# NORMAL TAKEOFF



TAKEOFF ALTERNATE:
- If departure weather is below landing minimums (CAT I) you need a takeoff alternate within one hour (still air - 390 nm).
- Takeoff alternate must meet same weather minimums as regular alternate.

**TAKEOFF MINIMUMS: 2 ENGINE**

| Standard / Reduced | TDZ | MID | ROLLOUT | LIGHTING | NOTES |
|---|---|---|---|---|---|
| Standard 1 mile 5000 | Not Req'd | Not Req'd | Not Req'd | | |
| Reduced to 1/4 mile or 1600 | Controlling if available | Not Req'd | Not Req'd | HIRL or CL or RCLM or other rwy marking | MID can sub for inop TDZ |
| Reduced to 1200 and Rollout 1000 | Required Controlling | Not Req'd | Required Controlling | CL and 2 RVR systems | MID can sub for TDZ or ROLLOUT if inop |
| Reduced to 500 500 500 | Required Controlling | Controlling If installed. | Required Controlling | CL and RCLM and 2 or 3 RVR systems | If one is inop other two are controlling |

1. Flaps 1 offers better climb performance than Flaps 5 but requires a little longer runway and about 6 kts more airspeed (1.5 sec)
2. If full thrust is desired during reduced power T/O, manually position levers to max thrust limit as indicated by cursors on N1 gauge. This is a distraction, however. (5 min. limit).
3. A/P can be engaged above 1,000 ft AGL.
4. CLB page has reduced climb info and Engine Out (L/D Max).
5. TAKEOFF REF page 2: check entry for desired THR REDUCTION.
6. Pitch attitude for tail strike, extended oleos,
   -300 =13° / -500 = 14.5° / -700 = 15° / -800 = 11° / -900 = 9°
7. Any takeoff requiring a penalty for runway clutter will be accomplished by the Captain.
8. Crosswind takeoff consideration: Spoiler deflection begins at 1.6 units control wheel steering for OG737 and 1.2 units for NG737
9. ICAO Procedure A
   Climb at V2 + 10-20 to 1500 ft AGL.
   At 1500 ft AGL: ***LEVEL CHANGE***
   Climb to 3,000 ft AGL at V2 + 10-20 with takeoff flaps.
   At 3000 ft AGL: ***VNAV*** Accelerate and retract flaps on schedule.
10. ICAO Procedure B
    Climb at V2+10-20 to 1,000 ft AGL
    At 1,000 ft AFE: ***VNAV, FLAPS 1***, or ***LEVEL CHANGE, SET TOP BUG, FLAPS 1*** (for flaps 5 takeoff)
    Accelerate to zero flap maneuvering speed, retracting flaps on schedule, and climb to 3,000 ft AGL at zero maneuvering speed.

| Review of Speeds: | |
|---|---|
| MAX ANGLE | Approx top bug + 10 kts |
| L/D MAX | Green Donut on 300/500 EFIS speed tape is Best L/D. Equals TGT SPD on Eng Out page. |

20K N1
91.9 / 93.1
THR REDUCTION
CLB 1000 AGL

**(-300/500)**
**FLAP MANEUVER SPEEDS**

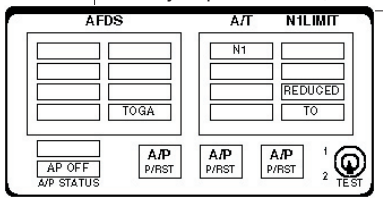
| Flaps | ≤ 117.0* | > 117.0* |
|---|---|---|
| 0 | 210 | 220 |
| 1 | 190 | 200 |
| 5 | 180 | 190 |
| 10 | 170 | 180 |
| 15 | 150 | 160 |
| 25 | 140 | 150 |

*with Rudder Pressure Reducer

At 3000' AGL:
**PF:** ***VNAV*** or ***LEVEL CHANGE, SET 250***

Climb at top bug to 3000' AGL and until given a heading in right direction, then 250 kts to 10,000'.
Max(L/D) is green donut on speed tape.
On Non-EFIS, equals TGT SPD for Eng Out.

- Non EFIS and EFIS FMAs immediately after TOGA.
- FCC commands 10° nose down.
- Approx. 60 kts F/D commands 15° up.
- Non EFIS-64 kts / EFIS-80 kts. N1 changes to THR HOLD, after which throttles can be positioned manually.
- TOGA will not be displayed if FD(s) are off.
- After you press TOGA, check FMA for proper annunciation.




N1 | TOGA | | FD

If the A/T is forgotten "off", turn it on and press TOGA again.
THR HOLD remains engaged for approximately 18 sec after liftoff and 400 ft RA, (800 ft NG) then annunciates ARM and thrust will remain at TO setting. A/T mode can only be changed after the ARM annunciation.
Technique: To make takeoff with FD off, turn FD off after rotation, not before, otherwise TOGA will not annunciate.

Maintain takeoff flaps for close in turn:
V2 - max bank angle 15°
V2+15 - up to 30°
(airspeed bug).

At 400' AFE:
PF: ***HDG SEL*** or ***LNAV***
This is the minimum alt. to start a turn unless:
Obstruction
Noise Abatement
Adverse conditions
Req'd for engine out

*Flaps 5 takeoff:*
1000' AFE and V2 + 15
PF: ***VNAV***, ***FLAPS 1,*** or ***LEVEL CHANGE SET TOP BUG, FLAPS 1***
At $V_M$ 1
PF: ***FLAPS UP AFTER T/O CHECK***

OR

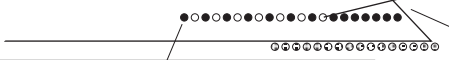
*Flaps 1 takeoff: (na-500)*
*1000' AFE and V2 + 15*
*PF:* ***VNAV***, or ***LEVEL CHANGE SET TOP BUG***
At $V_M$ 1
PF: ***FLAPS UP AFTER T/O CHECK***

OR

*Flaps 15 takeoff.*
*1000' AFE and V2 + 15*
*PF:* ***VNAV, FLAPS 5*** , or ***LEVEL CHANGE SET TOP BUG, FLAPS 5***
At $V_M$ 5
PF: ***FLAPS 1***
At $V_M$ 1
PF: ***FLAPS UP AFTER T/O CHECK***

PF: Stabilize thrust approx. 40% N1
Push to 70 - 80 % N1,
Press TOGA (check A/T movement)
**CHECK POWER**
PM: **POWER SET __% N1** . . .
Check FMA - TOGA, N1
Check all engine instruments.
FF at full power approx: 8500 pph
Check airspeed alive.
100 kts.
Both compare primary airspeed to standby.

Stabilize at V2 + 20
(V2 + 25 if light)
Transition to FD



5 knots prior to V1:
V1, ROTATE
Rotate at 2.5° per sec. to approximately 6° in an 800/900 to 10° in a classic.
After liftoff, continue rotation to 15°.

After positive rate of climb is sensed on both the IVSI and the altimeter:
Either pilot: **POSITIVE RATE**
PF: **GEAR UP**
IAS and VS are primary instruments.

As the RA and V/S increase, the FD will command pitch to maintain V2+20, allowing the pilot to transition to the FD.
FD commands wing level until HDG is called.
Develop habit of looking through the FD at the pitch indicator. If the FD command does not seem right, fly the pitch indicator and disregard the FD command bars.

***BOLD ITEMS*** - Req'd call

Not endorsed by **any** airline. Attempt to make AC120-29A compliant.
www.fmcguide.com - click on Pilot Support
Last change made Jan 29, 2005. Do not use copies obtained from someone else as they may not be up do date.

# ILS APPROACH
## MONITORED PROCEDURE / CAT I, II, III

**PF** = Pilot Flying / **PM** = Pilot Monitoring

***B737 PROFILES***
**PF** = Pilot Flying
**PM** = Pilot Monitoring

Check weather, select desired approach, brief transition and approach, especially stepdowns. Complete **IN RANGE CHECK**. Use autothrottle and autopilot.

Downwind:
PF: ***FLAPS 1, SPEED****
***APPROACH CHECK***
Get this checklist out of the way ASAP.

6°
60% N1

Turning base:
PF: ***FLAPS 5***
***SPEED****

6°
60% N1

On base leg:
PF: ***FLAPS 10***
***SPEED****

6°
60% N1

- Cleared for approach: Arm LOC or APP **
- Observe VOR/LOC and/or GS ARM annunciation on FMA.
- Engage second A/P.
- Transition to the ADI.

1 1/2 dots below GS,
PF: ***GEAR DOWN***
***FLAPS 15, SPEED****
***LANDING CHECK***

GS capture,
PF: ***FLAPS 30 / 40***
***TARGET****
Set M/A altitude.
FMA annunciates G/S ENGAGED and GA

- On course is within 1 round dot either side.
- LOC: 1 dot = 1°
- Localizer scale expands at 5/8 dot.
- LOC EXP: 1 square = 1/2°
- LOC Capture, set rwy hdg.

6°
70% N1

2-3°
57% N1

When APP mode switch extinguishes, APP mode can only be de-activated by disengaging both A/Ps and FDs, or by detuning the ILS, manual override to CWS pitch, or pressing TOGA. Then turn both F/Ds back on, selecting roll and pitch modes. Re-engaging an A/P in CMD would engage A/P and F/D in HDG SEL and LVL CHG.

Press TOGA - If A/T is on, press once for reduced thrust, twice for full thrust.
If A/T is off, straight-arm throttles to cursors.
Single A/P
A/P disengages
Manually rotate to 15°. *Look at the ADI*
Dual A/P
A/P rotates to 15° then controls pitch to hold airspeed based on flap maneuvering speed.
Accomplish the following steps no faster than you can do them, and actually check each applicable instrument. Slow down. No need to rush.
**PF:** ***FLAPS 15, CHECK POWER*** *Look at the N1 ind*
***POSITIVE RATE*** *Look at the VSI* ***GEAR UP***
***CHECK MISSED APPROACH ALTITUDE***
A/T advances to GA/N1 thrust if ON.
GA/N1 is annunciated.
Speed cursor displays maneuvering speed for flap setting.
FD initially commands 15° pitch and a bank to maintain existing ground track.
Pitch stays in TOGA until altitude acquire or other pitch mode is selected.

400'
PF: ***HDG SEL***
or ***LNAV***
Tell tower of Missed and intentions.

1000' AFE and VREF 30 + 15
PF: ***LEVEL CHANGE***
***SET TOP BUG***
***FLAPS 5***
(last AP engaged clicks off)
At VM 5
PF: ***FLAPS 1***
At VM 1
PF: ***FLAPS UP***
***AFTER T/O CHECK***
Climb to 3000 ft AFE at VM 0
3000 AFE: VNAV or
SET 250

**Tolerances on final approach segment**
(Published glideslope intercept altitude intersects the glideslope)
G/S: ± 1 Dot
LOC: ± 1 Dot
Airspeed: -5/+15 of target
Unstable approach below 1,000 ft must terminate in a go-around.

**APP LIMITS CAT II / IIIA**
Tolerances in Decision Regime
(500' to Flare):
G/S: ± 1 Dot
LOC: ± 1/3 Dot
Airspeed: ± 5 kts of target
Max rate of descent: 1,000 fpm
Max stabilized crab angle: 10°
No new warning lights or flags
Raw data must match computed data
No GPWS activation
Wind limits
headwind 20 kts tailwind 10 kts
crosswind 15 kts
No LLWAS
No reported W/S gain or loss greater than 10 kts

**(-300/500)**
**FLAP MANEUVER SPEEDS**

| Flaps | ≤ 117.0* | > 117.0* |
|---|---|---|
| 0 | 210 | 220 |
| 1 | 190 | 200 |
| 5 | 180 | 190 |
| 10 | 170 | 180 |
| 15 | 150 | 160 |
| 25 | 140 | 150 |

*with Rudder Pressure Reducer

The Captain will make the following calls above TDZE:
***1000 … 500 … 400 … 300… 200 (CAT IIIA only)***
At 500 ft on autoland approach the FO calls FLARE ARMED
At 100 above DA(H) DDA:
***APPROACHING MINIMUMS, I'M GOING HEADS UP***
If decision is to pass the DA(H) DDA: ***I HAVE THE AIRCRAFT***

If engine fails in landing configuration:
- disengage A/T and A/P, configure to flaps 15, VREF 30 + 15 (bug), inhibit GPWS FLAP.
- ***"flaps 15, add 15, inhibit"***
- If G/A is necessary:
VREF 30/40 + 15 ***
***FLAPS 1, CHECK POWER…***
***POSITIVE RATE, GEAR UP***
***CHECK MISSED APPROACH ALTITUDE***

At DA (H)
PF: ***MINIMUMS, GO-ING AROUND***

VREF 30 +15
(bug)

1,000 ft

Landing Target Speed w/o autoland is VREF + half the steady and all the gust, not to exceed 20.
Min target is VREF + 5 (use at flare)
Max is VREF + 20 (800-900 + 15)
When A/T is disconnected the target speed must reflect full wind correction.
Landing Target Speed with autoland is VREF + 5 regardless of wind speed.

