Airbus A340 Procedures

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PROCEDURES

USE OF THE FLIGHT MANAGEMENT AND GUIDANCE SYSTEM

The FMGC has 3 functions:

- The two FG (Flight Guidance) functions:
  Autopilot (AP) and Flight Director (FD)
  Autothrust (A/THR)

- The FM (Flight Management) function.

Autopilot and Flight Director
The AP and FD guide the aircraft along the intended flight path or at the intended speed according to the guidance modes as engaged by the pilot on the Flight Control Unit (FCU). (e.g. NAV-HDG-V/S...)

The FCU is the short-term interface between the pilot and the FMGC, used to select guidance targets and arm/engage guidance modes. There are 2 types of modes and associated targets:

- Managed modes and targets - the aircraft is guided along the FMS lateral and vertical Flight Plan and speed profile. These modes and targets are armed or engaged by pressing the FCU knobs.

- Selected modes and targets - the aircraft is guided by selected targets according to the modes selected on the FCU. These modes and targets are armed or engaged by the pilot by turning and pulling the FCU knobs.

The armed and engaged modes are indicated on the Flight Mode Annunciator (FMA) on top of the PFD; the targets (SPD, ALT, HDG...) are indicated on the associated scales on the PFD.

Autothrust (A/THR)
The A/THR may be active in one of the following modes:

- THRUST mode: the A/THR maintains a fixed thrust level (e.g. THR CLB or THR IDLE) when the AP/FD guides the aircraft in climb or descent at a constant speed (e.g. CLB or DES modes).

- SPEED/MACH mode: the A/THR varies the thrust so as to maintain a target speed when the AP/FD guides the aircraft on a given trajectory (e.g. V/S, ALT, G/S modes).

When the A/THR is active, the throttle levers are set to detents (e.g. MCT, CL); they remain in this fixed position while the A/THR varies or sets the thrust according to the active mode. When the A/THR is active, the throttle lever position defines the maximum thrust available for the A/THR.

Flight Management System (FMS)
The FMS provides assistance to the crew for:

- Navigation

- Flight planning

- Aircraft performance (optimum speeds/altitudes)

- Predictions

The FMS is an important long-term planning and management tool that is linked to the AP/FD. When the AP/FD is engaged in Managed modes, the aircraft is guided along the FMS flight plan using the FMS target speeds. The Multipurpose Control and Display Unit (MCDU) is used to insert and retrieve data to/from the FMS.

FLIGHT PREPARATION

Optimum Flight Level

If flight 9000 ft below optimum is intended an increase of about 10% in trip fuel should be expected (usual contingency is 5%).
If flight above optimum (up to ceiling) is intended the increase in consumption may reach 4%.

Fuel Transportation

The policy regarding "tankering" of fuel on sectors where a favorable fuel price differential or operational requirement exists should be checked. The effect of carrying unnecessary extra fuel is to increase the fuel consumed for that sector and affects the economy of the operation (lower flex temperature, tire and break wear, climb phase duration, lower optimum flight level, etc.).

ENGINE START

Automatic Engine Start

- ENG MODE sel: IGN START
- ANNOUNCE: START ENG 1 and 2
  Engines 1 and 2 are usually started first
- MASTER sw 1 then 2: ON
  Wait until ENG 1 N2 is at about 10% before switching the ENG 2 MASTER sw at ON

ON ECAM UPPER DISPLAY	ON ECAM LOWER DISPLAY
N2 increases	Corresponding start valve in line Bleed pressure indication green Oil Press increases
At 16% N2:	Indication of the active igniter (A or B)
At 22% N2: - FF increases Within 10 sec after fuel is on - EGT increases - N1 increases	
At 50% N2:	Start valve cross line Igniter indication off

- MAIN AND SECONDARY ENG. IDLE PARAMETERS: CHECK NORMAL
  At ISA SL: N1 about 20%, N2 about 60%, EGT about 400°C and FF about 300 kg/h
- ANNOUNCE: START ENG 3 and 4
- MASTER sw 3 then 4 (ENG 4 when ENG 3 N2 at about 10%): ON

Turning the ENG START selector to NORMAL indicates the end of the start sequence.
After start, to avoid thermal shock, the engines should be operated at idle or near idle for at least 2 minutes prior to advancing the thrust lever to high power. Taxi time at idle may be included in the warm-up period.

TAXI

Thrust Levers
In order to get the aircraft moving, little if any power above idle thrust will be required (max N1 is 40%).
Use of engine anti-ice increases ground idle thrust, care must be taken on slippery surfaces.
Avoid high thrust settings at low ground speeds due to the risk of ingestion (FOD).
"Square wheel effect" may be noticed if the aircraft was parked for a long time (more than 6 hours) in high temperature conditions with a high weight.

Speed
The normal maximum taxi speed should be 30 kts in a straight line on long taxiways, 10 kt for a sharp turn. Monitor the ground speed on the ND. Do not ride the brakes - as 30 kt is exceeded with idle thrust, apply brakes smoothly and decelerate to 10 kt, release the brakes and allow the aircraft to accelerate again.

Auto Brake
Set autobrake to MAX. Selection of MAX mode before takeoff will improve safety in the event of an aborted takeoff. If takeoff must be aborted, the autobrake system will apply the maximum braking (if ground speed is above 72 kt) as soon as the thrust levers are set to idle.

180° Turn On Runway
A standard runway is 45 meters wide. The following procedure may be applied to make a turn on a dry runway in the most efficient way.

- Taxi on the right hand side of the runway and turn left to maintain 20° divergence from the runway axis. Reduce ground speed to the minimum possible.
- When the captain is physically over the runway edge, apply and maintain full deflection on the nose wheel and increase N1 on ENG 1 and 2 up to 55% while the aircraft starts turning.

