Control your Speed… During Descent, Approach and Landing

This article is the conclusion of our theme of speed management during a flight, which began in Safety first Issue #18. We are entering into the descent phase. Our objective is to cover descent from cruise altitude down toward the destination airport and prepare the aircraft for its approach and landing.

This article aims to highlight how the reference, limit and operating speeds are useful during descent, approach and landing.
It also provides a description of the tools that are available and operational recommendations on how to manage the aircraft energy during the last phases of flight.

Energy management, and as a consequence speed management, is critical during descent, approach and landing phases. An aircraft flying at cruise altitude, and at its cruise speed, has a lot of energy to dissipate before reaching its destination airport and to land with an appropriate speed. Incorrect management of the speed in descent can result in excess-energy in final approach phase. This is shown to be a major cause of runway overrun events.

MANAGING YOUR DESCENT, APPROACH AND LANDING: UNDERSTAND SPEEDS

Maneuvering speeds

As for the previous flight phases, Green Dot, S and F speeds guide the flight crew during descent and approach phases.

Green Dot (GD) speed

» Definition

GD speed **(fig.1)** is the engine-out operating speed in clean configuration. It provides an estimate of the speed for best lift-to-drag ratio.

GD speed is the managed speed target in CONF CLEAN when the FMS approach phase is activated. It is also the recommended speed to extend flaps to CONF 1 and for a holding in clean configuration.

» How is GD speed determined?

The Auto Flight System (AFS) computes GD speed using the aircraft weight, based on the Zero Fuel Weight (ZFW) entered in the FMS during flight preparation, and the pressure altitude. The GD formula has been set up so that the resulting airspeed provides the best lift-to-drag ratio for a given altitude and aircraft weight, in clean configuration with one engine out.

In some phases of flight, GD is computed to minimize drag and thus, the fuel consumption (for example during the HOLD phase).

> " Green dot is the managed speed target in CONF CLEAN when the FMS approach phase is activated. "
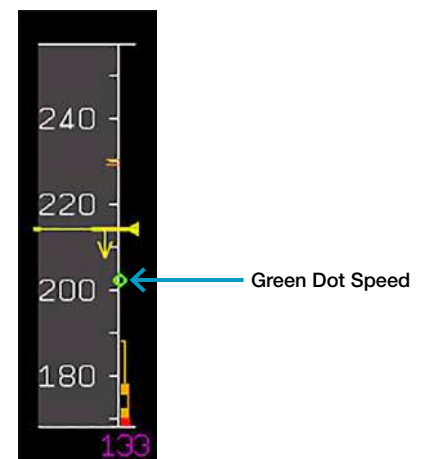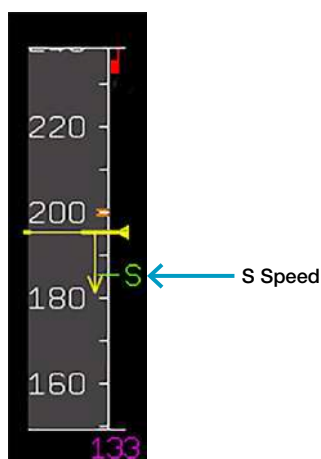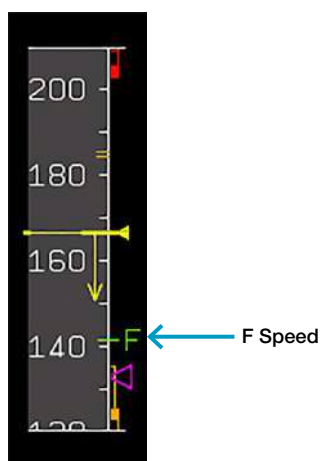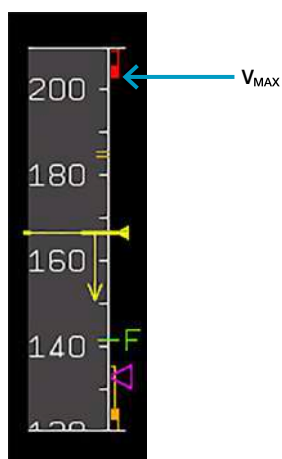

(fig.1)
Green Dot speed on the PFD speed scale

(fig.2)
S speed on the PFD speed scale

(fig.3)
F speed on the PFD speed scale

(fig.4)
V_{MAX} speed on the PFD speed scale

S and F speeds

≫ Definition

S speed:
In approach phase, S speed is the managed speed target, when in CONF 1 or 1+F. It is the recommended speed to select CONF 2.

It is displayed as a green "S" on the PFD airspeed scale **(fig. 2)** and shown only when the Slats/Flaps control lever is on position 1 (CONF 1 or 1+F).

F speed:
In approach phase, F speed is the managed speed target, when in CONF 2 or 3. It is the recommended speed to select CONF 3 when in CONF 2, and to select CONF FULL when in CONF 3.

It is displayed as a green "F" on the PFD airspeed scale **(fig. 3)** and shown only when the Slats/Flaps control lever is in CONF 2 or 3 during the approach phase and go-around.

≫ How are S and F speeds determined?

S and F speeds are obtained using the Stall speed of the corresponding configuration (V_{s1g}) demonstrated during flight tests multiplied by a specific factor depending on the aircraft type. Margins are kept with the Minimum Control speed at Landing (V_{MCL}) determined during flight tests, and with the maximum speed with Flaps Extended of the next configuration ($V_{FE\ NEXT}$):

$$S \text{ or } F = V_{S1G} \text{ x factor}$$

$$S = k \text{ x } V_{S1G\ CLEAN} \text{ with } 1.21 \leq k \leq 1.23$$

$$F_{CONF2} = k \text{ x } V_{S1G\ CONF\ 2} \text{ with } 1.38 \leq k \leq 1.47$$

$$F_{CONF3} = k \text{ x } V_{S1G\ CONF\ 3} \text{ with } 1.32 \leq k \leq 1.36$$

Limit Speeds

During descent, approach and landing, the operation of the aircraft is also framed within limit speeds. Their indication on the PFD or on a placard enables the flight crew to easily identify the aircraft speed envelope.

V_{MAX}: Maximum speed

≫ Definition

V_{MAX} is the maximum speed defining the aircraft's flight envelope. V_{MAX} is equal to:

- V_{MO}/M_{MO} in clean configuration with landing gears up.
- V_{FE} in high lift configurations with landing gears up.
- V_{LE}/M_{LE} in clean configuration with landing gears down.
- The minimum of V_{FE} and V_{LE}/M_{LE} in high lift configurations with landing gears down.

On the PFD airspeed scale, it corresponds to the lower end of the red and black strip **(fig.4)**.

V$_{MO}$/M$_{MO}$: Maximum Operating speed/Mach number

>> **Definition**

In CONF CLEAN, V$_{MO}$/M$_{MO}$ is the higher limit of the aircraft speed envelope.

>> **How is V$_{MO}$/M$_{MO}$ determined?**

V$_{MO}$/M$_{MO}$ is derived from the design limit Mach/speed V$_D$/M$_D$ by applying a margin related to aircraft dive characteristics. For more details on V$_{MO}$/M$_{MO}$ determination, refer to the Safety first issue 21 dated January 2016.

V$_{FE}$: maximum speed with the Slats/Flaps extended

>> **Definition**

V$_{FE}$ is the maximum speed with the slats or flaps extended.

There is one V$_{FE}$ per configuration.

The V$_{FE}$ is displayed on the airspeed scale of the PFD as the V$_{MAX}$ **(fig. 5)** when the Slats/Flaps are extended, based either on the Slats/Flaps lever position or the actual Slats/Flaps position.

(fig.5)
V$_{FE}$ speed on the PFD speed scale

Aircraft	A320 A330/A340*	A340-500/600	A350/A380
V$_{FE}$ PFD display based on:	Slats/Flaps lever position	Actual Slats/Flaps position	**For retraction:** Actual Slats/Flaps position **For extension:** Slats/Flaps lever position

(fig.6)
Table showing source of information for V$_{FE}$ display on PFD

* A340-200/300.

The V$_{FE}$ of each Slats/Flaps configuration is also available on the speeds placard in the cockpit.