- Basic ILS minimums are 4000 RVR (3/4 mi.)
- Approach lights bring it down to 2400 RVR.
- Minimum is brought down to 1800 RVR with TDZ and CL lights.

* Don't take hand off spd knob until you see flap movement.
** Caution: Consider waiting until the "feather" before arming GS.
"**TAP**" **T**wist HDG SEL, **A**rm LOC/APP, push the second AP **P**addle on.
*** VREF 30/40 + 15 is approximately equal to V2 for F1.

***BOLD ITEMS*** - Req'd call

Not endorsed by **any** airline. Attempt to make AC120-29A compliant.
www.fmcguide.com - click on Pilot Support
Last change made Jan 29, 2005. Do not use copies obtained from someone else as they may not be up do date.

# ILS APPROACH
## NOTES

**PF** = Pilot Flying / **PM** = Pilot Monitoring

***B737 PROFILES***
**PF** = Pilot Flying
**PM** = Pilot Monitoring

**CAT I: DA/MDA ≥ 200 Visibility ≥ 1/2 mile or RVR ≥ 1800**

1. Requires one transmissometer.
2. If both autopilots are inop, the Monitored Approach Procedure should still be used with the FO flying manually.
3. CAT I or Non-precision approach, PM will call ***"Approach lights in sight"***, and/or ***"Runway in sight"***. Informative, not directive.
4. When conducting non-precision or CAT I ILS approach, you may descend to 100' above TDZE with approach lights in sight.
5. May not descend below 100' above the TDZE unless visual reference to the runway is established.
6. MDA and DA *altitude* value measured by barometric altimeter and is controlling. *Height* value from a radio altitude is advisory.
7. CAT I using MDA are: VOR, LOC, NDB, RNAV without VNAV
8. CAT I using DA are ILS and RNAV with VNAV

**CAT II: DH ≥ 100 RVR ≥ 1200 RVR ≥ 1000***

1. Will be made with autoland if a/c and crew are autoland capable.
2. Single autopilot is authorized to CAT II minimums.
3. First Officers, think of taking it to the DH then to a missed app.
4. *Height* value (DH), based on RA, is used for CAT II ops except where procedures have "Radio Altitude Not Authorized" (RA NA). Due to irregular underlying terrain, typically use the first indication of arrival at the inner marker as a means to establish DH. A*ltitude* value (DA) measured by barometric altimeter is advisory.
5. CAT II Autoland and CAT IIIA procedures are the same except for the decision height.
6. For CAT II, TDZ, MID, and ROLLOUT RVR should be provided for any runway over 8000 ft.; TDZ and ROLLOUT for runways less than 8000 ft.
7. You are required to have landing minimums prior to GS intercept altitude. If weather goes below landing minimums once established on the glideslope, you may continue to landing on CAT I or CAT II approach if approach lights, red terminating bars, runway end lights, touchdown zone lights, etc are visible at miminums.
8. May not descend below DH unless visual reference to the CAT II lighting system is established.

* If published as the approach minima.

If weather conditions are below 4000 RVR or 3/4 mile visibility a FD must be used or a coupled approach must be made.
LOW VISIBILITY APPROACHES (CAT I, II, III)
If TDZ RVR is at or below 2400 (defines a low visibility approach)
a. monitored Approach should be flown,
b. autopilot should be used,
c. the crew must brief (and fly) the category of approach having the lowest minimum applicable to facility, aircraft, and crew.
If TDZ RVR is at or below 1800 an auto-coupler is required.
If TDZ RVR is below 1600, two transmissometers are required.
If TDZ RVR is below 1200
a. autoland is required,
b. braking action must be fair or better,
c. takeoff or landing ops require Surface Movement Guidance and Control System (Low Visibility Taxi Procedure - ICAO)

**CAT III: DH < 100 or no DH RVR < 1200**
**CAT IIIA: DH < 100 or no DH RVR ≥ 600**
~~CAT IIIB: DH < 50 or no DH RVR < 700 but ≥ 150~~

1. Requires 737-NG and autoland.
2. SMGCS defines Low Visibility Taxi Routes and goes into effect when visibility is less than 1200 RVR.
3. Four operational differences between CAT II Autoland and CAT IIIA approach:
   a. Status annunciator must indicate CAT IIIA
   b. RVR minimums for CAT IIIA approach have specific transmissometer requirements (3). (See chart at bottom)
   c. CAT IIIA procedure using a fail-passive autoflight system incorporates a DH set on RA (or an equivalent IM position fix).
   d. Captain makes additonal callouts of "***200***" at 200 ft above TDZE and "***Approaching minimums, I'm going heads up***" at 150 ft above TDZE.
4. You are required to have landing minimums prior to GS intercept altitude. And, you must have the minimum RVR for landing prior to the DH. (May continue to landing if you can use CAT I or II criteria.)

FAIL PASSIVE
A system which, in the event of a failure, causes no significant deviation of aircraft flight path or attitude.

AC 120-29A groups instrument approaches into 3 categories:
(a) xLS
- ILS, MLS, GLS (Global Landing System)

(b) RNAV
- FMS, RNAV using traditional VOR/DME sensors, GNSS

(c) Instrument Approach Procedures other than xLS or RNAV
- traditional approaches such as VOR, NDB, LOC, LOC Back crs, and ASR

| Visibility | RVR |
|---|---|
| 1 | 5000 |
| 3/4 | 4000 |
| 1/2 | 2400 |
| 1/4 | 1600 |

| APPROACH TYPE | BARO SET TO | RA SET TO |
|---|---|---|
| CAT I | **Published DA** | Published DH |
| CAT II | Published DH (TDZE + 200 ft) | **Published RA** |
| CAT IIIA | TDZE + 50 ft | **50 ft RA** |

**BOLD** indicates controlling altimeter.

**GENERAL:**

1. Captain briefs Monitored Procedure; FO briefs the approach chart.
2. Flaps 40 slightly more sight over nose
   a. Landing lights optional, cockpit lights low
   b. Max Seat height (consider sighting of FMA)
   c. Autobrakes req'd - recommend 3 and don't kick off till < 80 kts.
   d. Start APU for backup electrics and check stby ADI in ILS APP.
3. ATC is required to have approach/runway lights on step 5.
4. Non-EFIS CAT II ops, both Captain and First Officer must position HSI switch to VOR/ILS prior to commencing the approach.
5. -500: This step not required for NG
   Both pilots must select MANUAL prior to commencing the approach to display ILS data on ADI.
6. Except for dual-channel approach and autoland, autothrottle must be disconnected prior to: non-autoland ILS, no lower than 50 ft AGL non-precision or visual, no lower than 100 ft AGL
7. CAT II and III approaches will not be flown if LLWAS or windshear with reported airspeed gain or loss is greater than 10 kts.

**AUTOLAND:**

1. Status annunciator will be either CAT IIIA on NG 737 or CAT II AUTOLAND on all other aircraft.
2. Autothrottle and two autopilots are required – criteria for engagement are: valid ILS frequency in both nav radios, same inbound course in both course windows, and APP armed.
3. If you practice an autoland with RVR >2400, ask Approach and Tower for "Beam Protection for autoland". ATC does not hold a/c short of the ILS Hold Short Line until 800 and/or 2 nm. The ILS signal is not protected from airborne interference (i.e. a/c ahead of you) until wx goes below 200 ft ceiling and/or 2000' RVR.
4. When cleared for the approach, arm APP and engage second A/P. If the second A/P is not engaged by 800 ft RA it is locked out.
5. After G/S capture and 1500 ft the second A/P pitch channel is engaged and the ILS Deviation Warning Test is performed. SINGLE CH disappears and FLARE ARMED is annunciated. Dual A/P GA is armed.
6. If FLARE is not armed by 350 ft RA both A/Ps disengage.
7. After touchdown, Captain must disconnect A/P because there is no automatic tracking of centerline.
8. On a missed approach, when LVL CHG is selected at 1000 ft AGL, the last autopilot engaged will disconnect; this will be "A" A/P under normal operations. The Captain, if flying the missed, should be aware that "B" A/P might be the master.
9. Wind limits: headwind 20 kts, crosswind 15 kts, tailwind 10 kts.

| | Down to: | Visibility Requirements: | TDZ | MID | ROLLOUT | NOTES | LIGHTS | RVR |
|---|---|---|---|---|---|---|---|---|
| CAT I | DA(H)/MDA ≥ 200 | Visibility ≥ 1/2 mile or RVR ≥ 1800 | Required Controlling | Not req'd Advisory | Not req'd Advisory | MID can sub for TDZ if inop | TDZ and CL | ** |
| CAT II | DH ≥ 100 | RVR ≥ 1200 * | Required Controlling | Not req'd Advisory | Not req'd Advisory | No Substitutions | HIRL, TDZ, CL ALSF I, II, ICAO | ** |
| CAT III | DH < 100 | RVR < 1200 | Required Controlling | Required Controlling | Required Advisory | If only two, both control. | ↓ | ** |
| CAT IIIA | DH < 100 | RVR ≥ 600 | Required Controlling | Required Controlling | Required Advisory | | ↓ | *** |
| ~~CAT IIIB~~ | ~~DH < 50~~ | ~~RVR < 600 but ≥ 150~~ | | | | | ↓ | *** |

* For CAT II approaches: if TDZ RVR is below 1600, an advisory Mid or Rollout RVR must be reported.
≥ 1000 if published as the approach minima

All US Cat I operating minimums below 1/2 statute mile (RVR2400) and all Cat II and III operating minimums are based on RVR.

** Controlling RVR must be at or above minimums prior to final approach segment.

*** Controlling RVR must be at or above mins prior to final approach segment and prior to descent below DH.

Not endorsed by **any** airline. Attempt to make AC120-29A compliant.
www.fmcguide.com - click on Pilot Support
Last change made Jan 29, 2005. Do not use copies obtained from someone else as they may not be up do date.

# VOR, LOC, NDB, LOC (Back Crs)
## (Traditional Step-Down Technique)

***B737 PROFILES***
**PF** = Pilot Flying
**PM** = Pilot Monitoring

**NOTES:**
1. VOR, LOC, NDB, LOC (Back Crs) approach with visibility equal to or less than 1 mi or 5000 RVR requires monitored approach procedure and autothrottles and autopilot if available.
2. For LOC or VOR approach: If the charted wpts match the wpts in the FMC, consider using LNAV. Single FMC w/o GPS use VOR LOC, (EXP displays TCAS and radar). Sometimes using the ground based navaid as opposed to LNAV keeps things simple; differing displays such charted wpts vs CDU wpts can be confusing, disrupting concentration on step downs.
   MP in Map mode for situational awareness.
3. For NDB or LOC (Back Crs) approach, use LNAV or HDG SEL.
   If using LNAV, you're shooting an "overlay" approach;
   raw data must be monitored and is controlling.
4. At each ALT HOLD, set next altitude and stay ahead of the airplane.
   The vertical work is the most difficult task of this approach.
5. At the FAF, V/S down at least 1000 fpm - check your ground speed.
6. At 1,000 ft AFE max V/S is 1,000 fpm. Level off at the MDA.
7. At VDP with approach lights in sight, start down to 100' above TDZE.
   You may not descend below 100' above the TDZE unless visual reference to the runway is established.
8. Disconnect AP at or prior to the MDA minus 50'.
9. RA technique: Set to 250 ft AGL (300 ft w/o FAF). This is the altitude the TERPS guarantees terrain clearance on final approach segment prior to MDA.
10. 4 ways to compute Visual Descent Point (VDP) described in back.
11. If your LEGS page has RNP / ANP, check the ANP is less than the RNP.
    A low ANP (.5 or less) indicates a pretty accurate FMC position.

NON PRECISION APPROACH - 1 ENGINE INOP
- Disconnect A/T prior to approach,
- 1–11/2 miles from FAF,
  ***GEAR DOWN, FLAPS 15, TARGET****
  ***LANDING CHECK***
  - Reduce to $V_{REF}$ 15 + wind additive.
  - Review SE missed approach procedures.

If overweight, may delay gear and landing flaps until landing is assured.

TOLERANCES:
A/S: -5/+10
MDA: +50,–0

Brief approach.
Complete ***IN RANGE CHECKLIST***
Use autothrottle and autopilot.

Downwind, 7 nm prior to FAF on straight-in, or 3 nm prior to procedure turn outbound:
PF: ***FLAPS 1***
***SPEED****

No later than turning base, 5 nm prior to FAF on a straight-in, or 1 nm prior to procedure turn outbound:
PF: ***FLAPS 5, SPEED****

If using the V/B technique, this is your V/B and V/S display if you are on a 3° descent path.