TAKEOFF

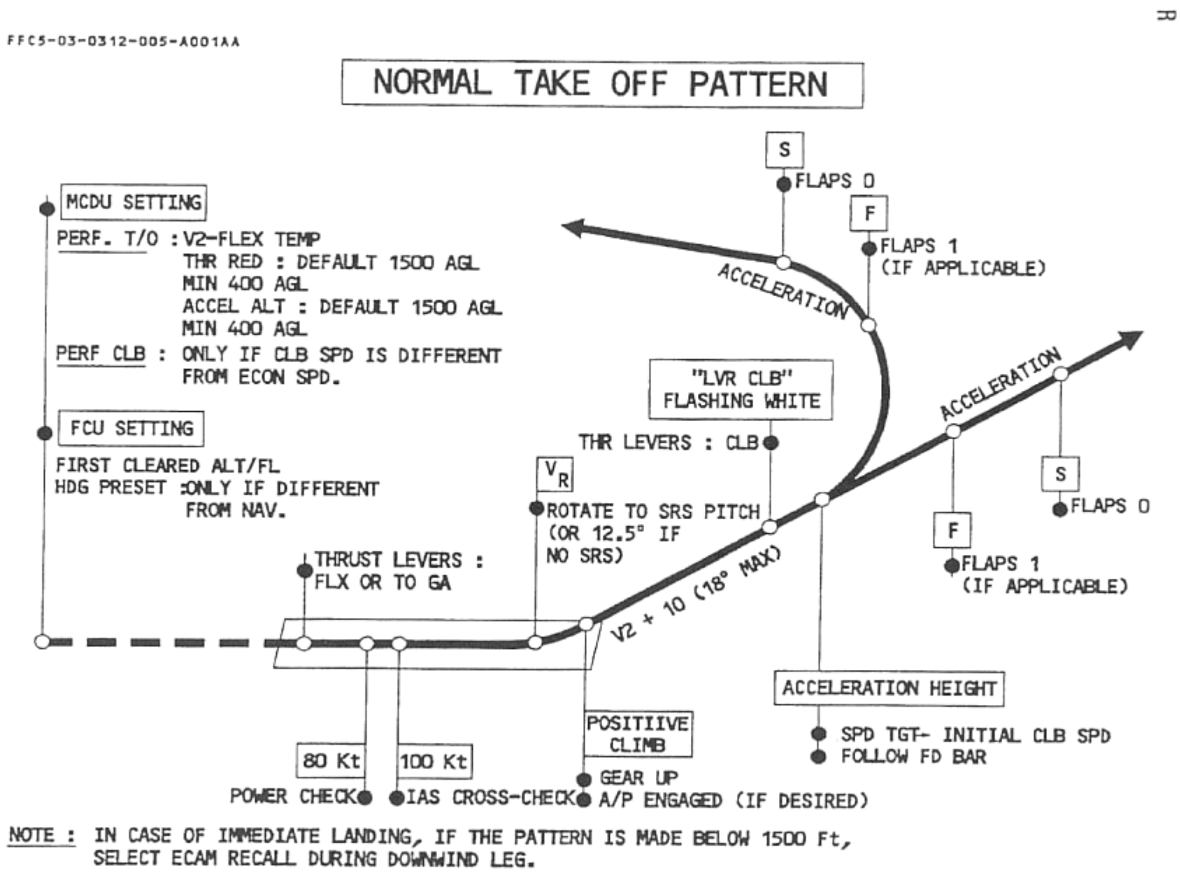
Takeoff Procedure

- BRAKES: RELEASE
  Rolling takeoffs are recommended when possible. They are required when the crosswind is greater than 20 kt to provide engine surge protection.
- THRUST LEVERS: Set 50% N1; when thrust stable set FLX or TO GA
  - PF modulates the thrust as necessary when turning on the runway at the beginning of a rolling TO then sets takeoff power.
  - At engine takeoff power setting apply half forward stick deflection until 80 kt. Release stick progressively to reach neutral at 100 kt.

- DIRECTIONAL CONTROL: USE RUDDER
  For crosswind takeoffs, routine use of aileron into the wind is not recommended. In strong crosswinds, small amounts of lateral control may be used to maintain wing level but care should be taken to avoid using an excessive amount resulting in spoiler deployment which increases the tendency to weathercock into the wind.
- CHRONO: START
- TAKEOFF N1: CHECK
  Check takeoff N1 is set before reaching 80 kts. Check EGT.
- ANNOUNCE: 100 KT
  Below 100 kt the decision to abort the takeoff may be taken according to the circumstances. Above 100 kt, rejecting the TO is a more serious matter.
- ANNOUNCE: V1
- ANNOUNCE: ROTATE
- ROTATION: PERFORM
  - At Vr, rotate the aircraft smoothly using a continuous pitch rate to a pitch attitude of 12.5°.
  - After liftoff follow the SRS pitch command bar. In the event of no FD, select 12.5 pitch.
  - If some lateral control has been applied on the ground, the stick should be centered during rotation so that the aircraft lifts off with a zero roll rate demand.
- ANNOUNCE: POSITIVE CLIMB
  Announce positive climb when the vertical speed indication is positive and the radio altitude has increased.
- ORDER: GEAR UP
- GRND SPLRS: DISARM
- AP: AS RQRD
  Above 100 ft AP 1 or 2 may be engaged.
- ANNOUNCE: FMA
- AT THRUST REDUCTION ALTITUDE (LVR CLB flashing on FMA), SET THRUST LEVERS: CL
  The thrust levers should be moved to the CL detent when the flashing LVR CLB prompt annunciates on the FMA. A/THR is now active. In manual flight, the pitch attitude change must be anticipated to prevent a speed decay at thrust reduction.
- AT ACCELERATION ALTITUDE, ANNOUNCE FMA: CLB/OP CLB
  Check target speed change from V2 + 10 to the first CLB speed (either preselected or managed).
  Note: For most normal operations, the thrust reduction and acceleration altitudes will be the same.

- ABOVE ACCELERATION ALTITUDE (or once in CLB phase), AT F SPEED ORDER: FLAPS 1
- AT S SPEED, ORDER: FLAPS 0
- Note: For high weight, when in CONF 1 + F the slat retraction speed S may be above the VFE of CONF 1 + F (215 kt). When accelerating above 220 kt, the flaps will automatically retract and the VFE will increase to VFE CONF 1 (240 kt).