>> **How is V$_{FE}$ determined?**

The V$_{FE}$ is based on the structural limit speed of the Slats/Flaps configuration plus a margin. It is a fixed value associated to the aircraft model.
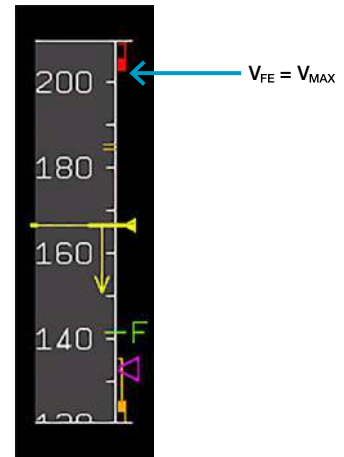
V$_{FE\ NEXT}$

>> **Definition**

The aim of the V$_{FE\ NEXT}$ is to remind the flight crew the maximum speed at which they can extend the next Slats/Flaps configuration during approach.

V$_{FE\ NEXT}$ is displayed on the airspeed scale of the PFD **(fig. 7)**.

V$_{FE\ NEXT}$ is displayed in flight, below FL200 (FL220 on A350).
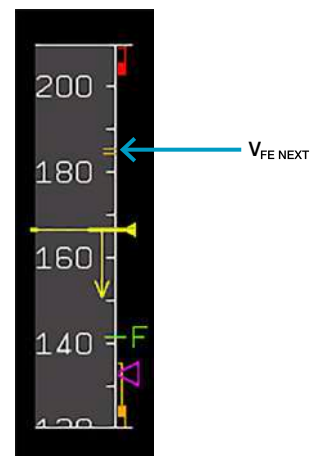
>> **How is VFE determined?**

V$_{FE\ NEXT}$ is the V$_{FE}$ of the next Slats/Flaps configuration.

(fig.7)
V$_{FE\ NEXT}$ speed on the PFD speed scale

(fig.8)
Example of speed placard on the A380

> ❝ Since Speedbrakes extension increases V_{s1g}, V_{LS} increases when the speedbrakes are extended. ❞
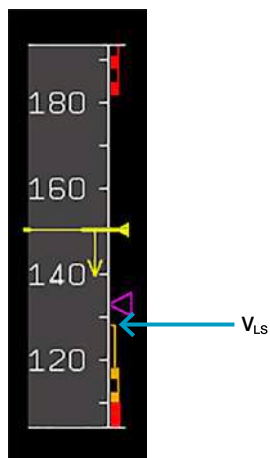
(fig.9)
V_{LS} speed on the PFD speed scale

V_{LE}/M_{LE}: Landing gear Extended speed/Mach

≫ Definition

V_{LE}/M_{LE} is the maximum speed/Mach at which the aircraft can fly with the landing gear extended.
V_{LE}/M_{LE} is displayed on the airspeed scale of the PFD as the V_{MAX} when the landing gear is extended as long as V_{LE}/M_{LE} is lower than V_{FE}. It is also available on the speeds placard in the cockpit **(fig. 8)**.

≫ How is V_{LE} determined?

V_{LE} is determined to provide sufficient flight domain with landing gear extended, taking into account the structural limitation of the landing gear and landing gear doors.

V_{LO}/M_{LO}: Landing gear Operating speed/Mach

≫ Definition

V_{LO}/M_{LO} is the maximum speed/Mach to operate (both extend and retract) the landing gear.
V_{LO}/M_{LO} is not displayed on the PFD; it is available on the speeds placard in the cockpit **(fig. 8)**.

≫ How is V_{LO}/M_{LO} determined?

V_{LO}/M_{LO} is determined to provide sufficient flight domain for landing gear extension/retraction, taking into account the structural limitation of the landing gear and landing gear doors.

V_{LS}: Lowest Selectable Speed

≫ Definition

V_{LS} is the lowest selectable speed for the autopilot and the autothrust. Even if the selected target speed is below V_{LS}, the A/THR will maintain V_{LS} as a minimum. V_{LS} is indicated by the top of the amber strip on the PFD airspeed scale **(fig. 9)**.

V_{LS} (of selected landing configuration: CONF 3 or FULL), is also displayed on the FMS APPR page.

≫ How is V_{LS} determined in descent and approach?

For descent and approach flight phases, V_{LS} of Fly-By-Wire aircraft is obtained using the Stall speed demonstrated during flight tests (V_{S1G}) of the corresponding configuration, multiplied by a factor of 1.23. On A320 family aircraft, the factor may be increased for some Slats/Flaps configurations for manoeuvrability improvement and/or to increase margins with protection speeds. V_{LS} is always greater or equal to the Minimum Control Speed at Landing (V_{MCL}).

$$\text{FBW aircraft (except A320 family): } V_{LS} = 1.23 \times V_{S1G}$$

$$\text{A320 family: } V_{LS} = k \times V_{S1G} \text{ with } 1.23 \leq k \leq 1.28$$

$$V_{LS} \geq V_{MCL}$$

Since Speedbrakes extension increases V_{s1g}, V_{LS} increases when the speedbrakes are extended.

Operating Speeds

ECON DES speed/Mach

» Definition

ECON DES speed/Mach is the optimum descent speed/Mach to lower the direct operating costs of the descent.

» How is ECON DES speed/Mach determined?

ECON DES speed/Mach is computed by the FMS based on the Cost Index (CI), cruise FL and on the aircraft weight.

V_{APP}: Approach speed

» Definition

V_{APP} is the final approach speed when the Slats/Flaps are in landing configuration and the landing gears are extended.

V_{APP} is displayed in the FMS PERF APPROACH page.

» How is V_{APP} determined?

The V_{APP} can be computed by the AFS or inserted manually by the pilot through the FMS PERF Page.

V_{APP} is based on the V_{LS} of the landing configuration. For Airbus aircraft, in normal operations, the V_{APP} is defined by:

$$V_{APP} = V_{LS\ Landing\ CONF} + APPR\ COR$$

AFS Computation of V_{APP}

When computed by the AFS, the APPRoach CORrection (APPR COR) used by the AFS is

$$APPR\ COR = 1/3\ Headwind\ with\ 5kt \leq APPR\ COR \leq 15\ kt$$

Excepted on some older A320 aircraft where the APPR COR used by the AFS is 1/3 Headwind + 5kt, limited at 15kt.

VAPP Computation by the Flight Crew

The flight crew can chose to insert any V_{APP} by computing its own APPR CORR as follows:

APPR COR = highest of:
- **5kt if A/THR is ON**
- **5kt if ice accretion (10kt instead of 5kt on A320 family when in CONF 3)**
- **1/3 Headwind excluding gust**
- **Flight crew speed increment (*)**

with APPR COR ≤15 kt

During autoland or when A/THR is ON or in case of ice accretion or gusty crosswind greater than 20kt, V_{APP} must not be lower than V_{LS} + 5kt.

> ECON DES speed/Mach is the optimum descent speed/Mach to lower the direct operating costs of the descent.

(*) In some situations (e.g. gusty conditions or strong crosswind), the flight crew may choose a higher V_{APP} than the AFS computation as good airmanship.

V$_{APP}$ in the case of a system failure

In the case of a system failure during flight, the flight crew computes a new V$_{APP}$ value:

$$V_{APP} \text{ System Failure} = V_{REF} + \Delta V_{REF} + APPR\ COR$$

$$\text{With } V_{REF} = V_{LS\ CONF\ FULL}$$

ΔV_{REF} is the speed increment related to the failure to counter associated handling qualities issues and/or increased stall speed.

APPR COR depends on the ΔV_{REF}, the ice accretion, the headwind value and the use of autothrust.

For more information on the determination of V$_{APP}$ with failure by the flight crew, refer to the Flight Crew Techniques Manual (FCTM). ■

> " The FMS can compute an accurate and optimized descent profile, provided the descent winds have been entered in the FMS during the descent preparation, and provided the PERF and IDLE factors are tuned according to the actual aircraft performance. "

MANAGING SPEED DURING DESCENT

The descent profile computed by the Flight Management System (FMS) is a very efficient and useful tool to help the flight crew in managing the aircraft energy during the descent and approach phases.

Descent Profile Computation

The FMS can compute an accurate and optimized descent profile, provided the descent winds have been entered in the FMS during the descent preparation, and provided the PERF and IDLE factors are tuned according to the actual aircraft performance.

