FS ACADEMY

JETLINER

CONTENTS

MANUAL VERSION
25 MARCH 2022

FS Academy – Jetliner will introduce you to the world of airline operations. Brought to you by a real A320 Captain, the Airbus will be our Jetliner of choice, but remember that these skills and techniques are transferrable to any modern passenger jet.

Airline pilots operate in accordance with Standard Operating Procedures (SOPs). The SOPs used in Jetliner are authentic and give a realistic representation of the procedures used day-in day-out by the professionals, adapted for use in Flight Simulator.

We commence our journey by climbing aboard flight 'Jetliner 488' from London Gatwick (EGKK) to Barcelona (LEBL). This flight is split up into 7 parts, from Taxi-Out to Taxi-In. Each part will focus on a particular aspect of airliner operations, such as automation, zoom climbs, flight computers and descent planning, all presented to you step-by-step by your instructor.

Once this sector is complete, you will progress through a series of scenarios, each of which will expose you to emergency situations and more challenging eventualities.

Each of the 12 missions have accompanying chapters in this manual that dig deeper into the theory behind each topic and supply the fundamental knowledge you'll need to succeed at handling the big jets.

TECH LOG

Just like a real airliner, small defects and work-arounds are recorded here in the Tech Log. Until they are addressed by Engineering, you will need to take the following precautions as you progress through the missions.

DEFECT	REQUIRED ACTION
Autopilot (AP) poor approach capture and Flight Director (FD) performance.	Allow AP extra time to establish on approach. No Autoland permitted, requires manual landing, disregard FD pitch bar on short final. CAT1 ONLY.
Cabin window at seat 9A misting.	Crew Awareness. Replacement arranged.
Engine 1 minor oil leak detected.	Refill at next maintenance base. Report further loss of fluid in excess of tolerances.

SIMULATOR SETTINGS

NAVIGATION DATABASE

The standard navigation database should be used, as installed with MSFS by default. We hope to expand compatibility to include Navigraph data, but this is not yet operational. For the time being, Navigraph users should temporarily disable the updated database, using their Navigraph management software, whilst progressing through Jetliner.

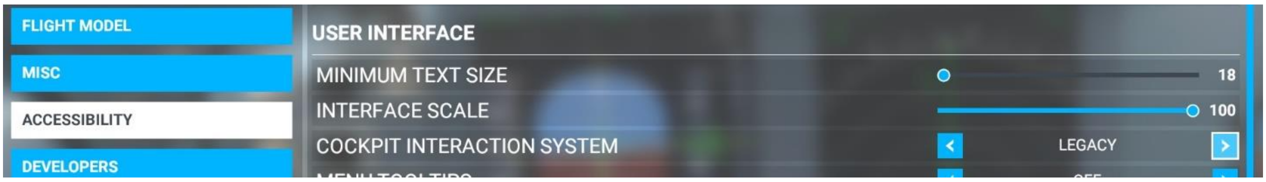
SUBTITLES

Full subtitles in English are available and can be displayed by enabling subtitles, found here:

OPTIONS → GENERAL → ACCESSIBILITY

COCKPIT INTERACTION SYSTEM

We recommend the use of 'Legacy' mode for best compatibility with the Flight Control Unit (FCU) when using Jetliner on PC with a mouse.



SUPPORT

Please visit our support page if you encounter difficulties.

www.fsacademy.co.uk/support-jetliner

Let's get started...

THE FLIGHT DECK

The earliest jet-powered airliners had immensely complex cockpits. Overflowing with instrumentation, classic jets had a full suite of indications for each aircraft system. Fuel flow rate, hydraulic pressure, electronic voltages etc. were all displayed on a dedicated dial, often requiring three flight deck crew to manage properly.

Over time, the introduction of computers and electronic displays permitted huge advancements with the presentation and simplification of these systems, requiring only a handful of screens to display countless aircraft parameters.