***After passing FAF***
ACT 300 KT SPD DES 1/1

| | |
|---|---|
| E/D ALT 149 | AT KERNS 173 / 3000 |
| TGT SPD .780 / 300 | TO T/D - 4000 1342.1z / 0.7NM |
| SPD REST 190 / FLAPS | WPT / ALT KERNS / 3000 |
| VERT DEV 384 HI | FPA 4.7 V/B 2.9 V/S 923 |
| < ECON | PATH > |
| < FORECAST | |

Continuous display of angle of aircraft to runway.

**1** **EXAMPLE:** (stepdown to MDA)
**MDA = 750'**
At FAF:
ALT SEL . . . . . SET 800'
V/S Thumbwheel . . 1000-1500 fpm Down
After ALT HOLD at 800':
Set Missed Approach altitude. (Arms V/S)
If still in IMC:
V/S Thumbwheel . . . . . 500' Down
At 750' . . . . press ALT HOLD (Lead 20').
At the VDP with field in sight:
FD bars may be used as reference or deselected. To set FD bars using V/S, take 1/2 groundspeed and add a zero (equals 2.8°)
A/P . . . . . DISENGAGE 50' below MDA min

Cleared for approach:
VOR or LOC approach:
Arm VOR LOC.
NDB or LOC / BC approach:
Use LNAV or HDG SEL.
Engage VNAV as early as possible. Set MCP to zero.

2 miles from FAF:
PF: ***FLAPS 30 / 40*****
***TARGET****

Ref: Procedure A, B, or C in back.

4 mi. from FAF:
PF: ***GEAR DOWN***
***FLAPS 15, SPEED****
***LANDING CHECK***

**1**

Set M/A hdg. when possible

6°
70% N1

Press TOGA - If A/T is on, press once for reduced thrust, twice for full thrust.
If A/T is off, straight-arm throttles to cursors.
Single A/P disengages. Manually rotate to 15°.
**PF:** ***FLAPS 15, CHECK POWER ...***
***POSITIVE RATE, GEAR UP***
***CHECK MISSED APPROACH ALTITUDE***
A/T advances to GA/N1 thrust if ON.
GA/N1 is annunciated.
Speed cursor displays maneuvering speed for flap setting.
FD initially commands 15° pitch and a bank to maintain existing ground track.
Pitch stays in TOGA until altitude acquire or other pitch mode is selected.

400'
PF: ***HDG SEL***
or ***LNAV******
*Tell tower of Missed and intentions.*

1000' AFE and $V_{REF}$30 + 15
PF: ***LEVEL CHANGE***
***SET TOP BUG***
***FLAPS 5***
At $V_M$ 5
PF: ***FLAPS 1***
At $V_M$ 1
PF: ***FLAPS UP***
***AFTER T/O CHECK***
Climb to 3000 ft AFE at $V_M$ 0
3000 AFE: VNAV or
SET 250

$V_{REF}$30 +15
(bug)

1,000 ft

**(-300/500)**
**FLAP MANEUVER SPEEDS**

| Flaps | ≤ 117.0* | > 117.0* |
|---|---|---|
| 0 | 210 | 220 |
| 1 | 190 | 200 |
| 5 | 180 | 190 |
| 10 | 170 | 180 |
| 15 | 150 | 160 |
| 25 | 140 | 150 |

*with Rudder Pressure Reducer

At 100 above MDA:
PM: ***APPROACHING MINIMUMS***
***At MDA:***
***PM: MINIMUMS***

6°
70% N1

At MDA and MA point:
PF: ***GOING AROUND***

- Do not descend prior to VDP.
- When at MDA and ALT HOLD annunciated, set M/A alt.
- Do not start descent prior to 2.8 - 3° angle from threshold.

* Don't take hand off spd knob until you see flap movement.
** Extension of flaps from 15 to landing flap setting can be delayed at pilot's option if ceiling and visibility are relatively high.
*** If entire Missed Approach has been programmed.

- On course:

RNP based approach: the magenta course line is within the confines of the a/c symbol in the 10 nm scale.
LOC is one half full scale deflection - one round dot
VOR is one half full scale deflection - one round dot
NDB approach is 5°

***BOLD ITEMS*** - Req'd call

Not endorsed by **any** airline. Attempt to make AC120-29A compliant.
www.fmcguide.com - click on Pilot Support
Last change made Jan 29, 2005. Do not use copies obtained from someone else as they may not be up do date.

# VOR, LOC, LOC (Back Crs), NDB

## (Single FMC and DME-DME Updating) (Dual FMC and GPS) / CAT I

***B737 PROFILES***
**PF** = Pilot Flying
**PM** = Pilot Monitoring

APPROACH MATRIX for 300-500 EFIS / non-EFIS

| | | |
|---|---|---|
| RNAV | modes: | LNAV & VNAV / NA |
| | displays: | PF - Map (10 mi scale) & AUTO<br>PM - Map (10 mi scale) & AUTO |
| | RNP: | per chart or .3 |
| GPS | NA | |
| LOC* | modes: | VOR LOC & VNAV |
| | displays: | PF - Map & MAN / VOR-ILS & MAN<br>PM - Map & AUTO / NAV & AUTO |
| LOC BC* | modes: | LNAV & VNAV |
| | displays: | PF - Map & AUTO / NAV & AUTO<br>PM - VOR ILS & MAN |
| VOR* | modes: | VOR LOC & VNAV |
| | displays: | PF - VOR ILS & MAN<br>PM - Map & AUTO |
| NDB* | modes: | LNAV & VNAV |
| | displays: | PF - Map & AUTO / NAV & AUTO<br>PM - Map & AUTO / NAV & AUTO |

* Raw data display required

APPROACH MATRIX for 700/800/900

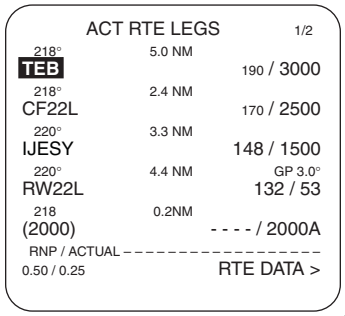
| | | |
|---|---|---|
| RNAV | modes: | LNAV & VNAV |
| GPS | displays: | PF - Map (10 mi scale)<br>PM - Map (10 mi scale) |
| | RNP: | RNAV = per chart, GPS = .3 |
| LOC* | modes: | VOR LOC & VNAV |
| | displays: | PF - Map (10 mi scale)<br>PM - Map (10 mi scale) |
| LOC BC* | modes: | LNAV & VNAV |
| NDB | displays: | PF - Map (10 mi scale)<br>PM - Map (10 mi scale) |
| | RNP: | .5 if no raw data display |
| VOR** | modes: | LNAV & VNAV |
| | displays: | PF - Map (10 mi scale)<br>PM - Map (10 mi scale) |
| | RNP: | .5 if no raw data display |

* Raw data display required

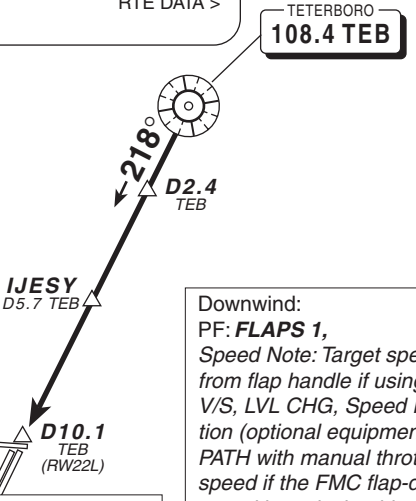
** Caution: Chart wpts may not match LEGS page

**NOTES:**

1. At each ALT HOLD, set the next altitude (or zero at FAF), and stay ahead of the airplane.
2. VNAV may be used for descent to the DA or MDA if a GP leg exists from the FAF to the runway. The approach must be selected from the database. Flying a constant angle vertical path using VNAV is an excellent tool. There's no need for a VDP and there is no level-off segment. No runway at minimums? … start the missed approach climb.
3. If using a DA, set the minimum bugs on the primary altimeters to the DA.
4. CO is authorized to set the MDA if the ball flag is present. If no ball flag, use MDA/DDA Rule.
5. **MDA/DDA Rule**: If using VNAV with an MDA, calculate a Derived Decision Altitude (MDA plus 50') and set the DDA on the baro. altimeter.




- The non-EFIS 737 is not approved for an RNAV approach, but LNAV may be used for an approach that has raw data backup, such as the NDB, VOR, LOC or LOC (Back Crs). Raw data must be monitored and is controlling.
- The non-EFIS 737 can use VNAV (ref: NOTES on this page)
- No RNP requirement for approaches using raw data.
- A VOR or NDB approach in aircraft with dual FMS and GPS has RPN requirement of .5 and raw data is not required.




VNAV GOTCHAS:
- Intercepting the wrong wpt.
- Arriving at the FAF with too much energy (too fast)
- Forgetting to dial zero in MCP altitude prior to FAF.
- Forgetting to engage VNAV at FAF.

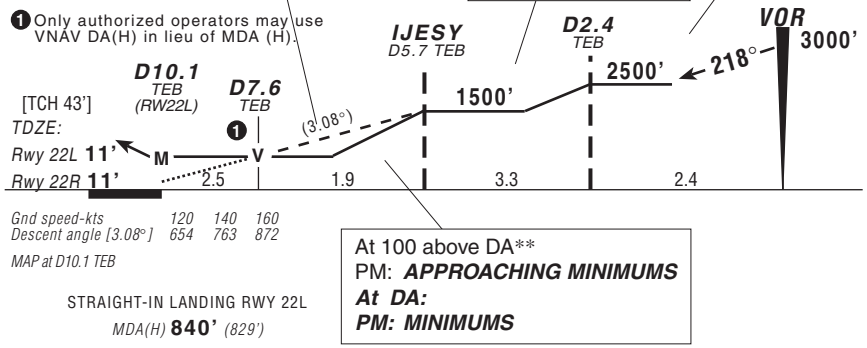
Press TOGA - If A/T is on, press once for reduced thrust, twice for full thrust.
If A/T is off, straight-arm throttles to cursors.
Single A/P
A/P disengages. Manually rotate to 15°.
PF: ***FLAPS 15, CHECK POWER …***
***POSITIVE RATE, GEAR UP***
***CHECK MISSED APPROACH ALTITUDE***
A/T advances to GA/N1 thrust if ON.
GA/N1 is annunciated.
Speed cursor displays maneuvering speed for flap setting.
FD initially commands 15° pitch and a bank to maintain existing ground track.
Pitch stays in TOGA until altitude acquire or other pitch mode is selected.

Approaching the FAF in ALT HOLD:
Set MCP to zero and engage VNAV.
Check FMA for LNAV and VNAV PATH.
PF: **FLAPS 30 / 40**
Target speed comes from FMC.

Downwind:
PF: ***FLAPS 1,***
*Speed Note: Target speed comes from flap handle if using VNAV. Use V/S, LVL CHG, Speed Intervention (optional equipment), or VNAV PATH with manual throttles to set speed if the FMC flap-derived speed is undesireable.*

Approx. 4 miles from FAF:
PF: ***GEAR DOWN***
***FLAPS 15,***
***LANDING CHECK***
***See** Speed Note.*

- During the vector phase:
  PF: **APPROACH CHECK**
- On base leg:
  PF: **FLAPS 5**
  See Speed Note.
- Intercept-leg-to a wpt on the final approach course. This can be tricky. To anticipate the wpt the controller is looking at, consider the altitude you're cleared to descend to.




At 100 above DA**
PM: ***APPROACHING MINIMUMS***
***At DA:***
***PM: MINIMUMS***

| VPA DEVIATIONS | |
|---|---|
| **A/P TEMP** | **ACTUAL VPA** |
| +30°C | 3.2° |
| +15°C | 3.0° |
| 0°C | 2.8° |
| -15°C | 2.67° |
| -31°C | 2.5° |

| (-300/500) FLAP MANEUVER SPEEDS | | |
|---|---|---|
| **Flaps** | **≤ 117.0*** | **> 117.0*** |
| 0 | 210 | 220 |
| 1 | 190 | 200 |
| 5 | 180 | 190 |
| 10 | 170 | 180 |
| 15 | 150 | 160 |
| 25 | 140 | 150 |

*with Rudder Pressure Reducer

* On course for RNAV Approach:
XTK ERR less than RNP entry (.3 nm deviation limit for RNP .3), or on 10 mile scale, the magenta route must not exceed the width of the aircraft symbol without correction. Approximately 1800 ft.
** For non-precision approaches that use a VNAV path, the minimum altitude may be specified as a decision altitude - DA (H). You may rotate through the DA during a missed approach.
If a DA is not published, add 50 ft to the MDA and treat as a DA.