To locate the Top of Descent (T/D), the FMS computes the descent profile backwards from the Missed Approach Point (MAP) , assuming the aircraft is stabilized at its VAPP 1000ft above the runway elevation, up to the T/D.

The FMS assumes the use of managed speed and accounts for all the speeds and altitude constraints coded on the FMS flight plan. Refer to **(fig.10)**.

During the descent, approach and landing the managed speed is equal to either:

- ECON DES speed or the descent speed manually entered in the PERF DES page of the FMS, or
- The speed constraint, or
- The manoeuvring speed of the current aircraft configuration, or
- V_{APP}.
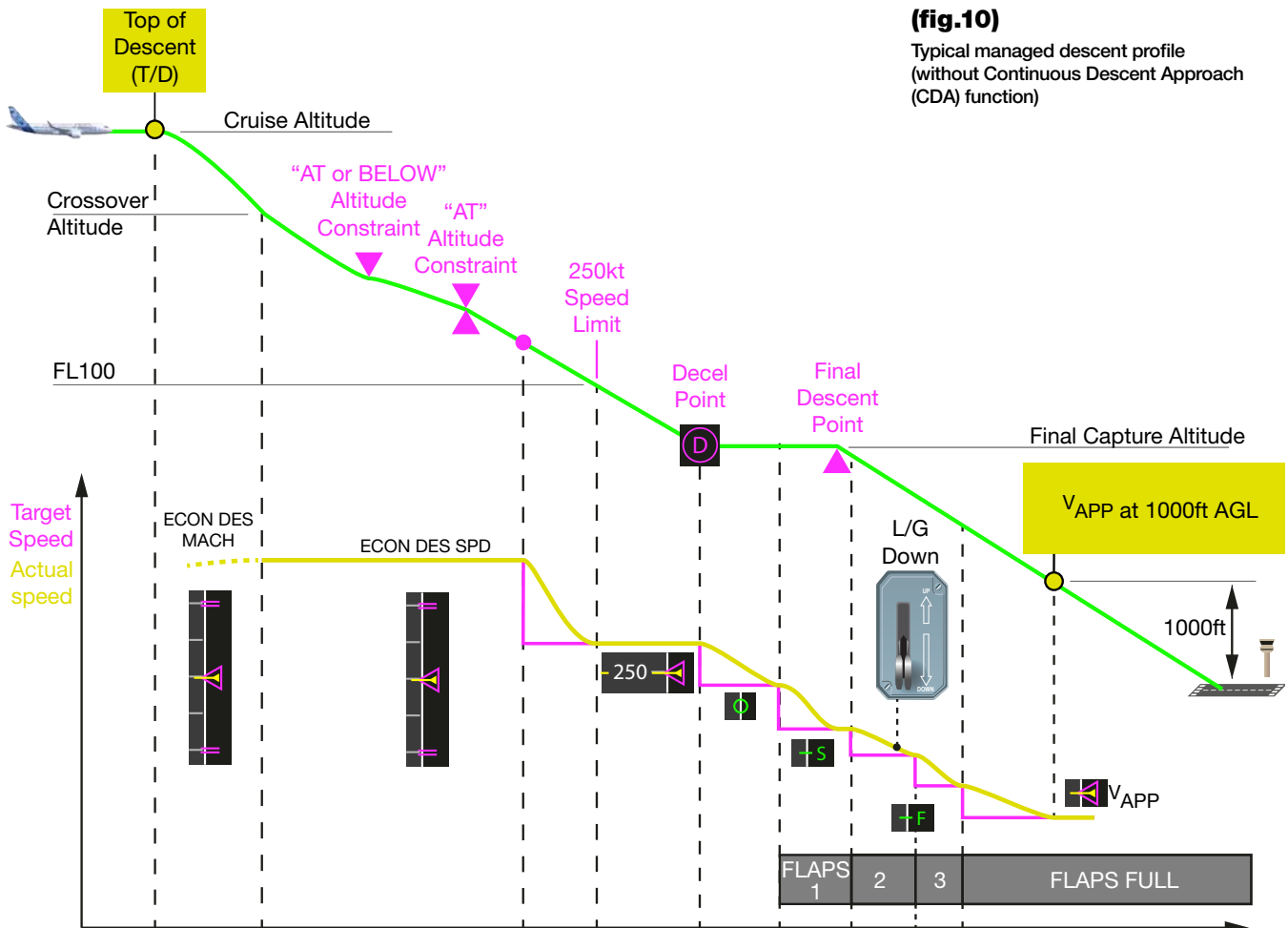
(fig.10)

Typical managed descent profile (without Continuous Descent Approach (CDA) function)

IMPACT OF THE WIND ON THE DESCENT PATH

The descent path computed by the FMS uses the forecasted wind entered in the DESCENT WIND page. However, in flight, actual conditions may vary from the predicted ones. As a consequence, the difference between the predicted descent wind and the actual wind (Δ_{wind}) affects the aircraft's behavior. If the speed target is maintained (as in OP DES mode), the aircraft tends to leave the FMS computed idle path **(fig.11)**.
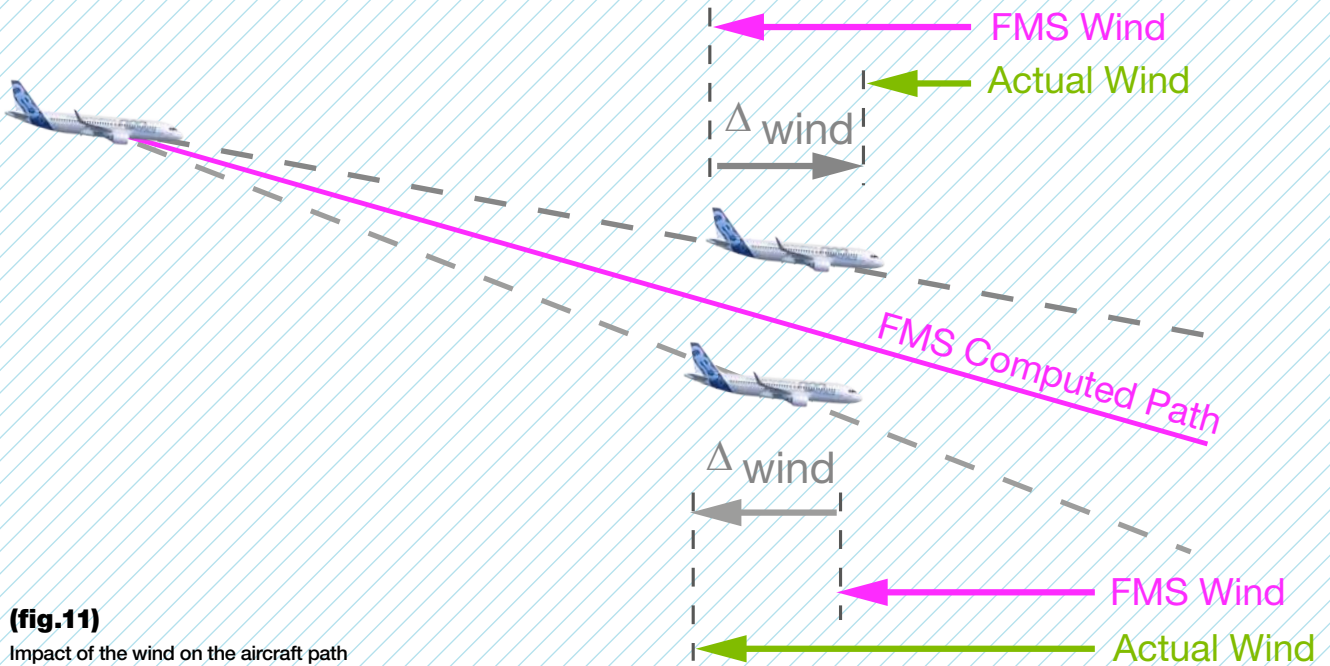
(fig.11)

Impact of the wind on the aircraft path

Managed Descent (DES)