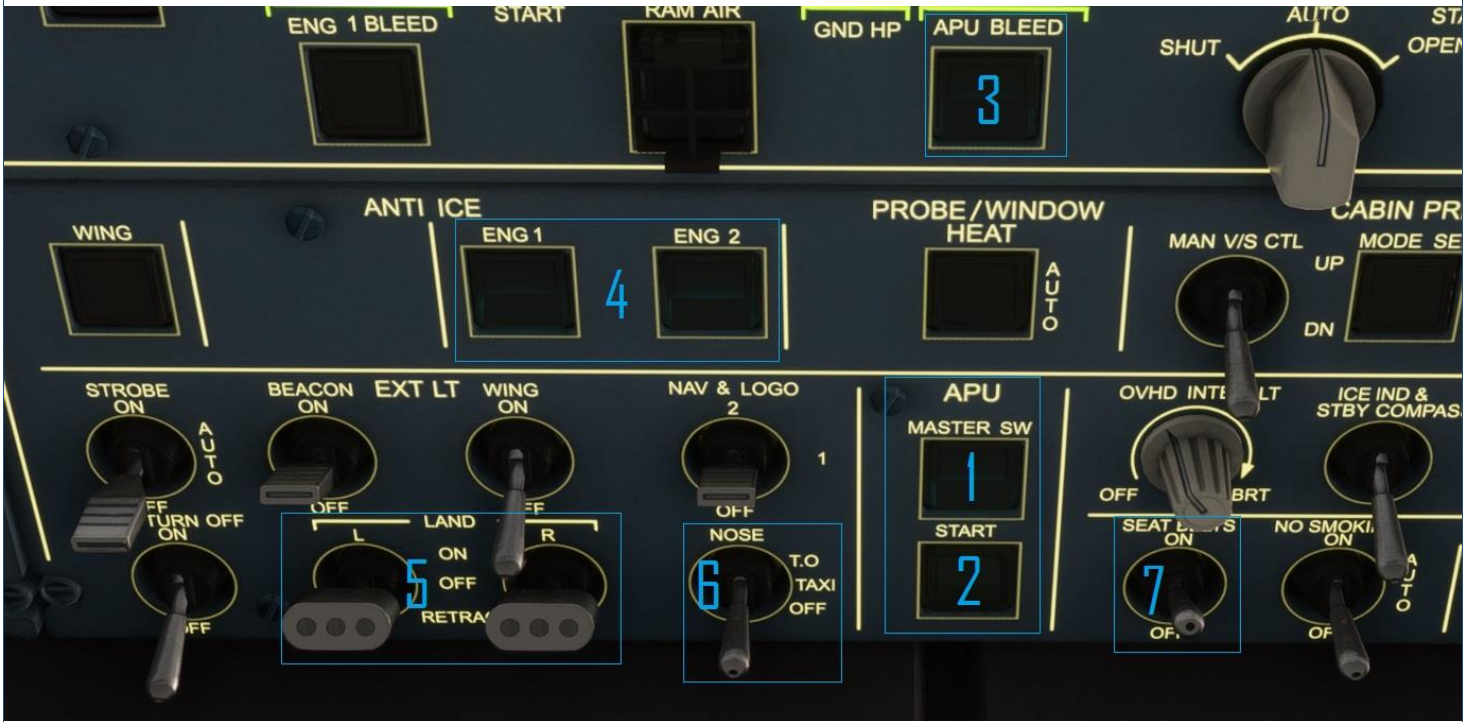
This new electronic approach improved the clarity and timely monitoring of each system, plus providing considerable weight savings. It became known as the ‘Glass Cockpit’.

Whilst these radical improvements have made the operation of an airliner significantly more streamlined, the modern flight deck remains a complex environment that you will need to become familiar with.

Stopping short of a deeply technical review of the Airbus A320, we will run through the basic controls and displays that you will devote the majority of your attention to over the course of Jetliner.

OVERHEAD PANEL

Although relatively minimalist compared to vintage airliners, the modern passenger jet still has a myriad of controls for operating the various on-board systems. Most of the switches and buttons located on the ceiling-mounted overhead panel are reserved for reconfiguring systems following a technical failure. Let's focus on the more routinely used controls.



1 – APU MASTER

Located in the tail, the Auxiliary Power Unit (APU) can supply both electrical and pneumatic power to support the aeroplane's systems whilst the main engines are shut down. The APU MASTER switch activates the electronic control and monitoring system that oversees the APU's operation and prepares the APU for starting. Pushing the MASTER while the APU is running will shut it down.

2 – APU START

With the MASTER turned on, pushing START will begin the start-up procedure, which takes around 1 minute to complete. Once the start-up is completed, a green 'AVAIL' light appears, indicating that the APU is 'available' for use.