***BOLD ITEMS*** - Req'd call

Not endorsed by **any** airline. Attempt to make AC120-29A compliant.
www.fmcguide.com - click on Pilot Support
Last change made Jan 29, 2005. Do not use copies obtained from someone else as they may not be up do date.

# RNAV, GPS, VOR, NDB APPROACH
## (Single and Dual FMC, with/without GPS) / CAT I

***B737 PROFILES***
**PF** = Pilot Flying
**PM** = Pilot Monitoring

1. RADAR required. 2. Baro-VNAV not authorized below -15°C (5°F). 3. GPS or RNP-0.3 required.
4. DME/DME RNP-0.3 not authorized.
5. Dual simultaneous approach authorized with ILS Rwy 26R or ILS Rwy 27.
6. Special aircraft and aircrew authorization required.

Check procedure notes and minimums for important information such as equipment, RNP requirements, etc. VOR-DME updating is never allowed for RNAV.

- Aircraft with single FMC and DME-DME updating may be authorized for RNAV approach to specific airports.
- Single FMC installations require special missed approach instructions in case of FMC failure. If the FMC fails, climb on an initial heading consistent with the published missed approach. Report to ATC that you have lost RNAV capability.
- These approaches must be selected from the database.
- After selecting the desired approach, verify the approach on the LEGS page matches the chart.
- RNAV RNP approach requirements per the chart. GPS approach requires RNP .3
- Manual entry of RNP in the LEGS page for "field of view" messaging. If the ANP exceeds the RNP, UNABLE REQD NAV PERF-RNP will display; a missed approach is required if this displays inside the FAF and without visual cues.
- Set the minimums (DA) on the baro altimeter.

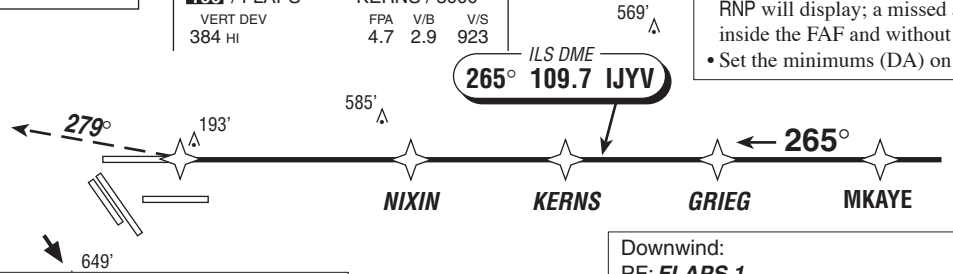
STRAIGHT-IN LANDING RWY **26L**
**LNAV / VNAV**
*DA(H)* **580'** *(483')*

| | | ALS out |
|---|---|---|
| A | RVR 60 or 1 1/4 | 1 3/4 |
| B | | |
| C | | |
| D | | |

With a DA/H there can't be any level flight for visual references, thus the visibility must be not less than the geometric destance from the DA/H point to the runway threshold. *(Roberts)*

- In this example, the next stepdown in VNAV PATH will begin in .7 nm. It is displayed on the Map by a green donut with this label.
- Consider doing stepdowns in VNAV SPD or a MCP tool to make things less confusing.

ACT 300 KT SPD DES 1/1
E/D ALT 149 — AT KERNS 173 / 3000
TGT SPD .780 / 300 — TO T/D - 4000 1342.1z / 0.7NM
SPD REST **190** / FLAPS — WPT / ALT KERNS / 3000
VERT DEV 384 HI — FPA 4.7 V/B 2.9 V/S 923




- Speed entries on the LEGS page are not required since speed control comes from the flap handle or from the speed window if using Speed Intervention.
- Any approach using LNAV should be flown with the autopilot or FD. AP recommended to reduce lateral error.
- From the APPROACH REF page, select the WIND CORR and VREF speed. This sets the target speed at the runway wpt on the LEGS page.

***RNAV / VNAV GOTCHAS:***
- Intercepting the wrong wpt.
- Arriving at the FAF with too much energy (too fast)
- Forgetting to dial zero in MCP altitude prior to step-downs and prior to FAF.
- Forgetting to engage VNAV prior to the FAF.

1000' AFE and VREF30 + 15
PF: ***LEVEL CHANGE***
***SET TOP BUG***
***FLAPS 5***
At VM5
PF: ***FLAPS 1***
At VM1
PF: ***FLAPS UP***
***AFTER T/O CHECK***
Climb to 3000 ft AFE at VMO
3000 AFE: VNAV or
SET 250

400'
PF: ***HDG SEL*** or ***LNAV***
Tell tower of Missed and intentions.

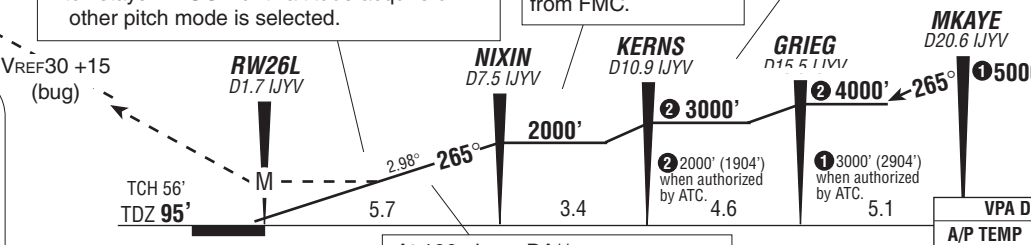
Press TOGA - If A/T is on, press once for reduced thrust, twice for full thrust.
If A/T is off, straight-arm throttles to cursors.
Single A/P
A/P disengages. Manually rotate to 15°.
**PF: *FLAPS 15, CHECK POWER ...***
***POSITIVE RATE, GEAR UP***
***CHECK MISSED APPROACH ALTITUDE***
A/T advances to GA/N1 thrust if ON.
GA/N1 is annunciated.
Speed cursor displays maneuvering speed for flap setting.
FD initially commands 15° pitch and a bank to maintain existing ground track.
Pitch stays in TOGA until altitude acquire or other pitch mode is selected.

Approaching the FAF in ALT HOLD:
Set MCP to zero and engage VNAV.
Check FMA for LNAV and VNAV PATH.
PF: ***FLAPS 30 / 40***
Target speed comes from FMC.

Downwind:
PF: ***FLAPS 1,***
*Speed Note: Target speed comes from flap handle if using VNAV. Use V/S, LVL CHG, Speed Intervention (optional equipment), or VNAV PATH with manual throttles to set speed if the FMC flap-derived speed is undesireable.*

Approx. 4 miles from FAF:
PF: ***GEAR DOWN***
***FLAPS 15,***
***LANDING CHECK***
***See*** *Speed Note.*

- During the vector phase:
PF: ***APPROACH CHECK***
- On base leg:
PF: ***FLAPS 5***
See *Speed Note.*
- Intercept-leg-to a wpt on the final approach course. This can be tricky. To anticipate the wpt the controller is looking at, consider the altitude you're cleared to descend to.
- Cleared for approach:
Engage LNAV*




* Established on inbound track for RNAV Approach: 10 mile scale: the magenta route must not exceed the width of the aircraft symbol without correction. Approximately 1800 ft.
** For RNAV approaches, the minimum altitude may be specified as a decision altitude - DA (H). You may rotate through a DA during a missed approach.
If a DA is not published, add 50 ft to the MDA, call it a DDA, and treat as a DA.

At 100 above DA**:
PM: ***APPROACHING MINIMUMS***
At DA:
***PM: MINIMUMS***

**VPA DEVIATIONS**

| A/P TEMP | ACTUAL VPA |
|---|---|
| +30°C | 3.2° |
| +15°C | 3.0° |
| 0°C | 2.8° |
| -15°C | 2.67° |
| -31°C | 2.5° |

**(-300/500)**
**FLAP MANEUVER SPEEDS**

| Flaps | ≤ 117.0* | > 117.0* |
|---|---|---|
| 0 | 210 | 220 |
| 1 | 190 | 200 |
| 5 | 180 | 190 |
| 10 | 170 | 180 |
| 15 | 150 | 160 |
| 25 | 140 | 150 |

*with Rudder Pressure Reducer

***BOLD ITEMS*** - Req'd call

# RNAV APPROACH
## NOTES



**RNAV Considerations:**

1. The RNAV Approach (or GPS Approach) is designed to be flown in LNAV and VNAV (BARO VNAV).
2. The RNAV approach in the 737 is not as easy as the ground based ILS but it beats the traditional step-down technique.
3. Practice in VFR conditions, especially if parallel approaches are being conducted. Do not wait until you actually need this tool to use it. With the A/P engaged, take the airplane right down to minimums to see just how well it lines up with the landing threshold. Expect a GPS updated system to perform the best.
4. BARO VNAV presents computed vertical guidance referenced to a specific vertical path angle (VPA). The computer resolved vertical guidance is based on barometric altitude. The correct setting of the altimeter does not correct for non-standard temperature. The only way to meet this requirement is to observe the limiting minimum aerodrome temperature annotated on the chart. Errors become proportionally greater with altitude above the altimeter site, usually an airport. The colder the temperature, the shallower the actual angle flown. Ref: VPA DEVIATIONS chart.
5. (300-500) Place both nav switches in AUTO.
   (700-800) You will notice a lower ANP with GPS input.
6. Speed Control:
   a. If your airline's management team has not had the foresight to order Speed Intervention, the RNAV Approach gets a little more complicated. (You can tell where I stand on this issue)
   b. Speed Intervention allows one to control speed using the open IAS / MACH window while remaining in VNAV.
      Speed Intervention should be standard equipment on the 737, just as it is on all the Big Boeings, but the factory does not see it that way.
   c. It hardly needs to be said that in today's environment, most approaches to a hub airport come with speed clearances from the approach controller. For the crew flying the 737 without Speed Intervention, you have two choices for speed control; use the Mode Control Panel V/S or LVL CHG, which opens the IAS / MACH window, or use VNAV, in which case the target speed follows the flap handle! VNAV offers altitude protection on the LEGS pages, but you may have to disconnect the autothrottle and set the throttles manually. The flap handle derived speed may not match the speed clearance (or your own desired speed). Do not use VNAV SPD with manual throttles.
7. Use the autopilot. This will reduce the chance of cross-track error. On the 10 mile range, the magenta route must not exceed the width of the airplane symbol.
8. When accomplishing the APPROACH CHECKLIST include/consider the following 2 items that are easily forgetten:
   RANGE SELECTOR..... 10 MILES
   RNP.....CHECKED / ENTERED (.3)

**Using V/S or LVL CHG to the FAF**

1. Advantages:
   a. For the crew without Speed Intervention, V/S or LVL CHG is the easiest method of meeting an ATC speed clearance during the stepdown phase; use of the autothrottles may be maintained throughout the approach.
   b. If there is no ATC speed clearance, VNAV SPD or VNAV PATH can be used.
2. Disadvantages:
   a. Each stepdown must be entered in the MCP ALT select.
   b. Tell your teammate to remind you to reset the MCP ALT after each ALT HOLD.
3. Monitor stepdowns using the green altitude trend vector.
4. Though you can use V/S to follow the PDI inside the FAF, I'd recommend transitioning to VNAV PATH at the FAF to maintain the constant vertical angle to the threshold. This will lower your workload.

**Using VNAV SPD or VNAV PATH to the FAF:**

1. Advantages:
   a. VNAV will not bust the altitude restrictions (stepdowns) on the LEGS page prior to the FAF as long as you remain in VNAV. If you ever leave VNAV or V/S or LVL CHG, be sure to re-check the MCP altitude.
   b. VNAV may bust the DA/DDA.
   c. The MCP ALT must be set below the FAF altitude or VNAV will disengage at the FAF. The MCP ALT may be set to zero (or whatever your SOP calls for).
2. Monitor stepdowns using the green altitude trend vector.
3. I recommend using VNAV SPD for step-downs because it's confusing trying to figure out when PATH will start each idle descent (unless you have the geometric point-to-point option).
   a. In VNAV SPD the airplane will descend at idle throttle at the active speed to the next altitude restriction on the LEGS page. Just like LVL CHG, it is not slaved to the path, but to speed.

**Arriving at the DA:**

If one of the *required visual references* is not in sight prior to the DA you must level off at the DA. This will result in a mandatory missed approach. Ideally, you want the runway in sight prior to DA/DDA. When the field is in sight, disconnect the autopilot no later than 50ft below the DA/DDA and continue the approach visually.

Initiate a Go-Around for the following:

1. Deviation from the lateral and vertical path, as described.
2. Lack of adequate visual references at minimums.
3. If the ANP exceeds the RNP inside the FAF (message UNABLE REQD NAV PERF).
4. Next Generation a/c with U10.2 software and up allows winding the MCP ALT to the missed approach altitude after passing the FAF by a few hundred feet.