The managed descent mode guides the aircraft along the FMS computed vertical flight path. The DES mode is preferred when conditions permit since it ensures the management of altitude constraints and reduces the operating cost when flying at ECON DES speed.
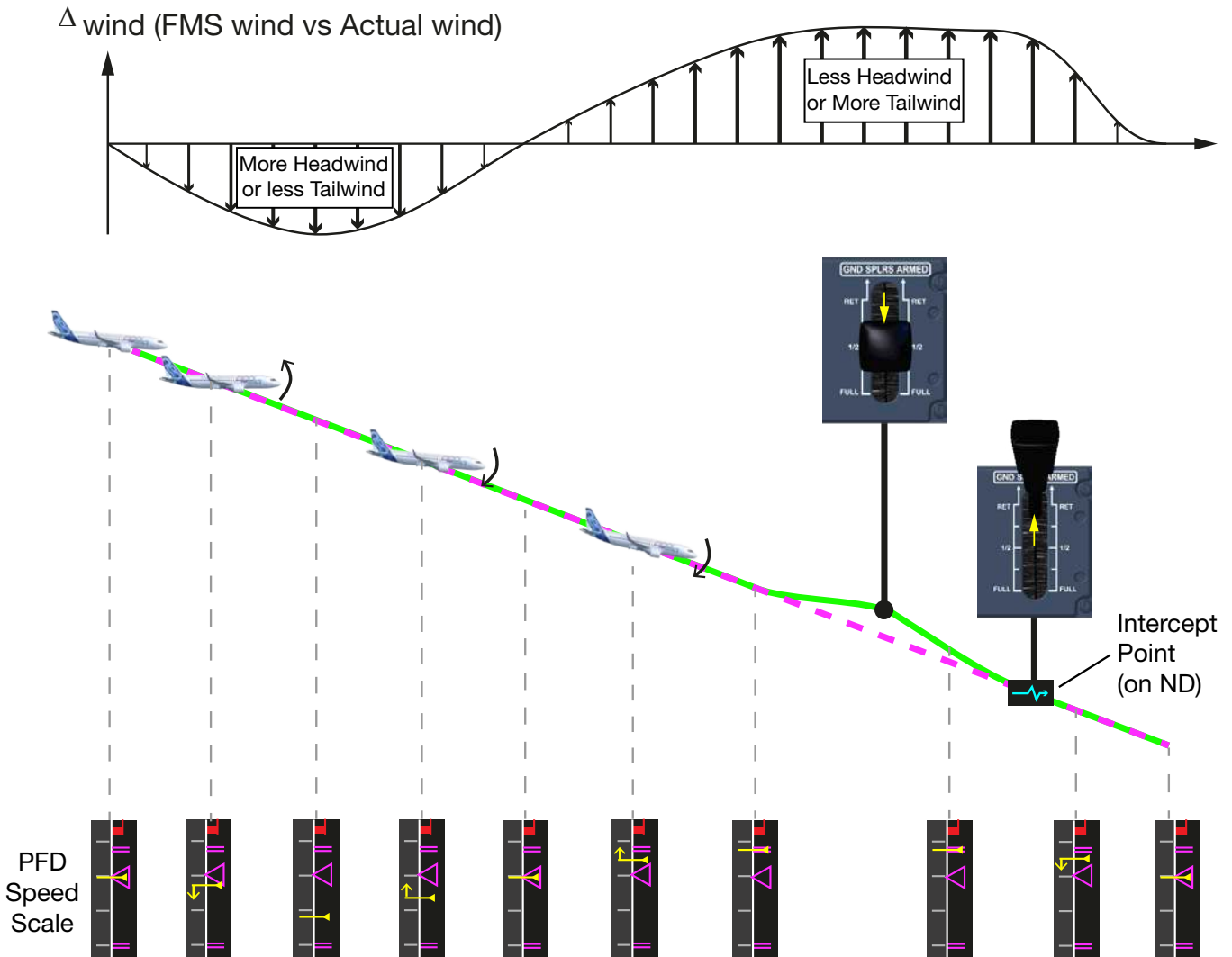
The DES mode is only available when the aircraft flies on the FMS lateral flight plan, i.e. when the aircraft uses the NAV horizontal guidance mode.

(fig.12)
Speed range principle during the idle segment of a managed descent.

≫ On idle segment

In DES mode with managed speed the elevators adjust the pitch to enable the aircraft to stay on the computed path and the A/THR commands idle thrust.

The AFS allows the aircraft speed to vary in a range of +/- 20 knots around the managed speed target (+5 kt or -20 kt in the case of a speed constraint), limited to V_{MAX} -5kt to stay on path:

- If the speed decreases down to its lower limit, the A/THR will increase the thrust

- If the speed reaches its upper limit, the aircraft will leave the path to maintain the upper limit speed.

>> **On geometric segment**

On the geometric segment, the A/THR adapts thrust to maintain the managed speed target.

>> **Use of speedbrakes in DES mode**

The use of speedbrakes in DES mode must be limited to the situation where there is either a strong tailwind or much less tailwind than expected, and the aircraft diverges from the profile. The flight crew should increase drag by extending the speed brakes **(fig.12)**.

As a visual clue the ND displays the intercept point at which the aircraft will reach the profile with half speed brakes extended. If the flight crew does not extend the speed brakes the interception point will continuously move forward along the flight plan. If the interception point gets closer to an altitude constraint, a "MORE DRAG" or EXTEND SPD BRK" message is displayed on the FMA and on the MCDU scratchpad/MFD.

Note: The speed range does not apply below FL 100 for A350 and A330 equipped with HONEYWELL P5 FMS 2 release 2. In this case, the aircraft stays on the path and the flight crew must monitor the speed and use speedbrakes when appropriate.

> " In OP DES mode, the A/THR commands idle thrust and the elevators adjust the pitch to maintain the target speed. "
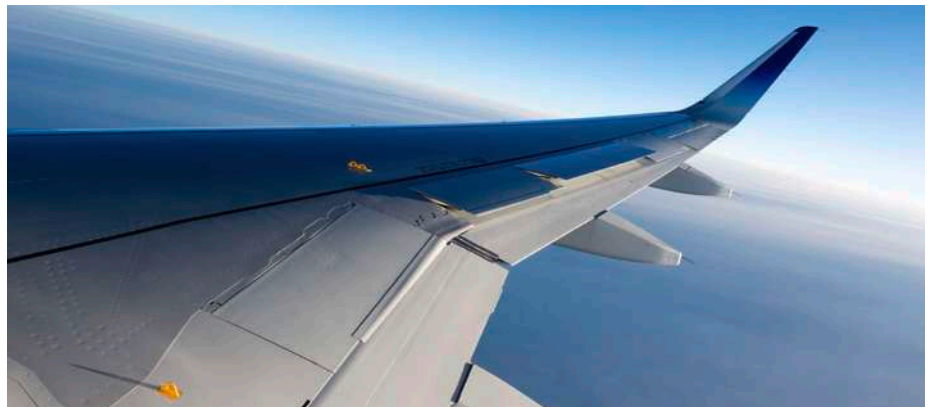
Selected Descent (OP DES and V/S)

In OP DES mode, the AFS commands idle thrust and the elevators adjust the pitch to maintain the target speed (managed or selected).

The OP DES mode can be used to increase or reduce the descent slope. In OP DES, the flight crew adjusts the target speed to modify the descent path **(fig.13)**.

(fig.13)
Adjustment of the selected speed to modify the descent path.

Selected Speed Increase
=
Descent Slope Increase

SPD
270

SPD
290

SPD
310
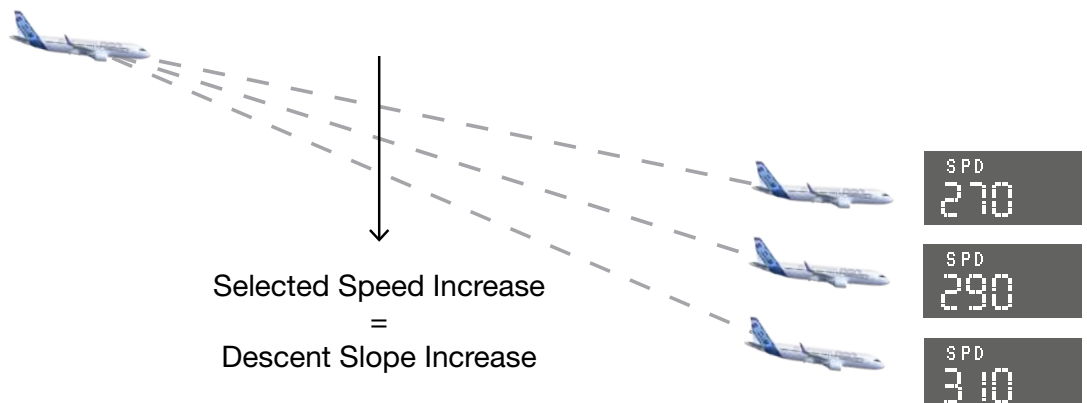
The flight crew can use the V/S mode during descent to get accurate guidance to recover the intended flight path by adjusting the V/S using the V/S selector.