3 – APU BLEED

Electrical power is supplied continuously whilst the APU is running. The pneumatic power used for starting the main engines, known as 'bleed air' can be toggled on or off with the APU BLEED pushbutton.

4 – ENGINE ANTI-ICE

The engine intakes are susceptible to icing if operating in temperatures of 10^{o}C or below when moisture is present, such as in cloud or fog. Turning on the ENG A.ICE redirects hot engine bleed air to circulate through the intakes to warm them and prevent ice build-up, at the expense of a minor loss of engine performance.

5 – LANDING LIGHTS

The main source of forward illumination is provided by the landing lights, which are controlled by this pair of switches, one for the left-hand and one for the right-hand light. As with all Airbus switches, move the switch UP for ON.

Landing lights have the dual purpose of assisting both seeing and being seen. Like the headlights on a car, the lights shine forwards and enhance runway visibility during takeoff and landing. Once airborne, the landing lights make the aeroplane more easily visible to other traffic. It is for this reason that the lights are used, even in the daytime, just before landing and shortly after takeoff.

6 – TAXI LIGHT

As the landing lights are very high power, their ground use is reserved for time spent on the runway only. The taxi light is used for movements on the taxiways and aprons. At close range, the taxi light is also very bright, so it is turned off before turning onto stand, to avoid dazzling the ground crew.

7 – SEAT BELTS SIGN

The seat belts sign indicates to the passengers that they should be seated with their seat belt fastened, during the periods of taxi, takeoff and landing. Once climbing above 10,000ft and clear of any turbulent cloud layers the signs are turned off to indicate that it is safe to move about the cabin.

Shortly after departure and before the passengers are released, the seat belt sign can be cycled (turned off then on again) to indicate to the cabin crew that they may leave their crew seats and commence their in-flight duties.

The signs are turned on again and an announcement made on the PA to signal to the cabin crew to begin securing the cabin for landing. This is most commonly performed when descending through 10,000ft during the arrival, or 10 minutes before landing.

FLIGHT CONTROL UNIT

Once the Autopilot (AP) is engaged, the Flight Control Unit (FCU) becomes the main interface between the pilots and the auto-flight systems. The three main control knobs for speed, heading and altitude allow for setting of Managed or Selected modes, based on whether the knob is pushed or pulled.

Pushing a knob will set the Managed mode for that parameter, whereas pulling the knob initiates Selected mode. To push or pull an FCU knob in Microsoft Flight Simulator (MSFS) move your cursor over the top half of the appropriate knob until the cursor becomes an up arrow. Clicking when an up arrow is shown will push the knob. Mousing over the bottom half of the knob shows a down arrow, which will pull the knob when clicked. Turning the knob can be achieved by using the mouse wheel or clicking when a rotation cursor appears.

1 – SPEED SELECTOR (SPD)

When pushed in, Managed Speed mode is active, where the speed target will be set according to the calculations of the Flight Management and Guidance Computer (FMGC). This will account for speed limits, efficient climb speeds and enroute speed restrictions. On approach with landing flaps set, Managed Speed will display the target approach speed.

Pulling the SPD knob activates Selected Speed mode, where turning the knob allows for manual selection of the speed target for the Autothrust (A/THR) to acquire.

2 – HEADING SELECTOR (HDG)

Pushed in, the HDG selector delegates lateral control to the Autopilot, which will follow the route as programmed in the FMGC. Turning the knob displays a heading selection in degrees on the digital window located above the knob. Pulling the knob will select the set heading as the target heading for the AP to steer towards.

3 – ALTITUDE SELECTOR (ALT)

Pushing the ALT knob sets a Managed vertical mode, depending on the flight phase and flight plan vertical profile, amongst other factors. This complex feature is not fully implemented by MSFS currently, and so can be disregarded. Our interests lay with the underlying techniques for climb and descent management, so we do not require the use of this mode.

Pulling the ALT knob commands either Open Climb (OP CLB) or Open Descent (OP DES). ‘Open’ indicates that any altitude constraints contained within the flight plan will be disregarded by the AP.

In Jetliner we will focus mainly on a combination of Selected SPD with OP CLB or OP DES. This allows us to preserve control over the automation in order to properly demonstrate the principles of airliner flying, whilst allowing the skills to be transferable across aircraft types.