A340 Normal Take Off Pattern



INITIAL CLIMB IMPROVEMENT PROCEDURES

When the takeoff weight is over 210 t, the following procedure can be used to improve initial climb performance:

Takeoff Data Insertion

Do not select a FLX TO TEMP above the maximum recommended value given in the following table:

MAX. RECOMMENDED FLEX TEMP (°C)					AIR CONDITIONING ON		
AIRPORT PRESS ALT. (FT)	OAT (°C)						
	BELOW 10	15	20	25	30	35	40
0	38	38	38	38	41	45	48
2000	35	35	35	38	42	45	48
4000	31	31	34	38	41	43	46
6000	26	28	32	35	38	40	43

Note: Air conditioning off - add 2°C to the max recommended flex temperature.

When possible, select THR RED ALT = ACCEL ALT.

If MAX TO thrust is used:

- At the thrust reduction altitude, set thrust levers to MCT and disregard LVR CLB flashing on the FMA.
- At 220 kt, set the thrust levers to CL.

If FLEX TO thrust is used:

- At the thrust reduction altitude, maintain FLX TO and disregard LVR CLB flashing on the FMA.
- At 220 kt or 5 minutes after brake release (whichever occurs first), set the thrust levers to CL.

CLIMB

OPT FL and MAX REC FL are displayed on the MCDU PROG page. The displayed MAX REC FL gives at least 0.3 g buffet margin. A cruise FL entry may be made above this level in the MCDU and will be accepted by the FMGS, provided is does not exceed the level at which the margin is reduced to 0.2 g.

If a speed change is required by ATC, or for turbulence or operational considerations, select the new speed with the FCU SPD selection knob and pull. Speed target is now selected. To resume MANAGED SPD profile, push the FCU SPD selection knob. Speed target is now managed.

The best rate of climb speed for long term situations lies between green dot and ECON speed. Acceleration from green dot to ECON speed at high altitude can take a long time. At high altitude, if the rate of climb is not satisfactory using managed speed, selected speed must be used (290 kt/0.79 Mach).

CRUISE
Flight progress must be monitored in the conventional way. When overflying a waypoint, check track and distance to the next waypoint as well as fuel.

Navigation accuracy must be monitored, particularly when any of the following occur:

- GPS PRIMARY LOST is indicated to the crew
- IRS only navigation
- LOW accuracy is displayed on PROG page or
- NAV ACCUR DOWNGRAD message appears

DESCENT PREPARATION
Descent preparation and approach briefing can take approximately 10 minutes, so they should be initiated approximately at 80 NM before top-of-descent.

Check or modify landing configuration (FULL or FLAP 3). Flap 3 as opposed to FLAP FULL may be used for landing at the pilot's discretion subject to runway length available and go around performance. The use of FLAP 3 is recommended if an encounter with windshear is considered possible on the approach or in certain abnormal situations.

Check Vapp and set Vapp on STBY ASI. Vapp is computed as follows:

- Vapp = Vls + 1/3 of head wind component. The wind correction is limited to 5 kt minimum and 15 kt maximum and is derived from the wind entered on the MCDU PERF APPR page. When using selected speed, it is recommended that the same method be used to compute Vapp.

During descent ENG ANTI ICE must be ON when icing conditions are encountered. With engine ANTI ICE ON, the FADEC automatically controls continuous ignition and selects a higher idle schedule which gives better protection against engine flame out. ANTI ICE ON reduces the descent path angle when at idle. It can be compensated for by an increase in descent speed or by extending up to half speed brake.

DESCENT
The normal method of initiating the descent is to select DES mode at the FMGS calculated TOD. If ATC requires an early descent, DES mode is used and will guide the aircraft down with a reduced vertical speed in order to converge with the required descent path. (V/S - 1000 fpm may also be used).

If a rate of descent increase is desired:

- Preferably increase descent SPD (by use of selected speed) if comfort and ATC permit. It is economically better (time/fuel).
- Maintain high SPD as long as possible.
- If the aircraft is high with high SPD, it is more efficient to keep high speed until ALT* and then decelerate rather that to mix descent and deceleration.
- If the aircraft goes below the desired profile, use SPEED V/S mode to adjust rate of descent.

In IDLE OPEN DES, speed brakes may be used to increase the rate of descent. In DES mode, if on or below the flight path, do not use speed brakes since rate of descent is dictated by the planned flight path and the A/THR may increase thrust to compensate for the increase in drag.

ILS APPROACH

Initial Approach

If ATC requires a particular speed, use selected speed. When the ATC speed constraint no longer applies, return to managed speed.

Intermediate/Final Approach (ILS approach entered in the flight plan)

The objective is to be stabilized on the final descent path at Vapp, thrust above idle, with landing configuration at 1000 ft after continuous deceleration on the glide slope. The advantages are:

- Lower fuel consumption
- Lower noise levels
- Time savings

A go around should be considered if the aircraft is not stabilized on the approach and in landing configuration at 1000 ft in instrument conditions, or at 500 ft in visual conditions.

Glide slope interception should be performed in level flight from below the beam at or close to the published minimum interception altitude. This will lower the probability of a pitch up at glide slope capture and reduce its magnitude. Nevertheless, if the glide slope is intercepted from above, select gear down and landing configuration and increase speed up to Vfe if necessary until the aircraft is established on the glide slope.