In V/S mode, the AFS adjusts pitch and thrust to maintain the selected vertical speed and the target speed.

Tools for Energy Management during Descent

V/DEV Indication

When in NAV lateral mode, the flight crew uses the "yoyo" indication to estimate its position relative to the FMS computed path. The Vertical deviation (V/DEV) value is provided on the FMS PROG page (A320/A330/A340) **(fig.14)** or PERF DES page (A380/A350).

V/DEV or "yoyo"

(fig.14)
example of V/DEV indication on the PFD and on the FMS PROG page (A320)

Energy Circle

When in HDG or TRK lateral mode, the ND displays the energy circle, and when the aircraft is within 180 NM of its destination. It provides a visual cue of the minimum required distance to land, i.e. the distance required to descend in a straight line from the current aircraft position at its current speed down to the altitude of the destination airport at approach speed. The descent profile used to compute the distance takes into account speed limits, the wind, a deceleration level off segment and a 3° final approach segment **(fig.15)**. In other words, if the destination airport is inside the energy circle, the flight crew needs to lose some energy by extending the speed brakes and/or modifying the aircraft's trajectory, and/or increasing speed during descent.

> In HDG or TRK lateral mode, the Energy Circle provides a visual cue of the minimum required distance to land.

(fig.15)

Level-off Arrow Computation Principle

Current Aircraft Altitude

Destination Airport Altitude

Descent from Current Altitude

Deceleration Level-off

3° Final Approach Slope

Required Distance to Land
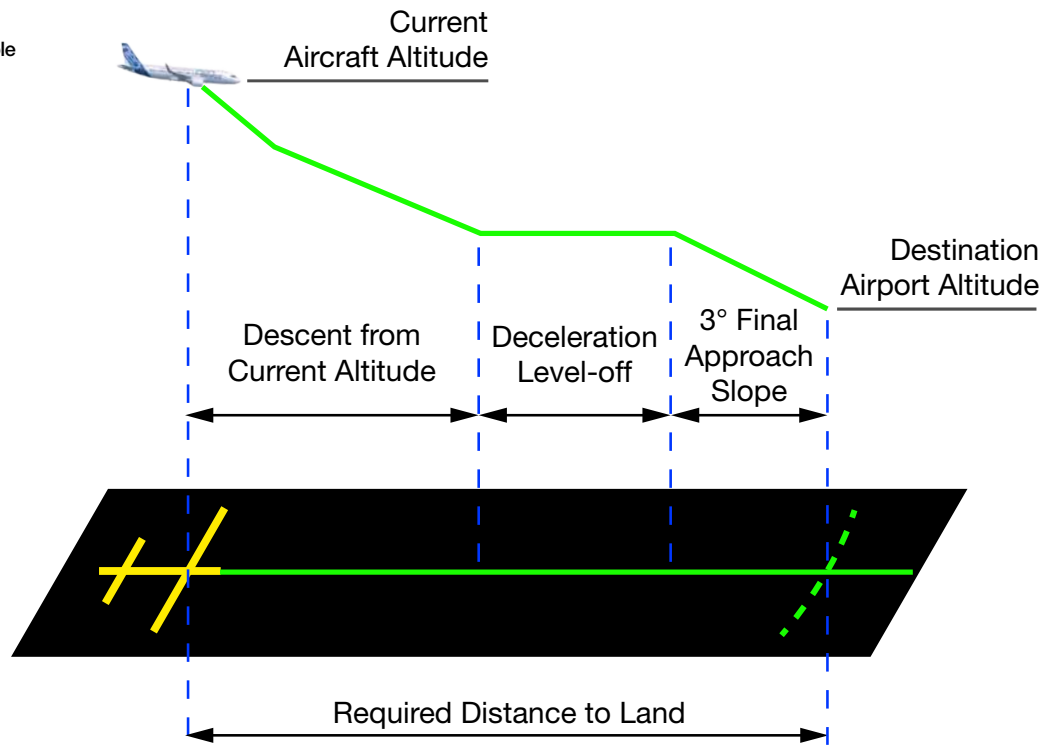
Level-off Arrow

Another useful tool to use during descent is the level-off arrow provided by the FMS. It provides an indication to the flight crew of where the aircraft will reach the altitude selected on the FCU **(fig.16)**. A blending of actual wind conditions and the values for winds entered in the FMS are used to improve the accuracy of the computation. If in selected descent, the flight crew can adjust the speed of the aircraft to adapt the descent path or V/S to the situation.

(fig.16)

Level-off Arrow Computation Principle

Current Aircraft Altitude

FCU Altitude

Required distance to reach FCU Altitude
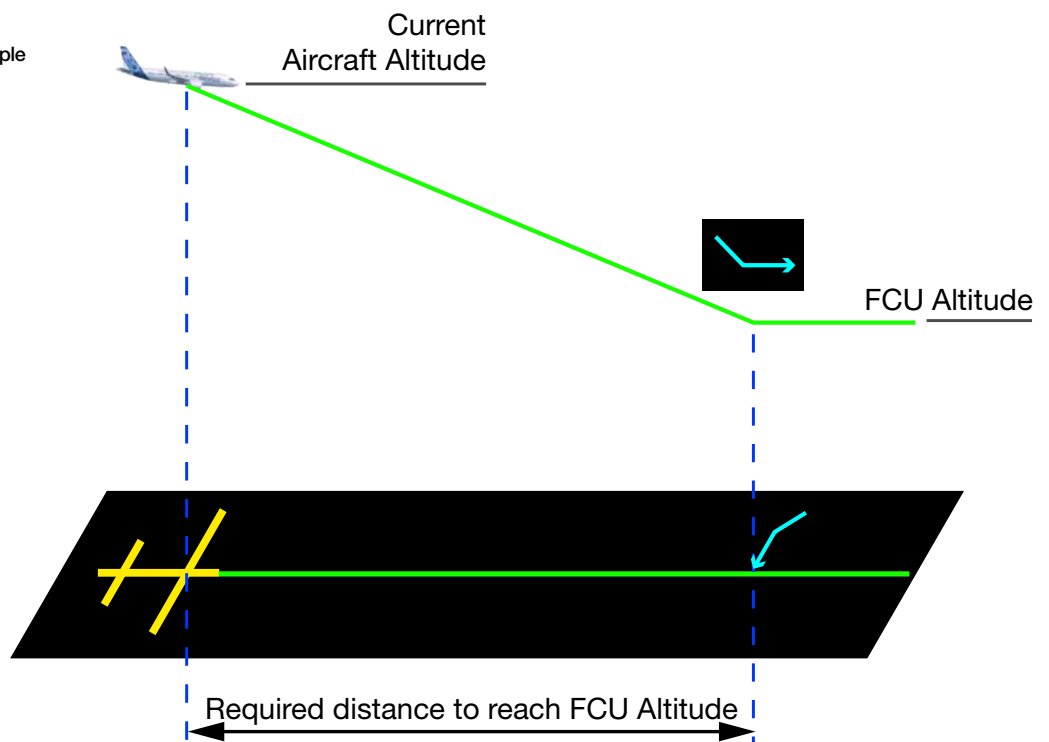
Overspeed Avoidance during Descent

Manual Flight at Crossover Altitude

When in descent close to M_{MO}, if in manual flight (AP off), the risk of exceedance of the V_{MO} at the crossover altitude is high. In this situation, the flight crew should know its crossover altitude and anticipate the switch to speed by reducing the aircraft pitch on approaching the crossover altitude.