4 – VERTICAL SPEED SELECTOR (V/S)

Vertical Speed is only used as a Selected Mode, achieved by turning the V/S knob to the desired climb or descent rate in Feet per Minute (FPM) and pulling the knob to activate V/S mode.

Pushing the V/S knob commands an immediate level off, targeting a V/S of zero FPM.

5 – AUTOPILOT (AP)

The A320 has two autopilot systems, AP1 and AP2. The convention is that the pilot in the left seat uses AP1 whilst the occupier of the right seat uses AP2. As you’re in the Captain’s seat, use AP1 throughout Jetliner.

6 – AUTO THRUST (A/THR)

The A/THR is automatically engaged after takeoff once the thrust levers are moved backwards into the Climb detent (covered in the dedicated section on page 14). A/THR can be disengaged by pressing the A/THR button on the FCU.

7 – APPROACH PUSHBUTTON (APPR pb)

To prepare the AP for approach interception, the APPR pb is pushed, as covered in Lesson 6.

8 – SPEED/MACH SELECTOR (SPD/MACH)

The selected speed target can be displayed on the FCU in either Knots or Mach Number. Pushing this button switches between the two modes.

9 – BARO SELECTOR

Push and turn to set altimeter. Pulling sets standard (STD) setting of 1013hPa.

PFD + ND

The main pair of screens used to display instrumentation are the Primary Flight Display (PFD) and Navigation Display (ND). Countless dials, needles and lights have been made obsolete by electronic displays such as these, known as Electronic Flight Information Systems (EFIS).

Flight data is all displayed in a smaller area, showing the pilot all they need to know, if you know where to look:

PFD	ND
1 – ATTITUDE 2 – AIRSPEED 3 – HEADING 4 – ALTITUDE 5 – VERTICAL SPEED 6 – BARO SETTING 7 – FLIGHT MODE ANNUNCIATOR (FMA) 8 – FLIGHT DIRECTOR (FD)	8 – AIRCRAFT SYMBOL 9 – FLIGHT PLAN ROUTE 10 – NEXT WAYPOINT DISTANCE + ETA 11 – TRUE AIRSPEED (TAS) 12 – WIND ARROW

E/WD

In the centre of the Flight Deck, you will find the Engine/Warning Display (E/WD). This is where you can view not only engine parameters, but also flap configuration and system messages.

Older generations of airliners would rely on several banks of gauges to display all engine parameters, with a light, horn or other system to announce anything that exceeds limits, such as high temperature or low pressure. Modern EFIS equipped aircraft make great use of the cockpit screens to display data in a more centralised location, also allowing for colour changes and flashing or highlighting in order to draw attention to a drifting parameter.

If a failure is detected, it will be announced in the Message Area, accompanied with actions to perform to help to resolve or stabilise the issue. This is part of the Electronic Centralised Aircraft Monitoring system (ECAM).

Whilst we won't make use of the ECAM in Jetliner, it is worth appreciating how modern airliners display the necessary information to the pilots in a quicker and clearer way than ever before, reducing reliance on paper checklists and manuals.

1 – N1
N1 Fan speed as a percentage.

2 – EXHAUST GAS TEMPERATURE
Temperature in Celsius of the exhaust air leaving the engine.

3 – N2
N2 Fan speed as a percentage.

4 – FUEL FLOW
Rate of fuel supply to the engine in KG per Hour.