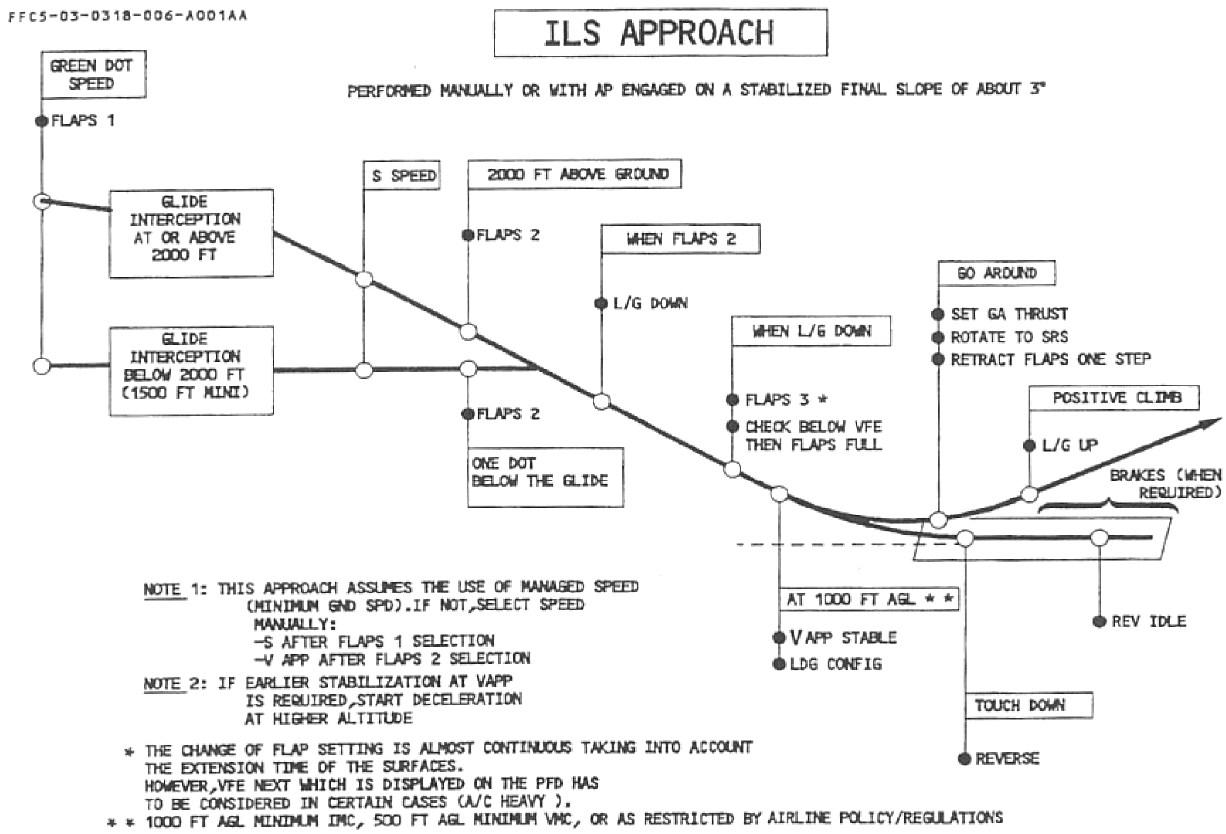
At Green Dot speed, select FLAPS 1. FLAPS 1 should be selected not later than 3 nm prior to the FAF. Check that the aircraft is decelerating towards S speed. The aircraft should reach or be established on the glide slope with FLAP 1 and S speed at or above 2000 ft AGL. In the event that the aircraft speed is significantly higher than S on the G/S, or the aircraft does not decelerate on the G/S, extend the landing gear in order to slow the aircraft down. Use of speed brakes is not recommended as it will cause an unwanted increase in Vls.

At 2000 ft AGL minimum, select FLAPS 2 and check deceleration towards F speed. If the glide slope is intercepted from below 2000 ft AGL, select FLAPS 2 at one dot below the glide slope. In the event that the airspeed is significantly higher than S on the glide slope or the aircraft does not accelerate, extend the gear in order to slow down. Speed brake use is not recommended.

When FLAPS 2, select gear down and arm the ground spoilers. Set autobrakes as required. The use of MAX mode is not recommended. When landing on short or contaminated runways or when operating in low visibility, the use of LOW or MED autobrake is recommended. On a normal length dry runway, the use of the autobrake system is not normally necessary. To save brakes, it is recommended to use reverse thrust until 70 kt (min 60 kt) and brakes as necessary according to the remaining distance.

When landing gear is down, select FLAPS 3. Select FLAPS 3 below Vfe. Then select FLAPS FULL. Check that the A/THR is in speed mode or off. Wing ANTI-ICE should be ON only if severe icing conditions exist.

A340 ILS Approach



NON-PRECISION APPROACH

Approach Guidance

Non-precision approaches can be performed using two different modes:

- Managed - APP NAV FINAL (AP/FD lateral and vertical guidance provided by FM)
- Selected - TRK-FPA (AP/FD lateral and vertical guidance selected by the crew on the FCU)

When the approach is stored in the NAV data base and the NAV ACCURACY check is positive, the managed guidance procedure is recommended. Otherwise, the selected guidance is mandatory.

Approach Speed Technique

The standard approach speed procedure is a stabilized approach using AP/FD and A/THR. This brings the aircraft to intercept the final descent path in the landing configuration and at Vapp. Therefore, Vapp should be inserted as a speed constraint at the FAF. In all cases, the use of managed speed is recommended. If ATC requires a particular speed use selected speed. When the ATC speed constraint no longer applies, return to managed speed.

Initial Approach

If the non ILS approach is stored in the nav data base, the navigation accuracy check will determine the strategy used for final approach (i.e., APP NAV FINAL or TRK-FPA). Monitor the approach using raw data. If the aircraft does not maintain accuracy in managed, revert to selected guidance mode.

Intermediate/Final Approach (Non ILS)
Two techniques may be considered for final approach - the decelerated approach and the stabilized approach.

- The Decelerated Approach - The objective is to be stabilized on the final descent path, thrust above idle with landing configuration at 1000 ft AGL or 800 ft above DH/MDA after continuous deceleration on the approach path. A go around should be considered if the aircraft is not stabilized on the approach and in landing configuration at 1000 ft in IFR conditions or at 500 ft in VFR conditions. This technique can be used when the non ILS approach is in the nav data base and the NAV ACCURACY check is positive. In NAV mode, deceleration will commence at the decel pseudo waypoint.
    - The recommended method:
        - AP should be engaged in APPR mode (FINAL/APP)
        - Use A/THR
        - Use managed speed
        - Select appropriate raw data on ND for monitoring tracking and descent
    - Procedure:
        - Once cleared for the approach, the APPR PB on the FCU is to be pressed when flying towards the FAF. Check APPR NAV engagement, FINAL armed and VDEV scale on PFD.
        - At green dot speed, select FLAPS 1. The aircraft will reach and be established on the pseudo glide slope with FLAPS 1 and S speed at or above 2000 ft AGL. SET the GO AROUND altitude on the FCU.
        - At 2000 ft AGL, set FLAPS 2. If pseudo glide slope is intercepted at or below 2000 ft AGL, select FLAPS 2 before reaching the final descent pseudo waypoint.
        - Refer to standard ILS approach - monitor raw data.
        - At MDA/MDH, continue with landing if visual references are acquired. Set AP to OFF. Go around in no visual reference.
- The Stabilized Approach - The objective is to be stabilized at the FAF at Vapp and to fly the final approach path at Vapp with landing configuration. This technique must be used when the non ILS approach is not in the nav data base or the NAV ACCURACY check is negative.
    - The recommended method:
        - AP should be engaged in TRK/FPA (HDG/V/S)
        - Use A/THR
        - Use managed speed