Impact of Wind Direction

Flight crews should pay particular attention monitoring their speed in descent close to V_{MO}/M_{MO} and when flying close to the wind direction **(fig.17)**. The impact of a wind gradient can be significant and bring the aircraft beyond V_{MO}/M_{MO}. ■

(fig.17)
Impact of wind direction

Wind

Headwind
Component

Wind

Headwind
Component

Flying close to the wind direction
=
Strong impact of potential
wind gradients on aircraft speed

Flying far from the wind direction
=
Limited impact of potential
wind gradients on aircraft speed
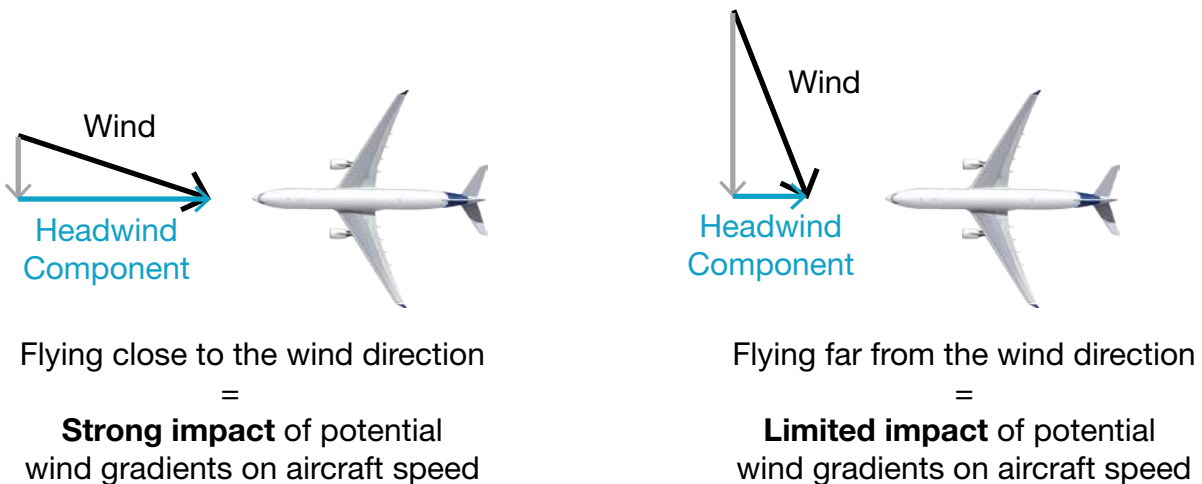
MANAGING SPEED DURING APPROACH AND LANDING

Initial Approach

When reaching the Initial Approach Fix (IAF) the flight crew should have a defined approach strategy based on the selected type of approach: a choice of the guidance mode that will be used and the associated approach technique (decelerated approach or early stabilized approach). The flight crew is then ready to start the key phase of the approach in terms of speed management: the Intermediate Approach phase.
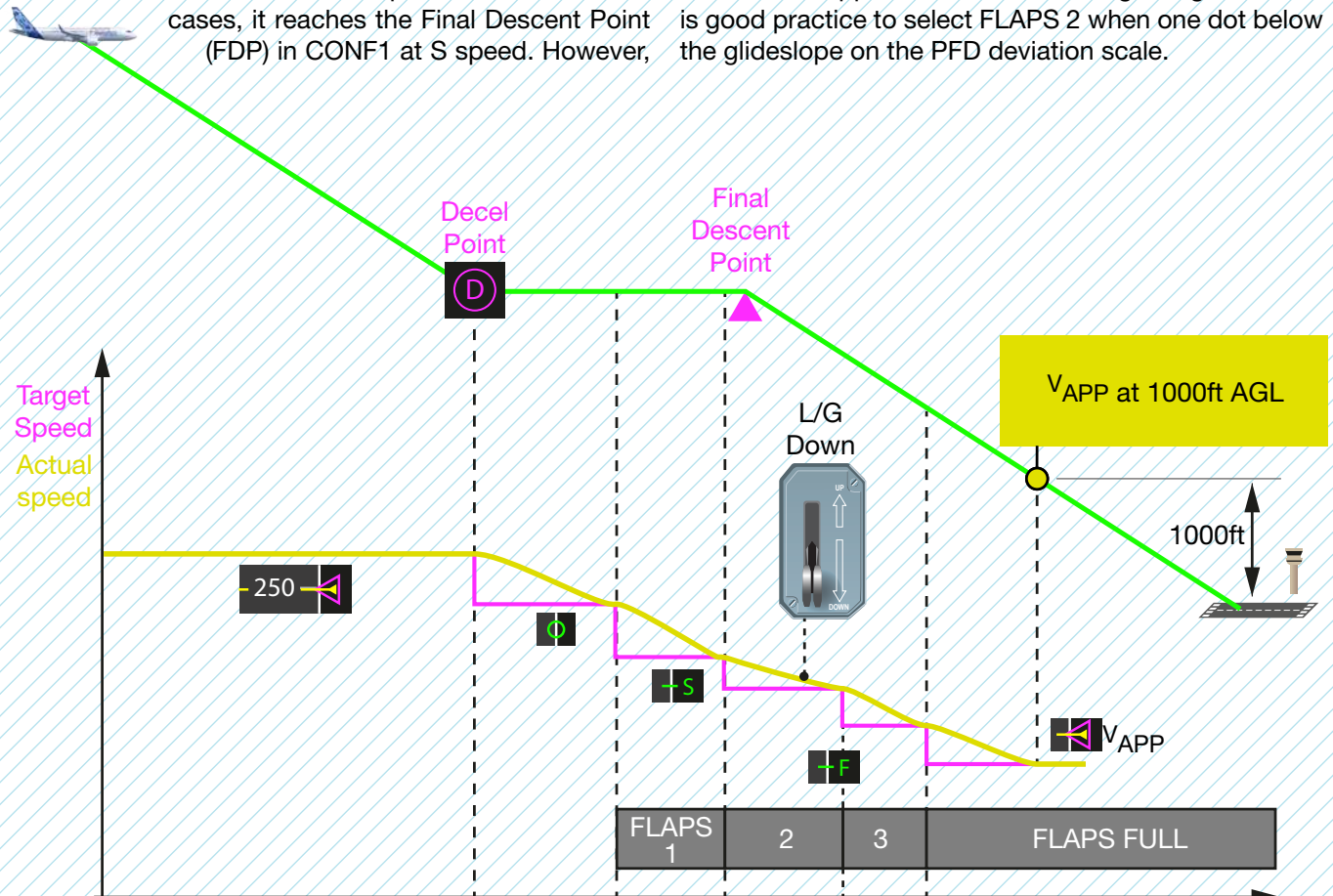
(fig.18)

Example of decelerated approach

DECELERATED APPROACH (WITHOUT CDA FUNCTION)

The decelerated approach is the default strategy used by the FMS to compute the descent and approach path. It is the recommended strategy for approaches using managed vertical guidance: ILS, GLS, SLS, MLS, FLS and FINAL APP.

In a decelerated approach, the aircraft is decelerating during its final approach segment to be stabilized at VAPP at 1000ft above the airport elevation. In most cases, it reaches the Final Descent Point (FDP) in CONF1 at S speed. However,

in some cases, when the deceleration capabilities are low (e.g. heavy aircraft, a high elevation airport or tailwind), or for particular approaches with a deceleration segment located at low height, the flight crew should select CONF 2 before the FDP. The FCOM recommends to select CONF 2 before the FDP when the interception of the final approach segment is below 2000ft AGL (A320) or 2500ft AGL (A330/A340, A350 and A380). In this case, for ILS, MLS or GLS approaches, or when using FLS guidance, it is good practice to select FLAPS 2 when one dot below the glideslope on the PFD deviation scale.

Decel Point

Final Descent Point

Target Speed

Actual speed

V_{APP} at 1000ft AGL

L/G Down

1000ft

250

S

F

V_{APP}

| FLAPS 1 | 2 | 3 | FLAPS FULL |

Intermediate Approach

The Intermediate Approach phase starts at the deceleration point or earlier, if the flight crew activates manually the approach phase of the FMS.

The aircraft reduces speed from its last descent speed, generally 250kt, corresponding to the speed limit below FL100. The aircraft slows down to green dot speed and then slows further to the manoeuvring speed for the various Slats/Flaps configurations. It finally ends up at V_{APP} at or before the stabilization point (decelerated approach) or at or before the Final Descent Point (early stabilized approach) depending on the approach strategy.