**VNAV PATH vs VNAV SPD**

VNAV PATH

a. The vertical flight path is slaved to the PDI.
b. VNAV PATH will be indicated on the FMA if in VNAV.
   The DES page will be titled ACT PATH DES.
c. The active speed will be highlighted at 3L on the DES page.
d. When being vectored for the approach, it will be a speed from the SPD REST field such as **240** or **210** or it may be flap driven such as **190 / FLAPS**
e. Unless you have the geometric point-to-point option (CO does not), the airplane will fly level until intercepting the next step-down path. Active speed is controlled by the flap-handle, or the Speed Intervention window (optional equipment).
f. For those without speed intervention, disconnecting the autothrottle allows manual control of the airspeed if needed.

VNAV SPD

a. The vertical flight path is slaved to the active speed on the DES page or the Speed Intervention window; it is very similar to LVL CHG.
b. VNAV SPD will be indicated on the FMA if in VNAV.
   The DES page will be titled ACT SPD DES.
   The PATH > prompt will be displayed at LSK 5R if the XTK ERR is less than the RNP and can be re-selected. The PATH > prompt will appear after an intercept-leg-to followed by engagement of LNAV or after a direct-to operation.
c. The active speed will be highlighted at 3L on the DES page.
d. When being vectored for the approach, it will be a speed from the SPD REST field such as **240** or **210** or it may be flap driven such as **190 / FLAPS**

**Arriving at the FAF:**

1. Don't arrive at the FAF with excess energy. If the controller requests "***190 to the marker***", just say "***Unable***"
2. Desireable configuration:
   4 miles from FAF – Gear down, Flaps 15
   PDI approaching center – Flaps 30
3. Though you can use V/S to follow the PDI, I recommend VNAV; this will lower your workload. If you press the VNAV button (sometimes necessary to hold for a couple of seconds) but it does not engage, then as a backup, use V/S to follow the PDI. Teach yourself how to use the FPA, V/B, and V/S information on the DES page. You did remember to spin the MCP ALT to zero before pressing the VNAV button didn't you?
4. The FMC will automatically change to VNAV PATH when you reach a LEG with a Gradient Path (GP). Gradient Path is a leg with an angle contained in the database, so there's no need to select the PATH prompt (DES page) prior to reaching the marker.
5. The target speed will come from your selection of the VREF on the APPROACH REF page plus the WIND additive. The target speed is active when the gear and landing flaps are selected. If you forget to make your VREF selection, the target speed will not go below the flaps 15 speed, and you'll get a message APPRCH VREF NOT SELECTED.

Not endorsed by **any** airline. Attempt to make AC120-29A compliant.
www.fmcguide.com - click on Pilot Support
Last change made Jan 29, 2005. Do not use copies obtained from someone else as they may not be up do date.

# CONSTANT ANGLE



## Pilot Procedural Technique
## (This is not "Vertical Guidance" (VNAV) or an RNAV Approach)

**Calculating a VDP**

4 ways to compute VDP, ranked by accuracy and ease of use:

*VASI* - but won't work if in the clouds or greater than 4 nm.

*Angle (V/B) indication on DEScent page*

Enter runway wpt and threshold altitude at 3R of DES page.

Assuming you are level at the MDA, the VDP is reached when the V/B indicates 2.8 to 3°. Ref: Procedures B and C. This takes study and practice but works great!

*DME*

300 ft per mile = 2.8° slope. Divide HAT by 300.

Ex: LOC 26 IAH. HAT at MDA is 464 ft. Divide by 300 = 1.5 nm needed to descend from MDA to runway.

VDP is 1.5 nm from runway threshold or D3.2 IJYV. (1.7 + 1.5)

*Timing*

For 130 kt gs: 10 ft per second = 2.8° slope.

[Time from FAF to MAP] minus [10% of HAT]

Ex: NDB 26 IAH. HAT at MDA is 624 ft or 62 seconds.

FAF to MAP is 2:27 at 140 kts. Subtract 62 = 1:25. So, FAF to VDP is 1:25. This is a rough estimate.

For each 10 kts above 130 kt groundspeed, add 10 seconds.

**V/S Selection at a 2.8° point such as the OM or the VDP:**

Divide the groundspeed by two. Add a zero. Ex: 140 kts = 700 fpm
This rate of descent will equal a 2.8° angle. Add 50' for 3°. (750 fpm)

CAUTION: As you descend, the ground speed usually decreases, necessitating a corresponding decrease in the selected vertical speed. Good rule of thumb when you're up to your knees in alligator ponds at night.

**BUILDING A RUNWAY WAYPOINT**

**ILS Approach loaded and no need to display step down altitudes.**

1. From the ARRIVALS page, select the ILS approach.
2. Delete all altitudes on the LEGS page except the altitude at the runway. Of course you don't want to use this technique when you plan to use these "LEG" altitudes on an RNAV approach.
3. When being vectored in HDG SEL, do an intercept-to or direct-to a wpt on the approach or the runway itself.
4. The V/B on the DES page will display your angle to the runway because it's the only wpt on the LEGS page left with a hard altitude.
5. Note: There can be no DISCOs on the LEGS page prior to the runway.

**Altitudes desired to be left on LEGS page.**

1. From the ARRIVALS page, select the runway or ILS approach.
2. Not req'd for 10.5 and up. Using the Along Track Wpt feature, place the runway in the s/p, type **/-.1** after it, and place back on top of the runway. A wpt one tenth of a mile inside the threshold will appear. Downselect this new wpt to the s/p and press the ERASE prompt. Now the LEGS page is unchanged. The new wpt in the s/p. This is your new runway threshold wpt. Put this created wpt in a FIX page for storeage for use later. (Ex: RW201)
3. When desired, place your runway wpt from the FIX page to the scratchpad and add the desired altitude to it. Example using RW26, we'd put RW201/0180 into 3R of the DES page. This wpt created .1 nm inside the runway always needs 30 feet more than the threshold crossing height. (needs 4 characters for altitude)
4. The V/B on the DES page will display your angle to the runway.

**Non EFIS with U1.x (old) software**

1. Must be manually built; two ways.
   Your teammate must back you up in constructing this wpt.
   (a) Retrieve the destination runway's coordinates using the REF NAV DATA page. Write them down then use REF NAV DATA again to build a wpt using these coordinates. Example: Name it R26
   (b) The runway wpt can also be built using a Place-Bearing/Distance method from the OM/FAF.
   Example: NDB approach to RW26 at IAH: NIXIN265/5.7
2. Put this created wpt in a FIX page for storeage and use later.
3. When desired, place your runway wpt from the FIX page to the s/p and add the desired altitude to it. Example using R26, we'd put R26/0150 into 3R of the DES page. The V/B on the DES page will display your angle to the runway.

**PROCEDURE A**
**STEP DOWN PROCEDURE**

1. Arrive at the FAF fully configured and at target speed.
2. The MDA should be set in the MCP ALT SEL window. V/S is armed.
3. At the FAF, dial 1000 to 1500 fpm descent in the V/S window.
4. At 1000 AGL, reduce V/S to 1000 fpm.
5. At MDA, (ALT HOLD annunciated) set missed approach altitude. V/S is armed.
6. If field is in sight start descent at the VDP, not before or after.
7. If field does not appear before the VDP fly to the missed approach point and accomplish the missed approach procedure.

**PROCEDURE B**
**CONSTANT ANGLE (VNAV inside FAF not available)**

1. At cruise and before briefing the approach, build a wpt at the runway threshold. Ref: *BUILDING A RUNWAY WAYPOINT*.
2. Plan to shoot the VOR or LOC approach with raw data. Use LNAV for an NDB and LOC Back Crs approach, but monitor raw data as it is controlling.
3. While being vectored, take the created wpt from the FIX page and place in 3R of the DES page with the desired altitude. Now you can monitor your angle from the runway by watching the *angle indicator* (V/B). Displays on the DES page at lines 3R and 4R will not interfer with a VNAV PATH/SPD descent. Think ANGLE, not PATH, when looking at the V/B. (Angle calculator)
4. While being vectored for the approach, accomplish an intercept-leg-to the applicable wpt and select the DES page to monitor the angle to the runway.
5. The V/B tool needs an accurate FMC position. The easiest way to check FMC position accuracy is to monitor the ANP. If you don't have ANP, a technique is to compare the LOC or VOR DME (RDMI) to the RNAV DME (FIX page). (Example: Raw data IGHI DME (110.9) vs: RNAV IGHI DME (IGHI entered in the FIX page.)
6. Arrive at the FAF fully configured and at target speed. The MDA should be set in the MCP ALT SEL window. V/S is now armed.
7. At the FAF, check the angle indicator; when it reaches 2.8°, and not until, thumbwheel the V/S that is indicated at line 4R of the DES.
   You're actually setting the FPA to 3°! The angle indicator (V/B), right next to the V/S display, shows the angle you are to the threshold. Do not let it get less than your own limit - mine is 2.8°. (2.75° - 3.77° are considered standard). It's best just to *bracket* 3°. Now keep the FPA at 3° using the V/S thumbwheel.
8. As you descend, the wind usually changes; the V/S required to maintain a 3° V/B will also change - it is very dynamic. If you get below 2.8°, set V/S to zero until the angle is within your desired range. The required V/S is usually higher at the FAF than at lower altitudes. You'll go below your desired V/B if your V/S is greater than that displayed at line 4. You'll find the angle indicator and FPA indicator very handy tools.
9. When the field is in sight, continue flying the V/S that maintains the 3° FPA, then take over visually. You'll be impressed with the smoothness of this technique. Caution: Don't use the FPA or V/B below the MDA or if the FMC position is not accurate.
10. If the field does not come in sight prior to the MDA, level at the MDA, set the missed approach altitude and continue to the missed approach point. Don't dive for the runway after passing the VDP or if the angle indicator is in excess of your own limit. (Don't rotate through the MDA unless your governing body has approved such a maneuver; the MDA cannot be treated like a DH.)

**PROCEDURE C**
**STEP DOWN PROCEDURE**
**USING V/B FOR VDP**

Steps 1 through 6 are the same as Procedure B.
(Steps 7, 8, and 9 are the same as steps 3, 4, and 5 of Procedure A.)

7. At the FAF, dial 1,000 to 1,500 fpm descent in the V/S window.
8. At 1000 AGL, reduce V/S to 1000 fpm.
9. At MDA, (ALT HOLD annunciated) set missed approach altitude. V/S is armed.
10. When the field comes in sight, start descent when the V/B indicates 2.8°, not before. Dial the V/S that is displayed at line 4R.
11. If field does not appear before the V/B indicates 3.0°, fly to the missed approach point and accomplish the missed approach procedure.

**LEARNING PROCEDURE**

Learn how to shoot Procedure B or C approaches by practicing when an ILS is being conducted in visual conditions. You'll learn how to quickly set the FMC up and how the V/B and V/S indications on the DES page operate. This will lead to confidence in the procedure.

**Notes**

The Constant Angle technique is only recommended if you do not have the capability of using VNAV. VNAV is superior to this Constant Angle technique because there's less work involved in setup, and the A/P can be coupled to the VNAV path. However, the RNAV approach must be contained in the database with a GP leg and your aircraft must be capable of such an approach; and your carrier must allow and train the procedure.

For non-precision approaches that do not have vertical guidance, the minimum altitude may be specified as a minimum descent altitude - MDA (H). You cannot rotate through the floor of an MDA.

For non-precision approaches that use a VNAV path, such as the RNAV approach in this package, the minimum altitude may be specified as a decision altitude - DA (H). You may rotate through the DA in a missed approach.

This is a collection of "angle notes" from practice over the past several years. The learning curve continues with this tool. Please send me your experiences and questions.

All examples below assume no wind. The angle should be adjusted if configured differently or if you have a headwind or tailwind on final.

With the runway threshold and altitude entered at 3R of DES page…

(1) The limit you can start your turn to base from a downwind is when V/B displays 8° (flaps 10, gr. down and 200 kts).

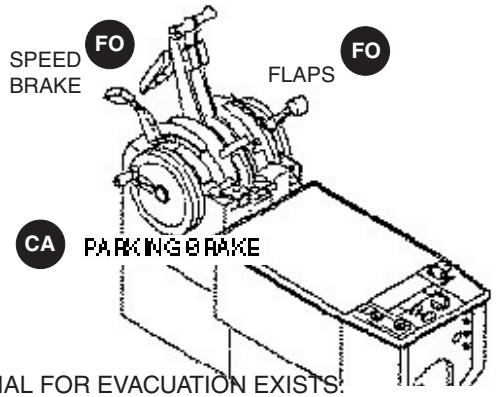
(2) You can start your turn to base…
from a teardrop when V/B displays 8.5° (flaps 10, gr. down and 200 kts).
You want about 4.5 degrees V/B on 2 nm base, and configured at 170 kts.
You want to be less than 4 degrees turning onto final, configured.
You can fly direct to the runway at 250 kts until the V/B from the threshold is 2.0°, then start decelerating (idle power) and configuring.