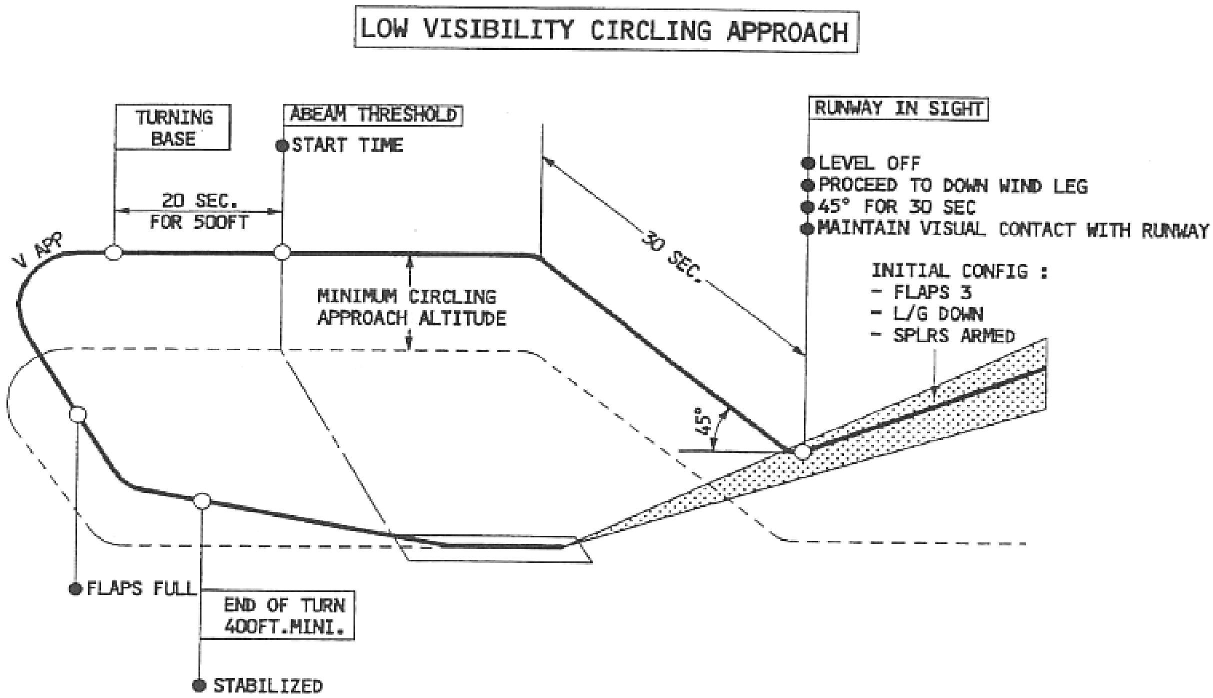
        - Select raw data
    - Procedure:
        - At green dot speed, select FLAPS 1.
        - At S speed, select FLAPS 2.
        - Upon reaching the FAF:
            - Check stabilized at Vapp, landing configuration, gear down
            - Select final approach track on FCU
            - Select FPA to final approach path angle
            - Select go around altitude on FCU
            - Monitor descent profile
        - Upon reaching MDA, if visual references are acquired, set A/P to OFF and continue visually. If no visual reference:
            - Select ALT mode
            - Search for visual references
            - If no visual reference at MAP at the latest, go around

Note:

- When neither the descent gradient is published nor accurate distance to run:
    - When reaching final descent point or FAF, select appropriate FPA or V/S in order to reach MDA slightly before visual descent point (VDP).
    - When reaching MDA, select ALT mode and search for visual references.
- In case of circling:
    - When reaching MDA, select ALT mode and search for visual references. If visual references are sufficient, adjust TRK for downwind. Disengage AP before base leg at the latest if applicable. If no visual references initiate a go around at the MAP.

Circling Approach
A circling approach should be performed in CONFIG 3 with F speed. Reaching MDA, push ALT pushbutton and search for visual references. If no visual reference is in sight, at MAP go around. If sufficient visual references exist, select TRK for downwind. Disengage AP before base leg at the latest if applicable.

A340 Non-Precision Circling Approach



VISUAL APPROACH

Objective

The visual approach uses visual references on a nominal 3 degree glide slope, to be established by 500 ft AGL on the correct approach path, in the landing configuration at Vapp.