Airbus recommends using A/THR in managed speed to reduce crew workload. If the flight crew needs to use selected speed, they should revert to managed speed when out of the ATC speed constraint because it will ease the deceleration handling.

(fig.19)
Typical early stabilized approach

EARLY STABILIZED APPROACH (WITHOUT CDA FUNCTION)

The early stabilized approach is the recommended technique for approach using selected FPA vertical guidance. When the interception height of the final descent segment is low (below 2000ft for A320 or 2500ft for A330, A340, A350 and A380), it may also be used as an alternative to the decelerated approach to reduce flight crew workload. Early stabilized approach can also be used when the weather conditions make it too difficult to use the decelerated approach. During an early stabilized approach, the aircraft reaches the FDP at V_{APP} and in its landing configuration. To do so, the flight crew enters a speed constraint at the FDP in the FMS flight plan to enable the FMS to compute an associated deceleration point.
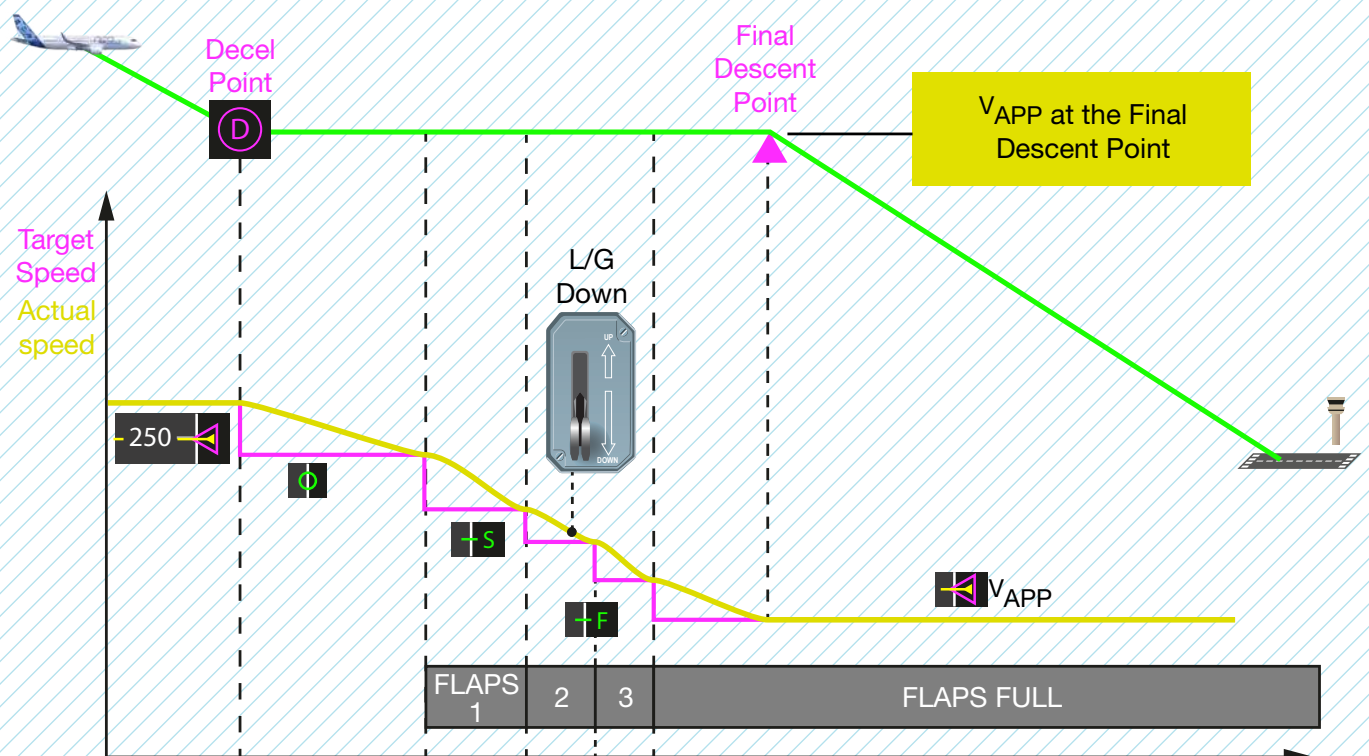
The deceleration rate of the aircraft varies with its weight. A heavy aircraft will not decelerate as quickly as a lighter aircraft.

Whatever the Approach technique chosen by the flight crew (decelerated or early-stabilized approach), respecting stabilization criteria is key for a successful landing. Refer to the Flight Crew Operating Manual FCOM/PRO-NOR-SOP-18-A Stabilization Criteria.
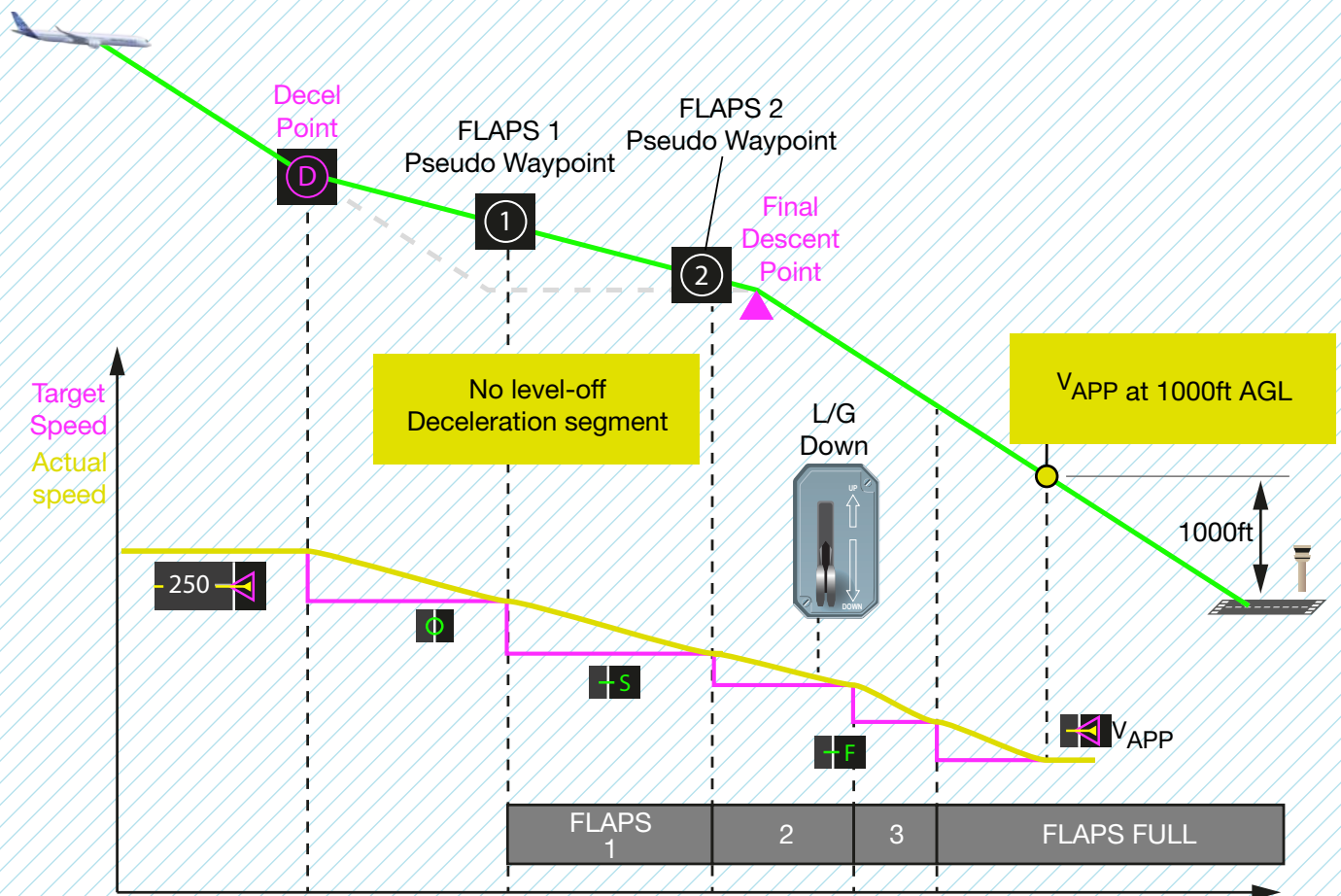
(fig.20)
Typical CDA approach

CONTINUOUS DESCENT APPROACH (CDA) FUNCTION

The CDA function removes the deceleration level-off segment for fuel economy and noise reduction purposes. The function displays pseudo waypoints on the ND to indicate where to extend the flaps at the latest to reach the stabilization point (V_{APP} at 1000ft AGL for decelerated approaches and Vapp at the FDP for early stabilized approached). CDA is basic on A350 aircraft and will be available as an option on A320 and A330 aircraft families on aircraft equipped with Release2 FMS standards from Honeywell.