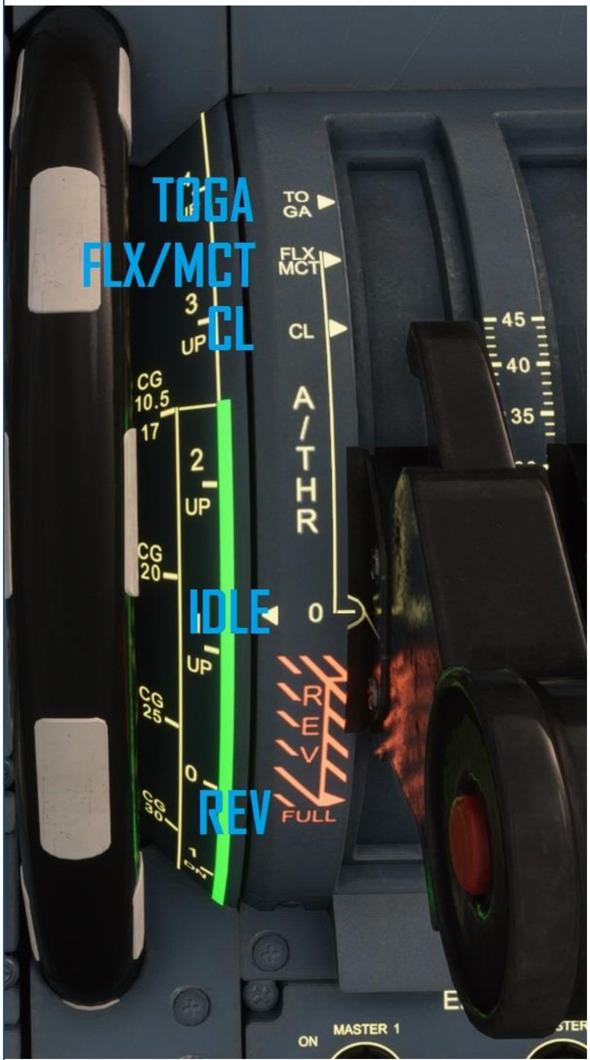
5 – FUEL QUANTITY
Total KG of fuel on board.

6 – FLAP/SLAT POSITION
Current flap setting.

7 – MESSAGE AREA
Space for system and ECAM messages.

THRUST LEVER DETENTS

The A320 thrust levers (THR LVRS) have a series of positions, known as detents. Each has a dedicated purpose, as covered here:



TOGA

Maximum engine power. Typically reserved for either departing a short runway or for initiating a 'go-around'; where a landing is aborted and a rapid climb is performed. TOGA may only be sustained for 5-10 minutes.

FLX/MCT

The takeoff thrust setting required is 'Flexible' (FLX) and is calculated before every departure to provide ample takeoff and climb performance, whilst saving fuel, noise and engine wear.

Max Continuous Thrust (MCT) demands a slightly lower power setting than TOGA, but provides a level of thrust that can be maintained for as long as necessary, such as when climbing with a single remaining engine after suffering an engine failure during the takeoff run.

CL

Once safely climbing away after takeoff, we move the thrust levers back into the Climb (CL) detent. This position also engages the Auto Thrust (A/THR) after takeoff.

Once set to CL, the levers will typically remain here until just before landing. The thrust levers of an Airbus aircraft do not move in response to thrust changes.

IDLE

The IDLE (zero) position commands minimum thrust from the engines. The movement of the levers into the IDLE detent disengages the A/THR and is set when nearing touchdown at the destination runway. IDLE is also the position used for engine start up.

REV

Thrust reversers can be selected after landing to help the wheel brakes slow the aircraft. Typically, only the minimum level of reverse is selected, known as Reverse IDLE. REV MAX may be needed in slippery conditions or on very short runways. Not all controller hardware offers easy selection of reversers, so their use is not a requirement in Jetliner.

PEDESTAL

1 – ENGINE MODE SELECTOR (ENG MODE SEL)
NORM: Normal operating position.
IGN/START: Prepares systems for engine start up and for continuous firing of engine igniters.

2 – ENGINE MASTERS
ON: Initiates start of associated engine.
OFF: Shuts-down engine.

3 – SPEED BRAKE (SPLRS)
ARM: Pull out vertically to reveal white collar at the base of the shaft (as shown).
DISARM: Push in to hide white collar.

4 – FLAPS LEVER

5 – TRANSPONDER (XPDR)
Use keypad to enter ATC “Squawk” code.

7700: Emergency code.

6 – PARKING BRAKE

MCDU

The Flight Management and Guidance Computer (FMGC) is a computer system that calculates the flight progress and provides steering guidance to the AP.

The FMGC is interacted with by the pilot using this keyboard and screen unit, known as the Multifunction Control and Display Unit (MCDU). Whilst the FMGC and MCDU are technically two separate systems, the terms are commonly used interchangeably.

1 – DIRECT TO (DIR)

Pushing the DIR button displays upcoming waypoints contained in the flight plan, which can be selected in order to program the AP to fly directly to that waypoint.

2 – FLIGHT-PLAN (F-PLN)

The F-PLN button reveals the full list of enroute waypoints, as shown in the image.