If you're flying direct-to or dog-leg-to the runway at V/B from the runway of 3°, 250 kts and calm winds, you've got an energy problem.

# REJECTED TAKEOFF



## EMERGENCY EVACUATION

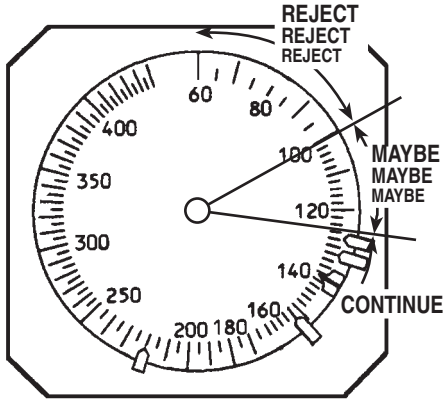



POTENTIAL FOR EVACUATION EXISTS:

CA
- STANDBY POWER .....
- BAT .....
- TOWER/GROUND .....CONTACT

FO
- FLAPS .....40°
- SPEED BRAKE LEVER ..... FULL FORWARD
- PRESSURIZATION .....MAN DC / MAN & OPEN

IF EVACUATION IS NECESSARY:
- PARKING BRAKE..... SET
- TOWER/GROUND ..... NOTIFY
- START LEVERS .....CUTOFF
- PASSENGER EVACUATION .....EASY VICTOR, EASY VICTOR
- EMERGENCY EXIT LIGHTS .....ON




**NOTES:**
1. Below 100 kts, reject for a takeoff configuration warning, engine failure or fire, OVHT / DET annunciation except APU DET INOP, fumes or smoke, system failure, unusual noise or vibratrion, tire failure, abnormal acceleration, or a WINDSHEAR ALERT accompanied by a reported *loss* of airspeed, or a MICROBURST ALERT.
2. Over 100 kts, reject only for engine failure (not just a fire warning) or confirmed unsafe configuration or other condition whereby plane would be unsafe or unable to fly.
   If a WINDSHEAR ALERT or a MICROBURST ALERT is received the takeoff may be rejected or continued at Captain's discretion.
3. Personal experience noted for educational purpose:
   I made the mistake of rejecting when a door light illuminated at 90 kts on a heavy -800 departing SEATAC for ANC. Speed peaked at 114 kts. Airplane stopped comfortably in 6500 ft. Over 30 minute brake cooling period was required. Decide ahead of time what, if any, amber lights you will reject for.
4. V1 is a flying speed, not a RTO speed. Be in a "go" mode.

**STEP 1**
Stop the airplane by accomplishing these items simultaneously for a high speed reject:

Ca: ***REJECT*** – note ground speed.
- Move throttles to idle,
- Disconnect autothrottles (in THR HOLD > 84 kts)
  - Speed brakes will deploy automatically with reverse thrust and over 60 kts.
- Apply brakes as required.
  - RTO feature will apply max braking when both thrust levers are placed to idle and groundspeed is 90 kts or greater. Equivalent to full manual braking.
- Apply reverse thrust - Go-around N1 consistent with conditions - approximately equal to T/O N1. (RT not factored into dry stopping distance but is for wet)

FO: Don't relinquish control of aircraft until Captain confirms he has control, especially the rudders.
Verify speed brake has deployed.
Note reject speed, apply slight nose down elevator and applicable aileron control if crosswind is present.
- Notify ATC of the rejected takeoff.
- ***REMAIN SEATED, REMAIN SEATED***

**STEP 2**
When the aircraft comes to a complete stop, the Captain will call:
***REJECTED TAKEOFF CHECKLIST***
Remain on runway until Rejected Takeoff Checklist is completed if reject was over 100 kts.
Rejected Takeoff Checklist leads to Emergency Evacuation OR After Landing checklist and Brake Cooling Chart.
Don't taxi until FA verifies all exits closed and passengers are seated.

CREW EVACUATION DUTIES:

Ca: Direct and assist passenger evacuation.
Ensure all passengers and crew have evacuated the aircraft. May need PBD.

FO: Assist FA as necessary to ensure forward door(s) open and escape slide activated.
Take a megaphone and proceed to ground without delay. Circle exterior of aircraft as necessary to coordinate and assist with evac.
Direct passengers to assembly point - up wind and off the concrete.

EFFECT OF LOSS OF BOTH GENS BEFORE LIFTOFF

| OPERATIVE | INOPERATIVE |
|---|---|
| Reversers | Autobrakes - DC Bus 2 |
| Anti-skid outbd | Anti-skid inbd |
| All N1s and EGTs | Auto spoilers |
| Left IRS | Right IRS |
| PA | # 2 Nav/Comm |

On the ground, move STBY PWR to BATT for #1 Comm.
(No overhead speakers)
Note: -600 / 700 / 800 auto-transfers on the ground.

Malfunction / Failure
Pilot recognizing problem:
***POWER LOSS, ENGINE FIRE,***
or whatever the unsafe condition.
If no REJECT called, continue to fly the airplane.

RUNWAY LIGHTING

| | |
|---|---|
| 3000'-1000' | CL lights change to alternate red-white |
| last 1000' | CL lights are all red! |
| last 2000' | rwy edge lights change from white to amber |

***BOLD ITEMS*** - Req'd call

# V1 CUT



| | | |
|---|---|---|
| Normal Takeoff | V2 + 20 (bug +5) | V2 + 15 for initial flap retraction. (bug) |
| V1 Cut | V2 (bug) | V2 + 15 for initial flap retraction. (bug) |
| Normal Go-around | Vref 30 + 15 (bug) | Vref 30 + 15 for initial flap retraction. (bug) |
| 1 Enging Go Around | Vref 15 + 5 | VM1 for flap retraction |

**NOTES:**
1. Tell tower of Emergency and intentions.
2. Stay on runway heading (Straight out to 800' AGL or unless terrain is a problem).
3. With autothrottle ON and in N1 mode, failed engine throttle advances 8°. This is the range of N1 equalization control.
4. With autothrottle ON and in SPD mode, both thrust levers advance together to maintain the target speed.
5. Turn autothrottle OFF for approach segment.
6. Take extra time if necessary.
7. As the FP, use your teammate to operate the MCP at your command.

- Brief FA. (TEST)
- Get WX
- Brief approach

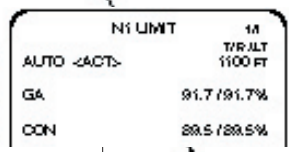
PF: ***ONE ENG INOP APPROACH AND LANDING CHECK***
(Includes In Range, Approach, and Landing Checks and closes fuel crossfeed.)

7°
75-80% N1

***"TEST"***
**T** Type of emergency.
**E** Evacuation necessary?
**S** Signal for brace and evacuation.
**T** Time available for preparation.
NOTE: 4 bells is emergency.

Watch speed - flap limits.
(± 78% N1)
Autopilot is OK for maneuvering but no input to rudder.
Fuel balance - use center tank fuel; otherwise, Crossfeed open and pump out of "dead engine" (monitor).

Climb at L/D Max
EFIS-green donut.
Non-EFIS, check Eng Out page.
Consider in-flight engine start.
Keep yoke centered with feet and rudder trim.

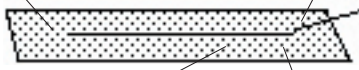



At V2 + 15 (bug) ☐
PF: ***FLAPS 1***
At $V_M$ 1 ☐
PF: ***FLAPS UP*** ☐
***SET MCT***
***ENG FAIL / FIRE CHECK***
Press CON on N1 LIMIT page to move chevrons but don't pull the power back until you're at top bug.

Maintain takeoff flaps for close in turn:
V2 - max bank angle 15° (salmon bug).
V2+15 - up to 30° (white bug).

Smoothly apply lots of rudder to parallel runway centerline, then dig your heel into the floorboard to lock in that rudder position. Maintain heading and keep the control wheel centered. Yoke points to rudder that needs application. The sky-pointer is also useful. Don't exceed 10° heading change.
Rotate to initial go-around altitude of 13°. Higher than normal pitch force required for rotation because of failed engine (decrease in power provides less pitch-up).
PM: **POSITIVE RATE**
PF: **GEAR UP**
Maintain visual reference to runway to maintain directional control until runway disappears under the nose.
Apply small rudder application with ankle movement to maintain constant heading and to keep control wheel centered.
Trim pitch after established on V2.
Climb at V2 for failure at V1 or if obstacle is present; otherwise, climb at V2 to V2 + 20, depending on when engine failed.
Transition to FD.
Straight out, keep heading within 5°. Takes about 4° rudder trim.

PF: Stabilize thrust 40 ± 5 % N1,
Push to 70 - 80 % N1,
Press TOGA (check A/T movement)
***CHECK POWER***
PM: Checks all engine instruments.
Check airspeed alive using drum.
Check FMA - TOGA, N1, TO.
FD commands 10° down.
***POWER SET __% N1 . . .***
***100 kts.***



PM: ***V1, ROTATE***
Rotate towards 13° pitch at 2.5° per sec. All engine liftoff attitude is 9 - 10°

Anyone may call
***POWER LOSS***
Check max power.

Climb at V2 to V2 + 20

400'
PF: ***HDG SEL*** or ***LNAV***
Declare an emergency.
You do have the gear up, don't you?

At 800 ft AGL or published obstruction clearance altitude for specific runway (10-7 page.)
PF: ***SET TOP BUG***
Accelerate in slight climb - 100 to 200 fmp.
If an engine fire occurs prior to 800' AFE or obstacle clearance altitude, at flap retraction altitude call
PF: ***SET TOP BUG, ENGINE FAIL / FIRE CHECK***
and complete through discharging the fire bottles.
If fire light extinguishes, test fire detection system.

**(-300/500)**
**FLAP MANEUVER SPEEDS**

| Flaps | ≤ 117.0* | > 117.0* |
|---|---|---|
| 0 | 210 | 220 |
| 1 | 190 | 200 |
| 5 | 180 | 190 |
| 10 | 170 | 180 |
| 15 | 150 | 160 |
| 25 | 140 | 150 |

*with Rudder Pressure Reducer

***BOLD ITEMS*** - Req'd call

# ONE ENGINE ILS TO A MISSED APPROACH



- Check weather, brief approach, company, and FAs.
- Use of autopilot is recommended.
- Complete ONE ENGINE INOP APPROACH and LANDING check at appropriate time. (Includes IN RANGE, APPROACH and LANDING checks)
- Flight Directors ON. Autothrottle OFF.
- Consider autobrakes 2-3 due to high landing speed.

Downwind
PF: ***FLAPS 1***
***SPEED****
***APPROACH CHECK***

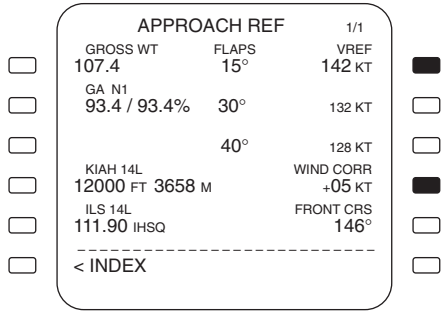
± 78% N1 thru F.15 deployment.

Turning base:
PF: ***FLAPS 5***
***SPEED****

8°
78% N1

On base leg:
PF: ***FLAPS 10***
***SPEED****

- If you get a little slow in a SE situation, it is easier to go to the next flap setting than it is to recover the lost speed.
- Any change in power will require a change inpitch and rudder.
- Practice is required to keep your scan sharp and quick.
- Make small corrections on the localizer.
- Include the sky pointer and the compass rose in your scan.




**NOTES:**
1. Because of the requirement for transfer of control, the Monitored Approach Procedure is not authorized with an engine inop even though an auto coupled approach is authorized. The pilot flying the approach in conditions at or below 2400 RVR with an engine inop should also make the landing.
2. Missed Approach
   Request straight out.
   Flaps can be left at 1° if returning.
   Maintain runway heading (center control column with rudder).
   Turn both FDs ON for TOGA.

Maintain flaps 1 for close in turn (terrain):
VREF15 + 5 - max bank angle 15° *** (target airspeed).

Watch speed.
Flap limits are easily exceeded with no autothrottle

- Cleared for approach: Arm LOC or APP **
- Observe VOR/LOC and/or GS ARM annunciation on FMA.
- Transition to the ADI.

LOC Capture
Set M/A hdg.

1 to 1 1/2 dots below GS
PF: ***GEAR DOWN***
***FLAPS 15, TARGET LANDING CHECK***
Pull throttle to 65% N1 to decelerate to VREF 15 + additive.

GS Capture,
Set M/A alt.