Decel Point

FLAPS 1 Pseudo Waypoint

FLAPS 2 Pseudo Waypoint

Final Descent Point

No level-off Deceleration segment

L/G Down

V_{APP} at 1000ft AGL

Target Speed
Actual speed

1000ft

250

ϕ

S

F

V_{APP}

FLAPS 1	2	3	FLAPS FULL

BEST PRACTICE

If needed and below V_{LO}/V_{LE}, early extension of the landing gear can help the aircraft to decelerate. The additional drag of the landing gear has a strong effect on the aircraft deceleration rate.

Final approach and landing

Speed Monitoring during approach and landing

When close to the ground, the wind can change, especially when in gusty conditions, and have a direct impact on the aircraft speed. As a consequence, monitoring of airspeed is crucial during final approach and landing to avoid:
- Runway undershoot, hard landing or tail strike if the aircraft speed becomes too low, or
- Runway overrun if the speed becomes too high.

If gusty conditions are expected at the destination airport, the flight crew can add an appropriate margin to the V_{APP} and manually enter the new V_{APP} in the FMS PERF APPR page.

Airbus recommends the use of autothrust during final approach to reduce crew workload and benefit from the Ground Speed Mini function (GS mini).

> " Monitoring of airspeed is crucial during final approach and landing. "

WHAT IS THE GROUND SPEED MINI FUNCTION?

Significant headwind changes can be caused by the boundary layer effect when the aircraft is getting closer to the ground. Ground speed mini function ensures that the aircraft speed remains at least at V_{APP} if a stronger than expected headwind were to suddenly drop to the tower wind value or below. The GS mini function is only available when the flight crew uses the managed SPEED mode.
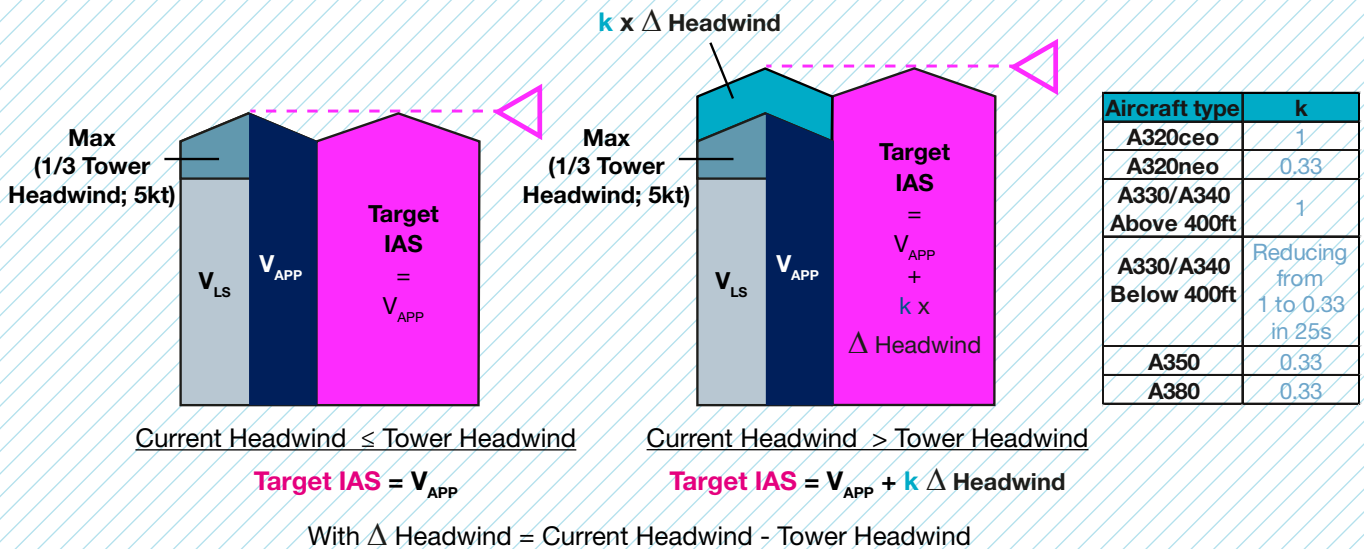
The AFS constantly computes and displays a target Indicated Airspeed (IAS) using:

- The approach speed (V_{APP} computed by the AFS or manually entered in the FMS),
- The tower headwind component from the tower wind value entered by the flight crew in the PERF APPR page of the FMS, and
- The current wind measured by the ADIRS.

As a consequence, the flight crew must ensure that the tower headwind value has been correctly entered in the FMS, even if it does not increase the V_{APP} (i.e. headwind < 15kts).

(fig.21)

Ground speed mini function

Current Headwind ≤ Tower Headwind
Target IAS = V_{APP}

Current Headwind > Tower Headwind
Target IAS = V_{APP} + k Δ Headwind

With Δ Headwind = Current Headwind - Tower Headwind

Aircraft type	k
A320ceo	1
A320neo	0.33
A330/A340 Above 400ft	1
A330/A340 Below 400ft	Reducing from 1 to 0.33 in 25s
A350	0.33
A380	0.33

Why is there a different 'k' factor for ground speed mini depending on the aircraft model?

The factor of 1 used on A320ceo aircraft could not be used for the other aircraft models due to differences of their deceleration capability. The A320ceo has a stronger deceleration capability when compared to A320neo, A330/A340 family aircraft, A350 and A380 aircraft.

In the case of a strong ground effect, a lower deceleration capability may lead to an excessive speed at flare. For example, a 20kt headwind at 200ft that reduces to 5kt on ground (corresponding to the 5kt tower headwind inserted in FMS PERF APPR page), a factor of 1 requires a deceleration of 15kt to reach V_{APP}. With a k value of 0.33, the aircraft only needs to decelerate by 5kt to compensate its lower deceleration capability. It reduces the risk of excessive speed at flare. The drawback is that there is a slight increase in thrust variations in gusty conditions, since the speed increment will not be sufficient to counteract the IAS increase due to a gust. The best overall compromise was demonstrated to be a 0.33 factor.

Manual Landing

In Normal or alternate law, the flight controls maintain the aircraft load factor demand (flight mode), if there is a wind change, the aircraft will maintain its path causing the speed to increase or decrease. This cannot be perceived by a pilot while looking outside, as the trajectory will not change (the aiming point will not move). Therefore, with autothrust disengaged, the flight crew must carefully monitor the speed as to detect any speed change. The role of the Pilot monitoring (PM) is key in this situation, especially when close to the ground.

Stabilisation criteria

Flight crews must respect the stabilisation criteria provided in the FCOM Standard Operating Procedures (SOPs). These criteria ensure a safe approach and landing. The aircraft must be at approach speed with stabilized thrust at the stabilisation height (1000 ft AGL in IMC, 500 ft in VMC or according to airline's policy) If it is not the case, the PM should make a callout and a go around must be initiated if the flight crew assesses that the stabilisation can't be obtained prior landing. ■

> " Flight crews must respect the stabilisation criteria provided in the FCOM Standard Operating Procedures. "

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The aircraft can be in either an over energy or low-energy situation at landing if the crew does not manage the aircraft's speed correctly from top of decent, through approach and down to the flare. The consequences upon landing are increased risk of runway excursion, tail strike, hard landing or runway undershoot.

Whatever the level of automation chosen during descent, approach and landing, the flight crew should be aware of its capabilities, take full advantage of the tools available on airbus aircraft and apply the procedures and techniques provided in the FCOM/QRH and FCTM.