3 – LINE SELECT KEYS (LSK)

Along either side of the screen are rows of keys. These are used to select an option that is displayed on screen alongside the line. On the image shown, pushing the bottom left LSK, where LEBL is listed, opens the screen used for managing approach selection.

4 – UP/DOWN ARROWS

Use the arrow keys to move a list shown on-screen, such as the F-PLN waypoints or approach options. Note that pushing UP moves the list UP the screen, which some find counter-intuitive at first.

LANDING GEAR PANEL

1 – GEAR INDICATOR LIGHTS

Three green DOWN triangles indicate that all three landing-gear legs are correctly extended and safely locked into position. Red indications appear whilst the gear is in transit, with blank lights shown when the gear is fully retracted.

2 – AUTOBRAKE PANEL

Low and Medium (LO and MED) settings are used prior to landing in accordance with the desired rate of deceleration to be targeted by the auto-brake system after touchdown. MAX is selected before Takeoff to allow maximum braking force to be applied automatically if a Rejected Takeoff (RTO) is performed, stopping the aircraft as quickly as possible.

3 – GEAR LEVER

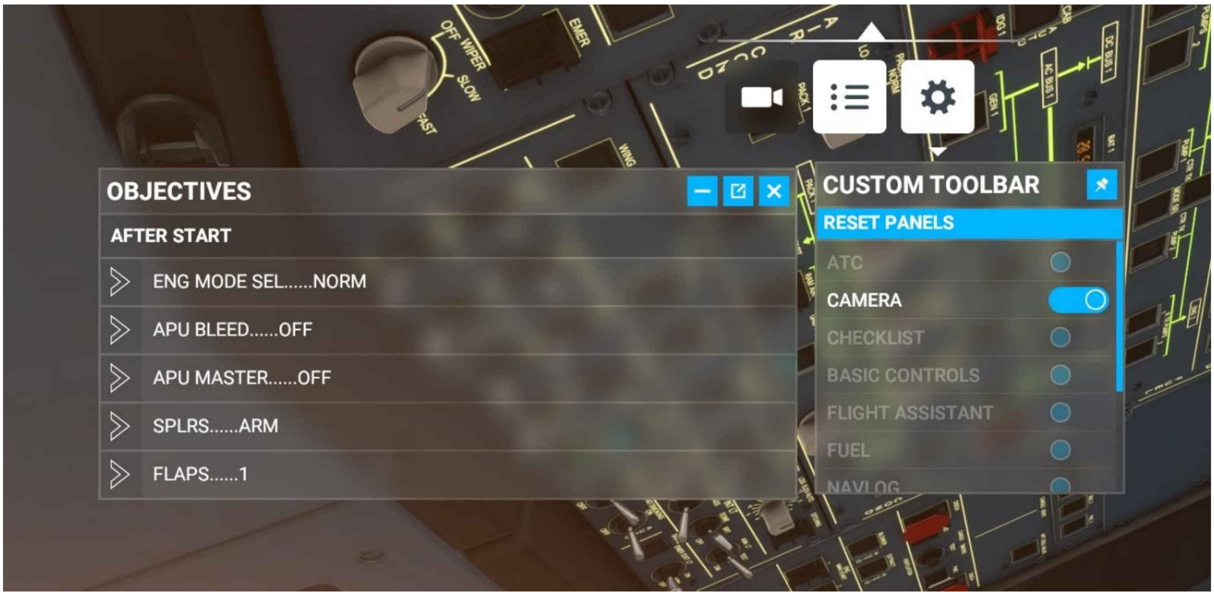
Landing gear retraction and extension is achieved conventionally by moving the gear lever to the UP or DOWN position respectively. A red DOWN arrow appears if the landing gear is not detected as down shortly before landing, accompanied by an audio alert.

01. TAXI-OUT

We commence our journey into the world of the Jetliners by embarking upon a standard flight (or "sector") from London Gatwick (EGKK) to Barcelona (LEBL).

ON-SCREEN GUIDANCE

Throughout the lessons, you will find on-screen instructions for the actions that are required, which turn green once completed. Refer to The Flight Deck section previously to learn about the cockpit controls you will be using. Display using the toolbar if they are not visible.



