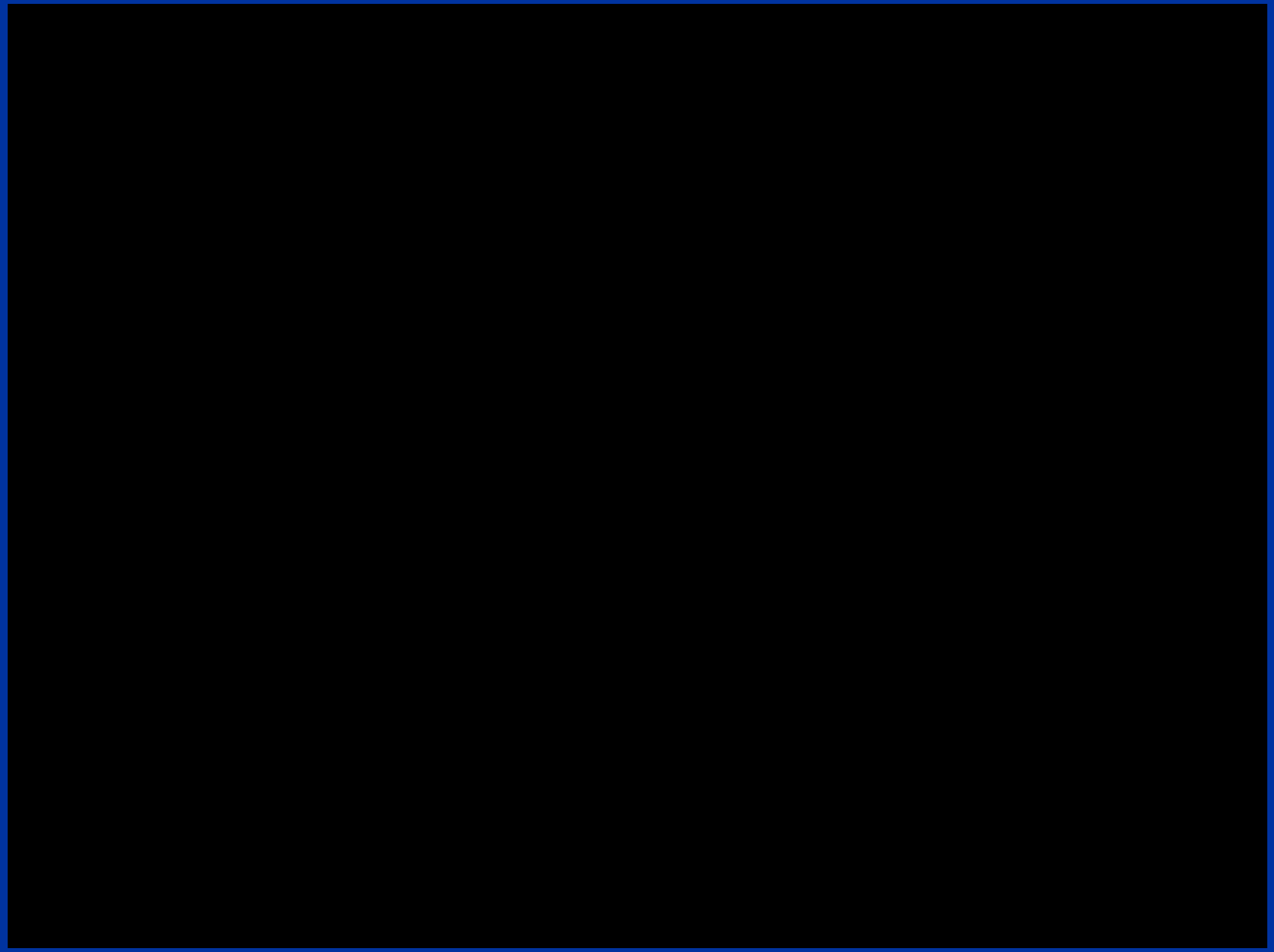
Power management is essential for a smooth landing. Here are some tips:

- Begin the power reduction at the ‘50’ RA (Radio Altimeter) Callout
- SLOWLY reduce the power. Do not cut the speed all at once.
- Aim to smoothly reduce power so you are at idle by 20 feet RA.
- Once below 20 ft RA, hold pitch angle and let speed fall naturally until touchdown

Helpful Visual Aids

HGS Autonomous Flare Cue

Opposite Runway End



Questions?
Comments?
Concerns?

Want to learn more?

Still curious on these topics or procedure details?

Ask our mentors!

- FlyUVA Mentors are available in our Discord server!
- Ask your question as a post on the **support-forum** and it will be answered!
- Our mentors are real-world pilots or have deep knowledge of the aircraft that they provide mentorship for.
- Don’t be scared to ask for help! There are no dumb questions!