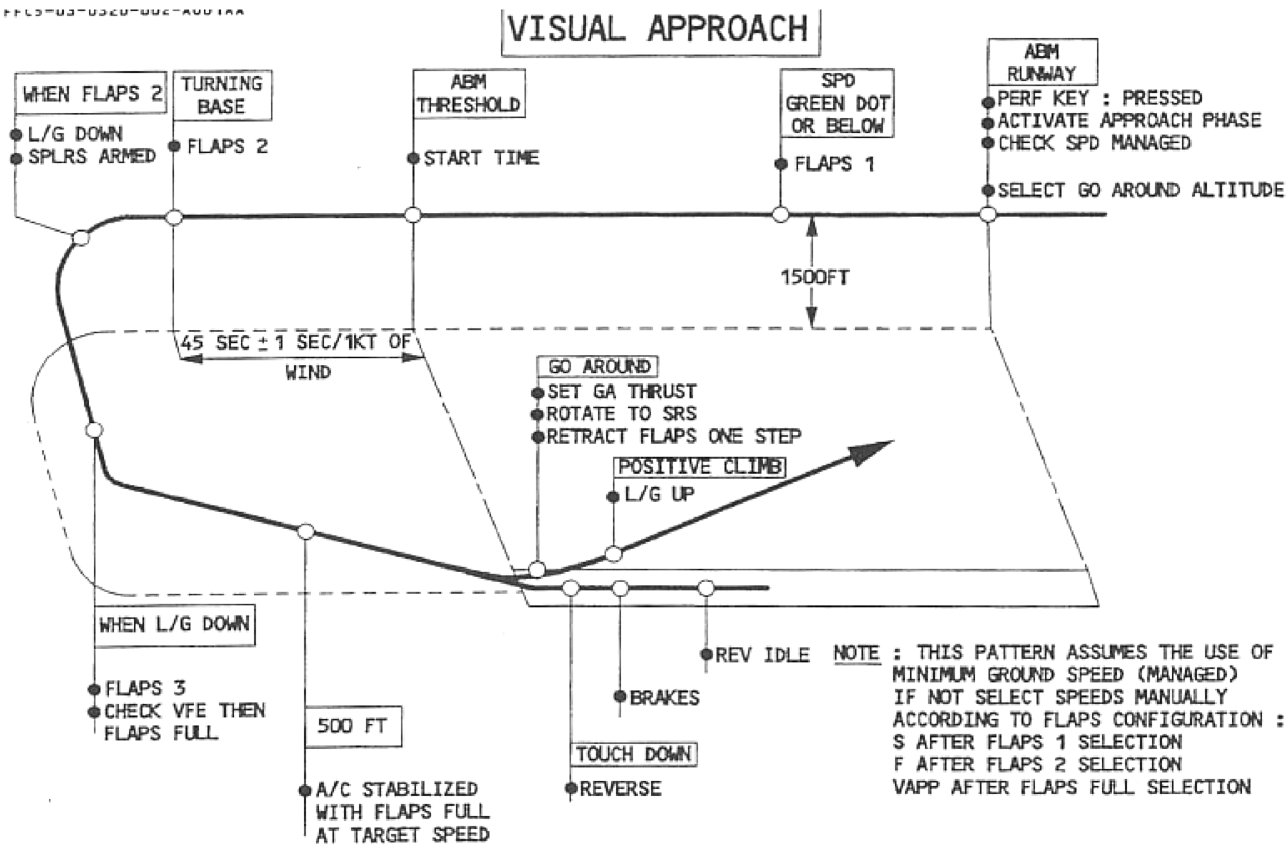
Method:

- The autopilot will not be used.
- Both FDs will be off.
- Use of the FPV is recommended.
- The use of A/THR is recommended with managed speed.

Final Approach

The speed trend arrow and FPV are achieving timely and correct thrust (if in manual thrust) and approach path corrections. Avoid descent through the desired approach path with the throttles at idle. If not stabilized by 500 ft AGL, go around. Avoid any tendency to "duck under" in the latter stages of the approach. Avoid destabilization of the approach in the last 100 ft to give the best chance of achieving a good touch down at the desired position.

A340 Visual Approach



LANDING

Landing Procedures

At about 30 ft, flare the aircraft and reduce the thrust levers to IDLE. Allow the aircraft to touch down without prolonged float. Avoid flaring high. A tail strike will occur if the pitch attitude exceeds:

- 12° (gear compressed), 16° (gear extended) for the A340-200
- 10° (gear compressed), 14° (gear extended) for the A340-300

The wing tip or engine will contact the runway if roll angle exceeds 10°.

Crosswind Landings

Either the forward slip or the decrab method may be used or a combination of them both. The preferred technique is to use the rudder to align the aircraft with the runway heading during the flare whilst using lateral control to maintain the aircraft on the runway centerline.

Derotation

Derotation should be commenced as soon as the main wheels have touched down. In flare law, the A340 will tend to nose down naturally as the aft stick applied for flare is relaxed towards neutral. A good nose wheel touchdown will be obtained if the stick is maintained just aft of neutral during derotation.

Reverse Thrust
Obtain idle reverse thrust at main landing gear touchdown. When REV green is indicated on the ECAM, select MAX REV. An interlock system on reversers 1 and 4 prevents the two thrust levers from being increased above idle reverse until both 1 and 4 reverser doors are fully open. Reversers 2 and 3 can be selected immediately. It is recommended to select idle reverse thrust at 70 kt (minimum is 60 kt). Stow the reversers when taxi speed is reached and before leaving the runway.

Brakes
The nose wheel should touchdown without undue delay if the MED autobrake position is selected. There is no limitation on commencing braking before nose wheel touchdown if required, but when comfort is the priority it should be delayed until nose wheel touchdown. Before 20 kt, disengage the autobrake system.

AFTER LANDING

Flaps
Set FLAP lever to 0. If the approach was made in icing conditions or if the runway was contaminated with slush or snow, do not retract the flaps until after engine shutdown and the ground crew has confirmed them clear of obstructing ice.

Engines
Following high thrust operation, such as maximum reverse thrust during landing, it is recommended that the engines be operated at idle for 3 minutes prior to shutdown to thermally stabilize the engine hot section. Operating time at idle, such as taxiing, is included in this 3 minute period. If operational requirements dictate, the engines may be shut down after a one minute cooling period.

SUPPLEMENTARY TECHNIQUES

OPERATING SPEED DEFINITIONS

General
For a conventional aircraft, the stall speed which is used for reference is VSmin based on a load factor lower than 1g, which gives a stalling speed less than the speed obtained at 1g (but not less that 94% of Vs1g). All operating speeds are expressed relative to this speed (for example, Vref = 1.3 Vsmin).