7-8°
75% N1

Habit - keep finger on TOGA. To go around, press "TOGA". Smoothly straight-arm the throttle to Go-Around thrust, applying rudder to maintain heading, then dig your heel into the floorboard to lock in that rudder position. Keep the control wheel centered.
Rotate to initial go-around altitude of 13°. Higher than normal pitch force required for rotation because of failed engine (decrease in power provides less pitch-up). Rotation thru approximately 10° yields positive rate of climb.
PF: ***FLAPS 1, CHECK POWER …***
***POSITIVE RATE, GEAR UP***
***CHECK MISSED APPROACH ALTITUDE***
Maintain visual reference to runway to maintain directional control until runway disappears under the nose.
Target speed is VREF15 + 5 *** Transition to FD.
Straight out, keep heading within 5°.

PF: ***MINIMUMS,***
***GOING AROUND***

5°-6°
67% N1

Stay on LOC.
At 400'
PF: **HDG SEL** or **LNAV**
PM: Tell tower you are going straight out to clean up.
Set radios for missed approach.

At VM 1
PF: **FLAPS UP** (option)
**SET MCT** (Press CON on N1 LIMIT page)
**ENG FAIL / FIRE CHECK**

At 800' or obstacle clearance altitude,
Decrease pitch,
PF: **SET TOP BUG**
Accelerate in slight climb.

Climb at VREF15 + 5 to flap retraction altitude.

**(-300/500)**
**FLAP MANEUVER SPEEDS**

| Flaps | ≤ 117.0* | > 117.0* |
|---|---|---|
| 0 | 210 | 220 |
| 1 | 190 | 200 |
| 5 | 180 | 190 |
| 10 | 170 | 180 |
| 15 | 150 | 160 |
| 25 | 140 | 150 |

*with Rudder Pressure Reducer

* Don't take hand off spd knob until you see flap movement.
** Caution: Consider waiting until the "feather" before arming GS.
*** Vref 15 + 5 is approximately V2 for flaps 1 and should be considered a minimum speed.

- Vref 15 + wind additive (Min 5 - Max 20)
- Pilot option on rudder trim. Try leaving about half in.

***BOLD ITEMS*** - Req'd call

Not endorsed by **any** airline. Attempt to make AC120-29A compliant.
www.fmcguide.com - click on Pilot Support
Last change made Jan 29, 2005. Do not use copies obtained from someone else as they may not be up do date.

# WINDSHEAR TAKEOFF / with Landing Notes

***B737 PROFILES***
**PF** = Pilot Flying
**PM** = Pilot Monitoring

First Rule: **AVOID WINDSHEAR**
MICROBURST WINDSHEAR PROBABILITY GUIDELINES
**H** = HIGH **M** = MEDIUM **L** = LOW

| Presence of Convective Weather Near Intended Flight Path | |
|---|---|
| • With localized strong winds (blowing dust) | **H** |
| • With heavy precipitation | **H** |
| • Onboard windshear detection system alert | **H** |
| • With Rainshower or Lightning | **M** |
| • With Virga (cooling air plunging earthward) | **M** |
| • With Moderate or greater turbulence | **M** |
| • With temp / dewpoint spread between 30 - 50°F | **M** |
| PIREP of Airspeed Loss or Gain | |
| • 15 kts or greater | **H** |
| • Less than 15 kts | **M** |
| LLWAS Alert / Wind Velocity Change | |
| • 20 kts or greater | **H** |
| • Less than 20 kts | **M** |
| • Forecast of convective weather | **L** |

**Takeoff Notes:**
1. Select longest suitable runway available that avoids suspected areas of windshear.
2. Flaps 1 offers better performance in airborne windshear but Flaps 5 results in better performance on the runway and is recommended as it covers a larger range of conditions.
3. Use max rated takeoff thrust.
5. Use increased rotation speed when available. Determine runway limit weight. Then determine $V_R$ for that weight (field length limit $V_R$). If the field length limit $V_R$ is greater than the actual gross wt $V_R$, use the higher. Do not reset the airpeed bugs.

Without Terminal Doppler Weather Radar:
If conditions exist and PIREPS indicate that a windshear in excess of 15 kts is possible and may be *building*, delay departure 30 min. If conditions indicates that the windshear is 15 kts or less and *subsiding*, delay departure 15 min.

With Terminal Doppler Weather Radar:
If a WINDSHEAR ALERT accompanied by a reported *gain* of airspeed is issued, you may take off but be alert for sudden airspeed increase.
If a WINDSHEAR ALERT accompanied by a reported *loss* of airspeed, or a MICROBURST ALERT is received, a takeoff should not be attempted. If either alert is received during takeoff prior to 100 kts the takeoff should be rejected. If either alert is received after 100 kts the takeoff may be rejected or continued at Captain's discretion after considering runway available, gross weight and related meteorological conditions.

4. Use FD. All CO aircraft have FCC - 2 or above, which can be used for windshear guidance.

Do not change flaps, gear or trim position until terrain contact is no longer a factor.
Focus attention on pitch attitude, and flying the airplane.
MP: Monitor attitude, IVSI, and altimeter.
Inform PF of impending and negative vertical speeds by a callout of **SINK RATE**.

**Landing Notes:**
Below 1000' AGL, if uncontrolled changes from normal steady flight conditions exceed the following tolerances, initiate the Windshear Recovery Procedure.
Exact parameters cannot be established.
- ± 15 kts
- ± 500 FPM V/S deviation from normal.
- ± 5° pitch attitude change.
- ± 1 dot glideslope displacement
- Unusual throttle position for a significant period of time.

A reported airspeed loss should be added to $V_{REF}$ and if this value is in excess of target, increase and maintain this speed. The target bug should remain set based on the surface wind additive only, so autothrottles cannot be used in this case.
If the additive to $V_{REF}$ (due to either surface wind or reported loss) results in an adjustment in excess of $V_{REF}$ + 20, the approach should not be continued.

After recovery is complete, use standard departure procedures.

With no W/S Recovery Enhacement, turn FD off .
PF: Stabilize thrust 40 ± 5 % N1,
Push to 70 - 80 % N1,
Press TOGA (check A/T movement)
***CHECK POWER***
PM: ***POWER SET __% N1 . . .***
***100 kts.***
Check all engine instruments.
Check FMA - TOGA, N1, TO.
Check airspeed alive using drum.
FD commands 10° down.

ALERT is enabled at rotation and remains enabled up to 1500'

TOGA cannot be selected above 2000'

Optimum pitch is stick shaker -2°

| | |
|---|---|
| 2300RA | PWS scan cone pattern (Alerts from 1200RA to TD) |
| 2000RA | F/D GA armed (to TD) (not annunciated) |
| | A/T GA armed (to TD+2) sec) (not annunciated) |
| | EGPWS Look Ahead Terrain Alerting (2000 baro to TD) |
| | Caution Alert (60 - 40 sec ahead) |
| | Aural - CAUTION TERRAIN |
| | Visual - amber TERRAIN on both NDs |
| | Warning Alert (30-20 sec ahead) |
| | Aural - TERRAIN, TERRAIN, PULL UP |
| | Visual - red PULL UP on both FFDs and red TERRAIN on both NDs |

Reject if below V1 with unacceptable airspeed variations or windshear alert.

Firewall the throttles.
Either pilot: ***MAX THROTTLE***
***PM: V1, ROTATE***
Rotate at least 2000' before end of runway - amber edge lighting.
Aft body contact may be unavoidable.

**Windshear Recovery Procedure**

| With **PREDICTIVE Windshear System** | With **REACTIVE Windshear System** | With no **REACTIVE Windshear System** |
|---|---|---|
| - Radar TEST says "WINDSHEAR AHEAD"<br>- provides detection of windshear a minimum of 10 sec prior to penetration.<br>- automatic below 1500' RA to TD.<br>- operates in alternate scan if radar is on<br>Caution alert (3 nm ahead)<br>Aural - "MONITOR RADAR DISPLAY"<br>Visual - symbol and amber WINDSHEAR on both NDs<br>Warning alert (1.5 nm directly ahead)<br>Aural - "GO AROUND, WINDSHEAR AHEAD"<br>Visual - symbol and red WINDSHEAR warning | - GPWS test says "WINDSHEAR, WINDSHEAR, WINDSHEAR"<br>- provides alert after penetration.<br>- mode of GPWS.<br>You'll get "WINDSHEAR, WINDSHEAR, WINDSHEAR" with red windshear lights.<br>Engage TOGA and follow the FD.<br>Apply max power: **MAX THROTTLE**<br>TOGA follows FD command bars but will capture the altitude that is set in the MCP ALT SEL window. | Apply max power: **MAX THROTTLE**<br>Rotate initially towards 15°.<br>Use the FD.<br>Monitor IVSI, attitude and altimeter. |

***BOLD ITEMS*** - Req'd call

# STEEP TURNS



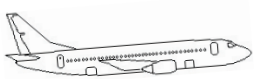
TOLERANCES:
± 100'
± 10 kts
45° bank ± 5°
Hdg ± 5° of recovery heading.

Panel lights on bright to see pitch bars.
**IN-RANGE CHECK**
**On your altitude:**
A/P ON **
A/T ON (set spd 250 kts)
Put CDI on nose and de-tune radio.
Note pitch and N1. 4 1/2°, 62% N1
A/T OFF
Deselect HDG
*Deselect ALT HOLD by spinning MCP ALT SEL up and canceling the ALT HOLD switch.
Set HDG bug on tail
A/P OFF

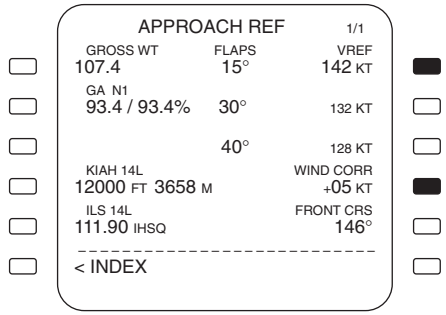
Start the turn.
As bank is increased beyond 25°, increase pitch 1/2° and push in power one knob (8% N1).
Non EFIS, use the F/S anticipator.
Pitch attitude control is utilized to maintain or correct back to the altitude; power is employed to maintain the airspeed.
Don't trim.

You'll be 5 ± 1/2° nose up at 45° bank.
Reference:
Control Instruments:
ADI – 5° pitch / 45° bank
Power – 68% N1
Performance Instruments:
Airspeed, (non-EFIS - F/S indicator) and altimeter.
Use light control pressures when making any corrections back to the desired pitch or bank indication.

Ask PM to call the 15° lead.
Rule: Average amount of lead is approximately 1/3 the angle of bank.
Rollout same rate as entry.
Control Instruments:
ADI – Relax back pressure to entry pitch.
Power – Pull throttles back to entry N1
Performance Instruments:
Airspeed, (non-EFIS - F/S indicator) and altimeter.
Repeat in other direction.
On your altitude:
A/P ON **
A/T ON (set top bug for next maneuver).
Prepare for stall series.



This APPROACH REF page shows where you find your ref speeds during the INRANGE check.




NOTE: Consider pitch change with power change. An increase in power pitches the nose up.

**(-300/500)**
**FLAP MANEUVER SPEEDS**

| Flaps | ≤ 117.0* | > 117.0* |
|---|---|---|
| 0 | 210 | 220 |
| 1 | 190 | 200 |
| 5 | 180 | 190 |
| 10 | 170 | 180 |
| 15 | 150 | 160 |
| 25 | 140 | 150 |

*with Rudder Pressure Reducer

* EFIS aircraft
** 3 STEPS TO ENGAGE A/P
A/P ON (set HDG SEL, press HDG and ALT HOLD)
A/T ON (set speed)
Check FMA

***BOLD ITEMS*** - Req'd call

These recovery procedures are for low altitude, minimum altitude loss situations with terrain a factor. If an indication of an impending stall is encountered at cruising altitude, the wing may have to be unloaded. It may be necessary to lower the pitch attitude below the horizon to trade altitude for airspeed.