Since the A340 incorporates a low speed protection feature (alpha limit) which cannot be overridden by the flight crew, the airworthiness authorities have reconsidered their position regarding the stall speed definition. All the operational speeds have been referenced to a speed which can be demonstrated by flight test. This speed is Vs1g and a factor 0.94 has been agreed to represent the relationship between Vs1g for A340 and Vsmin for previous aircraft types. As a result, the A340 is allowed the following factors:

- V2 = 1.2 x 0.94 Vs min = 1.13 Vs1g
- Vref = 1.3 x 0.94 Vs min = 1.23 Vs1g

These speeds are identical to those that would have been achieved had the A340 been conventionally certificated to the 94% rule. Compared to a conventional aircraft, the A340 has exactly the same maneuver margin at its reference speeds. ***In the Flight Crew Operating Manual (FCOM), Vs1g will be designated Vs.***

Symbology and Definitions

- Vs: Reference stalling speed (equal to Vs1g)
- Vmcg: Minimum control speed on the ground from which a sudden failure of the critical engine can be controlled by use of the primary flight controls only, the other engines remaining at takeoff power.
- V1: The latest speed at which the decision must be made to either continue the takeoff or to stop the aircraft.
- Vr: The speed at which rotation is initiated to reach V2 at an altitude of 35 ft after an engine failure.
- V2: Takeoff safety speed reached before an altitude of 35 ft with one engine failed and maintained during the 2nd segment phse of climb. Minimum value for V2 is equal to 1.13 Vs of the corresponding configuration.
- Vmca: The minimum control speed in flight at which the aircraft can be controlled with 5° max bank in case of the failure of one engine, with the other engines remaining at takeoff power. Flaps at takeoff setting and gear retracted.
- F: The minimum speed at which the flaps may be retracted to CONF 1. Corresponds to approximately 1.18 Vs of CONF 1+F.
- S: The minimum speed at which the slats may be retracted to CONF 0. Computed by the FMGC, corresponds to approximately 1.23 Vs of CONF 0.
- 0 (Green Dot): This is the engine out operating speed (best lift to drag ratio speed or drift down speed) in clean configuration. It is also the final takeoff speed. It varies according to weight and altitude. It corresponds to 115 + 0.6 W (in tons) + 1kt/1000 ft above FL200 with all engines operative.
- Vfe: The maximum speed for each flaps and/or slats configuration.
- Vref: Reference speed used for a normal final approach. It is equal to 1.23 Vs of configuration FULL.
- Vls: Lowest selectable speed. it is represented by the top of an amber strip along the airspeed scale. Vls is computed according to the actual slats/flaps position. It is equal to 1.13 Vs during the takeoff or following a touch-and-go. It becomes 1.18 Vs as soon as flaps are retracted, then 1.23 Vs when slats are retracted. It remains at this value until landing. Vls is corrected when speed brakes are extended. At takeoff, Vls is limited to 1.05 Vmca. Vls is corrected for Mach effect to maintain 0.3g buffet margin.
- Vmcl: Minimum control speed in flight at which the aircraft can be controlled with the critical engine failed in approach configuration. On the A340-300:
    - C2/C3 engines, Vmcl = 121 kt
    - C4 engines, Vmcl = 125 kt

  On the A340-200:

- C2/C3 engines, Vmcl = 124 kt
- C4 engines, Vmcl = 128 kt

- Vapp: This is the final approach speed. The minimum value is Vls. The minimum value for Autoland or autothrottle engaged is Vls + 5 kt. The minimum value in icing conditions is Vls + 5 kt. The maximum value is Vls + 15 kt. The value displayed on the MCDU APPR page is calculated by the FMGC as follows: Vapp = Vls (selected config) + 1/3 of headwind component. The wind correction is limited to 5 kt minimum and 15 kt maximum. If the Vls is not shown on the PFD, the approach speed is given in the quick reference handbook with regard to Vref (Vls CONF FULL). Vapp = Vls + any increment given by procedure. However, wind correction may be added up to a maximum of 20 kt additional speed (wind correction + abnormality increment) on Vls CONF FULL.
- Vapp Target: Calculated by the FMGC, Vapp Target = GS minimum + actual headwind (measured by ADIRS) with GS minimum = Vapp - TOWER WIND (headwind component on runway axis calculated by FMGC from tower wind entered on MCDU).
- Vsw: Stall warning speed. It is represented by a red and black strip along the speed scale when the flight controls normal law is inoperative. It is equal to 1.05 Vs of the present configuration. At high altitude it also gives a margin of not less than 1° angle of attach to buffet onset.

FLIGHT CONTROLS

General
The fly-by-wire (FBW) system for the A340 has been designed and certificated to make the new generation of aircraft more cost effective and smoother to fly than a conventional aircraft.

A340 On Ground
The side sticks have full authority over the controls in pitch and roll while on the ground. Nose wheel steering is also FBW with no mechanical connection between the nose wheel and the steering tiller. The forces are light and care should be taken initially to make gentle movements on the tiller to avoid unnecessarily high rate turns. Very tight turns can be made but a tendency to over control initially may be noticed.

A340 In Flight, Takeoff Mode
Takeoff is very conventional. Side stick position may be monitored by use of the PFD stick position indicator. Apply half forward stick deflection until 80 kt.

Thrust management is very easy. Select a FLX thrust by stopping the thrust levers in the FLX/MCT detent and check that the N1 achieved is compatible with the N1 target. MAX TO power is achieved with the thrust levers fully forward.

Rotation is conventional. After lift off, the control laws will change to the flight mode; the change in roll is quick and therefore it is important that any lateral control applied during the ground roll is neutralized during rotation. Pitch trim can begin to work at 50 ft.

A340 In Flight, Flight Mode
The normal condition is side stick neutral with the aircraft, in the short term, stable in pitch and roll in straight or turning flight within certain limits. As a result, the A340 is best flown with little or no stick input. Hands off, the system maintains 1g in pitch, corrected for pitch and roll

attitudes and zero roll rate in the lateral axis within certain limits (+ 30°, -15° of pitch and ±33° of roll). With hands off, within these limits, the A340 will be resistant to disturbance from the atmosphere and will ride well even in heavy turbulence.

Changes of trim due to speed and configuration are almost totally compensated. The pitch trim wheel will be seen moving as the control law compensates for these changes.

Turning is also made easier as a result of the control laws. First, there is protection against over banking and second, at the chosen bank attitude (less than 33° of bank), the system will maintain zero roll rate, stick free. Steep turns can be made up to 67° of bank. This is the bank angle limit chosen because it is just possible to maintain level flight at 2.5g at 67° of bank. Beyond 33° of bank, the pitch trim stops working and a lateral stability term is introduced. This term become progressively stronger with bank angle so that it is equal to full side stick demand at 67° of bank, hence forming the limiting system. Because there is no pitch trim compensation beyond 33° of bank, it is necessary to hold the nose up in a steep turn. If the stick is released, the nose will drop and the aircraft will roll out to less than 33° of bank and stabilize at whatever pitch and bank angle it achieves at less than 33° of bank.

A340 Landing Mode
The landing mode has been developed to give a conventional flare and touch down. At 100 ft, the normal flight law is changed to the flare law: a form of direct law compensated for CG and for certain pitching effects so that the pilot has to make a progressive pull to maintain a gently increasing attitude in the flare. The thrust levers should be retarded at or above 20 ft and landing should be made without a long flare.

Crosswind landings are very conventional. Either wing down or kick off drift techniques can be utilized. Lateral control mode does not change until the wheels are on the ground and so that there is no control law discontinuity. The aircraft tends to roll gently in the conventional sense as drift is reduced. Some lateral control may be needed to maintain the desired roll attitude.

Even during approach in considerable turbulence, the control system will resist the disturbances quite well without pilot inputs. In fact, one should try to limit ones control inputs to those necessary to correct the flight path trajectory and leave the task of countering air disturbances to the flight control system. Pitch trim will reset to 5 after the transition to ground law, which happens 5 seconds after the ground condition is confirmed.

A340 Protection Systems

- Attitude Limits - Bank limiting is provided at 67°, this corresponds to approximately the bank angle needed for a level 2.5g turn. Pitch attitude is limited to + 30° and - 15°. The + 30° limit is reduced at low speed to 25°. If these limits are approached, the aircraft pitch and roll rate will start to decrease some 5° before the limit so that it will stop at the limit without overshooting.

- Maneuver Limit - The 2.5g limit (2g slats extended) is provided to allow adequate maneuvering without structural risk should an avoidance maneuver become necessary. In this instance (GPWS operation for example) the pilot should rapidly apply full control and hold it until a safe flight path is assured so as to have the maximum capability of the aircraft.

- Overspeed Protection - The aircraft will recover on its own if it is disturbed nose down. As speed exceeds a threshold of Vmo + 6 kt or Mmo + 0.01, the pitch trim is frozen, the bank limit for lateral stability is reduced to wings level and the bank limit reduced to 40°. As speed further increases, the nose down authority is gently reduced to zero at about Vmo + 16 kt or Mmo + 0.04. Beyond this speed, a nose up recovery is introduced which the pilot cannot resist. The flight path will recover to Vmo/Mmo.

- Stall Protection - If a stall is attempted as speed approaches the amber and black barber's pole, the aircraft will be felt to want to pitch down. This tendency can be resisted until speed reaches the red band when further nose up control is not available. Between these two points, thrust will have been added automatically by alpha floor to GA thrust. Full back stick can be maintained if needed (see windshear) and the aircraft will stabilize at an angle of attack close to, but before, the 1g stall. When flying at alpha max, gentle turns can be made if necessary.

- Windshear - Windshear can be survived only if the aircraft has sufficient energy to carry it through the loss of performance field. This can be achieved in 3 ways:

    - Carry extra speed - the A340 does this automatically in some cases (i.e., managed speed)

    - Add maximum thrust - the A340 does this automatically when alpha floor engages

    - Trade height energy for speed as with any aircraft

  Added to this is pilot technique. Follow SRS orders, even if full back stick is needed to do so. At this stage, maintain full back stick until the shear is passed. The A340 will hold close to the maximum angle of attack automatically.

ICE AND RAIN PROTECTION

Icing Conditions
Extended flight in icing conditions with slats extended should be avoided. In case of suspected significant ice accumulation on non de-iced parts, increase the approach speed by 5 kt and multiply landing distance by 1.1. In case of suspected significant ice accumulation on de-iced parts (WING ANTI-ICE inop) increase the approach speed by 10 kt and multiply landing distance by 1.2.

ELECTRONIC INSTRUMENT SYSTEM

Use of Flight Path Vector (FPV)
The FPV is an indicator of performance and not a director or a command. Because there is always a slight lag between an attitude change and the change in flight path that results from it, an attitude change should first be made and then the resulting flight path can be checked using the FPV.

POWER PLANT

Manual Thrust Control
With autothrust deactivated, thrust control between idle and maximum takeoff or go around thrust is entirely conventional. Thrust lever angle determines the thrust demanded. With the thrust levers positioned in a detent (CL or MCT/FLEX), the engines will be controlled to that limiting parameter.

Autothrust
With autothrust active either speed, thrust or retard will be controlled as appropriate. The engine limit corresponds to the thrust lever position. If the thrust levers are below the CL detent, then the TLA determines the engine power limit. With all thrust levers above the CL detent, autothrust is deactivated, except if alpha floor is active.

Use of Autothrust During Approach
Use of autothrust on final approach will usually give more accurate speed control, but be aware that in turbulent conditions the actual airspeed may vary by up to +/- 5 kt from the target speed. When using autothrust for the final approach, it is recommended to keep A/THR engaged until the thrust levers are placed at idle for touchdown. If the landing is to be made using manual thrust, it is recommended to disconnect the A/THR by 1000 ft.

If a shallow flare is made with A/THR engaged, the thrust will be increased to maintain the approach speed until the thrust levers are placed at idle. Thus, avoid a shallow flare and/or retard the thrust levers early before the "retard" reminder is given, assuming it is no longer necessary to carry thrust.

TWO ENGINE TAXI

General
Except in some operational environments, such as an uphill slope, slippery taxiways or high gross weight, taxi on two engines may be preferred. Caution must be exercised when taxiing on two engines to avoid excessive jet blast. It is recommended to taxi with the outer engines to pressurize the green hydraulic system to permit normal operation of the braking and nose wheel steering systems.