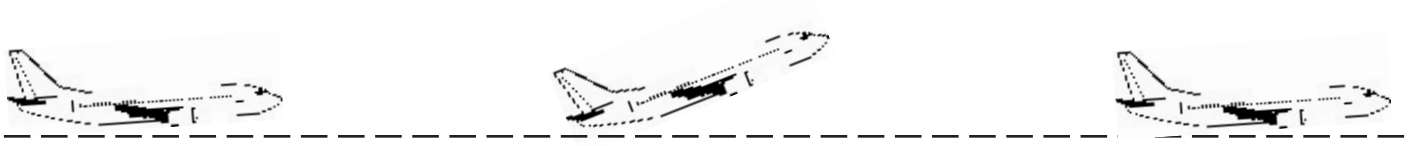
# APPROACH TO STALL

***B737 PROFILES***
**PF** = Pilot Flying
**PM** = Pilot Monitoring

| | | | | |
|---|---|---|---|---|
| **CLEAN CONFIGURATION**<br>Recovery objective:<br>Accelerate to normal maneuvering speed with no altitude loss | ***IN-RANGE CHECK***<br>Set seat back so shoulders do not leave the seat when you throw the throttles forward. This will keep the control column hand stationary.<br>On your altitude:<br>A/P ON**<br>A/T ON, set top bug | Note pitch and N1<br>7° / 60% N1<br>A/T OFF<br>A/P OFF<br>Deselect HDG<br>*Deselect ALT HOLD by spinning MCP ALT SEL up and canceling the ALT HOLD switch.<br>***SET 40% N1*** | Scan pitch, altimeter and VSI.<br>Maintain altitude or slight rate of climb.<br>**Do not lose any altitude.** Use trim.<br>Note pitch at first indication of stall.<br>***MAX THROTTLE*** - push throttles to their mechanical stops, using finger tips if necessary, keeping shoulders in place.<br>Reference:<br>Control Instruments:<br>ADI – Hold pitch attitude. As airspeed starts to increase, push pitch to entry attitude. Adjust pitch to hold altitude.<br>Power – As speed approaches target, pull throttles to entry N1. | Set pitch from step 2.<br>On your altitude:<br>A/T ON, set top bug<br>A/P ON **<br>Set up for next stall maneuver. |
| **TURNING CONFIGURATION**<br>Flaps 5, Gear down, 20° bank<br>Recovery objective:<br>Maintain altitude and accelerate to Flaps 5 maneuvering | ***IN-RANGE CHECK***<br>On your altitude:<br>A/P ON<br>A/T ON (set spd $V_M$ 0)<br>***FLAPS 1,*** set $V_M$ 1<br>***FLAPS 5,*** set $V_M$ 5<br>***GEAR DOWN,***<br>***LANDING CHECK*** | Note pitch and N1<br>6-7° / 67% N1<br>A/T OFF<br>A/P OFF<br>Deselect HDG<br>*Deselect ALT HOLD by spinning MCP ALT SEL up and canceling the ALT HOLD switch.<br>Start turn to 20° bank.<br>***SET 50% N1*** | Establish 20° bank.<br>Maintain altitude or sight rate of climb. Be patient until 10°.<br>At 12-13°, pitch is very active.<br>Use trim.<br>Shaker at ± 18° (if 1 g.)<br>**Do not lose any altitude.**<br>Note pitch at first indication of stall.<br>***MAX THROTTLE*** - push throttles to their mechanical stops.<br>Reference:<br>Control Instruments:<br>ADI: Level wings, hold pitch attitude. As airspeed starts to increase, push pitch to entry attitude. Adjust pitch to hold altitude.<br>Power – As speed approaches target, pull throttles to entry N1. | Set pitch from Step 2.<br>Return to entry speed.<br>On your altitude:<br>A/T ON (set spd at 190)<br>A/P ON **<br>Set up for next maneuver. |
| **LANDING CONFIGURATION**<br>Flaps 30, Gear down<br>Recovery objective:<br>Maintain altitude and accelerate to Flaps 30 Target | On your altitude:<br>A/P ON **<br>A/T ON<br>Should have flaps 5, gear down from previous maneuver.<br>**FLAPS 15,**<br>**LANDING CHECK**<br>(Set 150).<br>**FLAPS 30** (Set target). | Note pitch and N1.<br>A/T OFF<br>A/P OFF<br>Deselect HDG<br>*Deselect ALT HOLD by spinning MCP ALT SEL up and canceling the ALT HOLD switch.<br>***SET 50% N1*** | Lots of drag. Airplane slows rapidly. Pull up aggressively into the stall.<br>**Do not lose any altitude.**<br>Note pitch at first indication of stall,<br>***MAX THROTTLE*** - push throttles to their mechanical stops<br>Reference:<br>Control Instruments:<br>ADI – Hold pitch attitude. As airspeed starts to increase, slowly push pitch to entry attitude. Adjust pitch to hold altitude.<br>Power – As speed approaches target, pull throttles to entry N1.<br>Performance Instruments:<br>Airspeed and altimeter. | Stabilize at Flaps 30 Target<br>***SET TOP BUG***<br>Clean up as you would in a go-around:<br>***FLAPS 15,*** (check power)<br>(Positive rate) ***GEAR UP …***<br>***FLAPS 5 …***<br>***FLAPS 1 …***<br>***FLAPS UP, AFTER TO***<br>On your altitude:<br>A/T ON<br>A/P ON ** |

* EFIS aircraft

** 3 STEPS TO ENGAGE A/P
A/P ON (set HDG SEL, press HDG and ALT HOLD)
A/T ON (set speed)
Check FMA



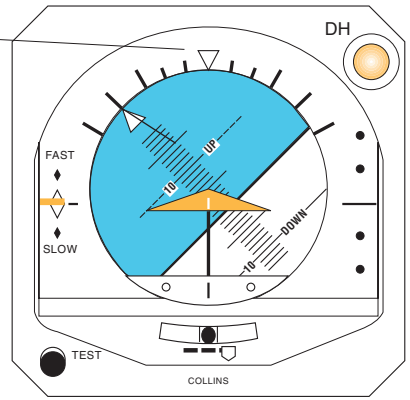
Not endorsed by **any** airline. Attempt to make AC120-29A compliant.
www.fmcguide.com - click on Pilot Support
Last change made Jan 29, 2005. Do not use copies obtained from someone else as they may not be up do date.

# PITCH 'N POWER
## CONTROL AND PERFORMANCE METHOD

*Helpful hints:*
*Go into the sim with a positive attitude. It's an opportunity to practice maneuvers, some of which you haven't had the chance to do for a while. It should always be a good learning experience. Practice to improve your instrument scan on the line by flying without the Flight Director on a regular basis. A good scan will help enormously during non-normal ops.*

*Helpful hints:*
*Anytime you turn a knob, move a switch, or issue a command, look for results.*
*"If..., then..."*
*Both pilots are flying all the time. Just happens one is on the controls.*
*When you take the active runway for takeoff, that's your que for full concentration.*

Always roll towards the "sky pointer"




Regardless of aircraft attitude, always consider the Bank Index Pointer as being straight up. Think of the Bank Index Pointer as the "sky pointer".

### PITCH 'N POWER

Parts from *INSTRUMENT FLYING*, Dept of US Air Force, 1960 (I've done some editing)

Learn *what to change* (pitch, bank, or power) and *how much change* is required. This is the *Control and Performance Method*.

The ***control instruments*** are the attitude indicator (ADI) and the power indicators (N1 or Fuel Flow).

The ***performance instruments*** will know when to change the attitude and / or power. They are the altimeter, vertical speed, airspeed, direction, and navigation (HSI or Moving Map) indicators.

Establishing an attitude and power setting (control) will result in the desired performance. Known pitch and approximate fuel flows or N1 will help reduce your workload.

How to know *what to change* (pitch and bank of the nose, or thrust) is simple. Pitch control, by raising or lowering the nose is used primarily to maintain an altitude or to control the vertical speed. Bank control is used to maintain a heading or a desired turn. Bank changes are made in reference to nav requirements, such as a heading vector, tracking the magenta line on the Map, or following the localizer. Fuel Flow/N1 is used for maintaining or changing the airspeed (except during fixed power maneuvers such as climbout).

After or during the change of attitude and / or power, the *performance instruments* are crosschecked to see if their indications changed as desired. Flying by reference to instruments is simply a continuous repetition of this process. You must glance from the ADI to the altimeter - back to the ADI - then a glance at another performance instrument, back to the ADI, and so forth, including the standby ADI. The proper relative amount of attention must be given to each performance instrument. Do not devote too much attention to one performance instrument and fail to cross-check the control instrument.

A good scanning skill can be maintained even when the autopilot is engaged.

Changes in the indications on the *performance instruments* will lag slightly behind changes of attitude and or power. When the attitude and power are properly controlled, indications on the *performance instruments* will stabilize or change smoothly with a minimum of lag.

A level-off leadpoint is the altitude at which you should begin applying control for level flight. This altitude is calculated by using 10% of the climb or descent rate. If you're climbing at 1,500 fpm, begin leveling off no later than 150 ft before reaching the target altitude.

When leveling the 737, pulling the thrust levers back will bring the nose down. Pushing the thrust levers up will raise the nose.

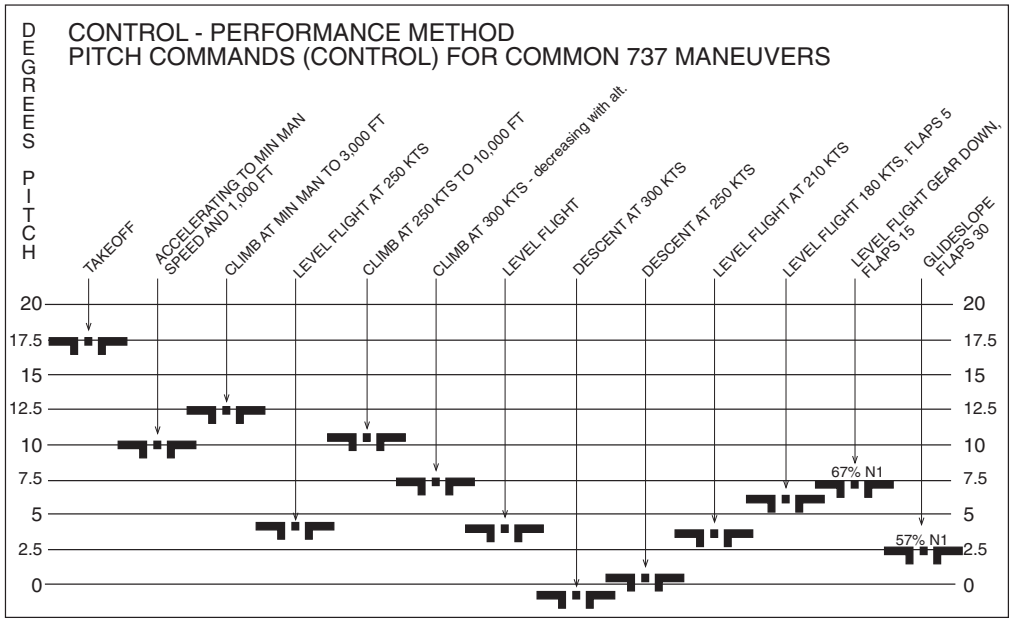
A scan technique should begin and end with the ADI. The instruments scanned depends on the maneuver, but it may include shifting the eyes from the ADI to the altimeter, dart over to the heading indicator, back to the ADI, then to the airspeed. This takes many hours of concentrated practice, especially in a high speed airplane. Left neglected, scanning skills pick up drag rather than speed.

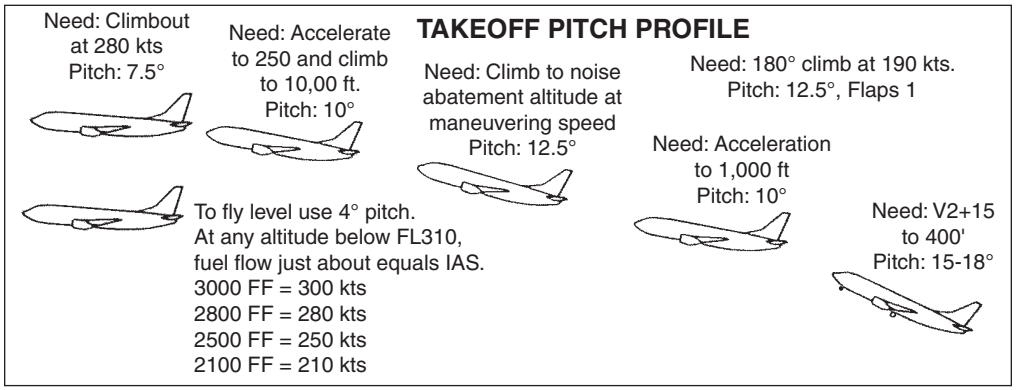
Symptoms of insufficient reference to the control instruments are readily recognizable. If you do not have in mind some definite attitude and power setting that are to be held or established and the indications on the performance instruments fluxuate erratically, then you are not referring sufficiently to the control instruments. You will be "chasing" indications, especially the FD.

Develop these skills and you can save an airplane, crew, and passengers that has lost a system such as the pitot-static or one that has improper Flight Director commands. Learning these skills will make you a better pilot because you can integrate the raw data with the FD cues, and increase your own self confidence.

Banking Rule: For heading changes more than 25°, use 25° bank. Heading change less than 25°, divide the heading change by 2.

Roll-out Rule: Divide the bank angle by 2. For a 20° bank begin roll-out 10° before the desired heading.



# PATTERN WORK

**For your personal study**