APU START

APU......START

Lesson 1 begins after the pushback from the gate has been completed and the parking brake has been set. The first action you will need to complete is to fire up the APU by pressing the APU START button. The MASTER should already be switched ON for you.

ENGINE START-UP

After a discussion of thrust lever detents, the levers will be in the IDLE position, ready for engine start. The engine start-up procedure is highly automated, so only a couple of simple steps need to be followed:

ENG MODE SEL……START

Rotate the Engine Mode Selector clockwise to the START position. This redirects the APU BLEED air from the air conditioning systems to the engine start units, used to spin the engines up to speed.

Modern jet engines are controlled and monitored electronically, with a system called Full Authority Digital Engine Control (FADEC). Turning the ENG MODE SEL to START also powers up the FADEC and prepares the engines for starting.

ENG MASTER 1……ON

Each engine has a dedicated MASTER SWITCH that provides simple control over start-up and shut-down. Move the ENG1 MASTER to the ON position and the start sequence will be commenced and controlled by the FADEC system.

The internal arrangements of a modern turbofan engine consist of a series of 'spools'. A spool is a solid shaft, running the length of the engine, with a large 'fan' at the front and a series of smaller turbine blades at the rear.

Each spool is referred to by the numbering of its fan. N1 is the large fan, with the smaller N2 located behind the N1, deeper inside the engine.

During start, high pressure APU Bleed air is used to turn the N2 spool. Once N2 has reached a suitable speed, fuel is introduced and igniters begin to fire within the combustion chamber.
The air within the combustion chamber is hot and rapidly expanding, which blasts out the exhaust, contributing to the thrust which will push the aircraft forwards. On its way out of the back of the engine, these exhaust gases push past the N2 turbines, causing them to gain speed.

As the turbines and fan are physically connected via a shaft, the rotation of the turbine also causes the N2 fan at the front of the engine to start spinning, drawing in more air, increasing the combustion further. This ever-accelerating cycle continues and N2 spins more and more quickly, until the air pushed by the N2 spool becomes enough to blow over the N1 spool, causing it to spin also.

The majority of thrust from a modern jet is supplied by the spinning of the N1 fan, rather than the blast of exhaust from the tailpipe. The N1 and N2 spools accelerate until reaching their 'self-sustaining' speed, where APU BLEED air is no longer required and the start-up sequence is considered complete.

ENG MASTER 2……ON
The APU has only enough power to start one engine at a time, so once engine 1 is up to speed, turn on the ENG MASTER 2 to initiate a start-up of the number 2 (right-side) engine.

AFTER START FLOW

To maximise consistent and safe operation, standardised procedures known as Standard Operating Procedures (SOPs) are implemented by both aircraft manufacturers and individual airlines. A major principle of SOPs is the 'flow'.
Flows are memory-based sequences of actions performed by the pilot in order to allow a configuration change of the aircraft systems to be repeatable and standardised. They are performed in a pre-defined order and ensure that actions are more easily memorised and consistently repeated. The first flow you will encounter is the AFTER-START flow:

ENG MODE SEL……NORM
Now that the start sequence is complete, setting NORM allows air to be redirected back to the air conditioning for cabin comfort.

APU BLEED……OFF
APU MASTER……OFF
Shuts off APU + APU BLEED. The engines are now supplying all pneumatic and electrical power.

SPLRS……ARM
Readies the wing spoilers to extend out of the top of the wing to aid deceleration in the case of an aborted takeoff.

FLAPS……SET
Normally Flaps 1 is used, unless a reduced takeoff distance is required for a short runway.

FLIGHT CONTROL CHECKS

As is standard procedure when flying everything from a small, piston engine training aircraft up to the biggest airliners, the flight controls need to be checked for full and correct movement in response to control inputs.

We will start our checks by applying FULL LEFT aileron input, which will be observed and confirmed by the co-pilot, with their response of "Full Left". Next, FULL RIGHT aileron is set and the response will be "Full Right", before the controls are returned to their NEUTRAL position. This process is repeated for the elevator and rudder, until all the controls are checked.

TAXI

Once our checks are complete and our taxi routing has been received from ATC, it is time to move the aeroplane to the runway for departure.

Our route will take us forwards before turning right onto Taxiway P ("PAPA").

To keep the aircraft centred on a taxiway or runway centreline, you have to remember that your viewpoint is not centred in the cockpit, but over to the left.

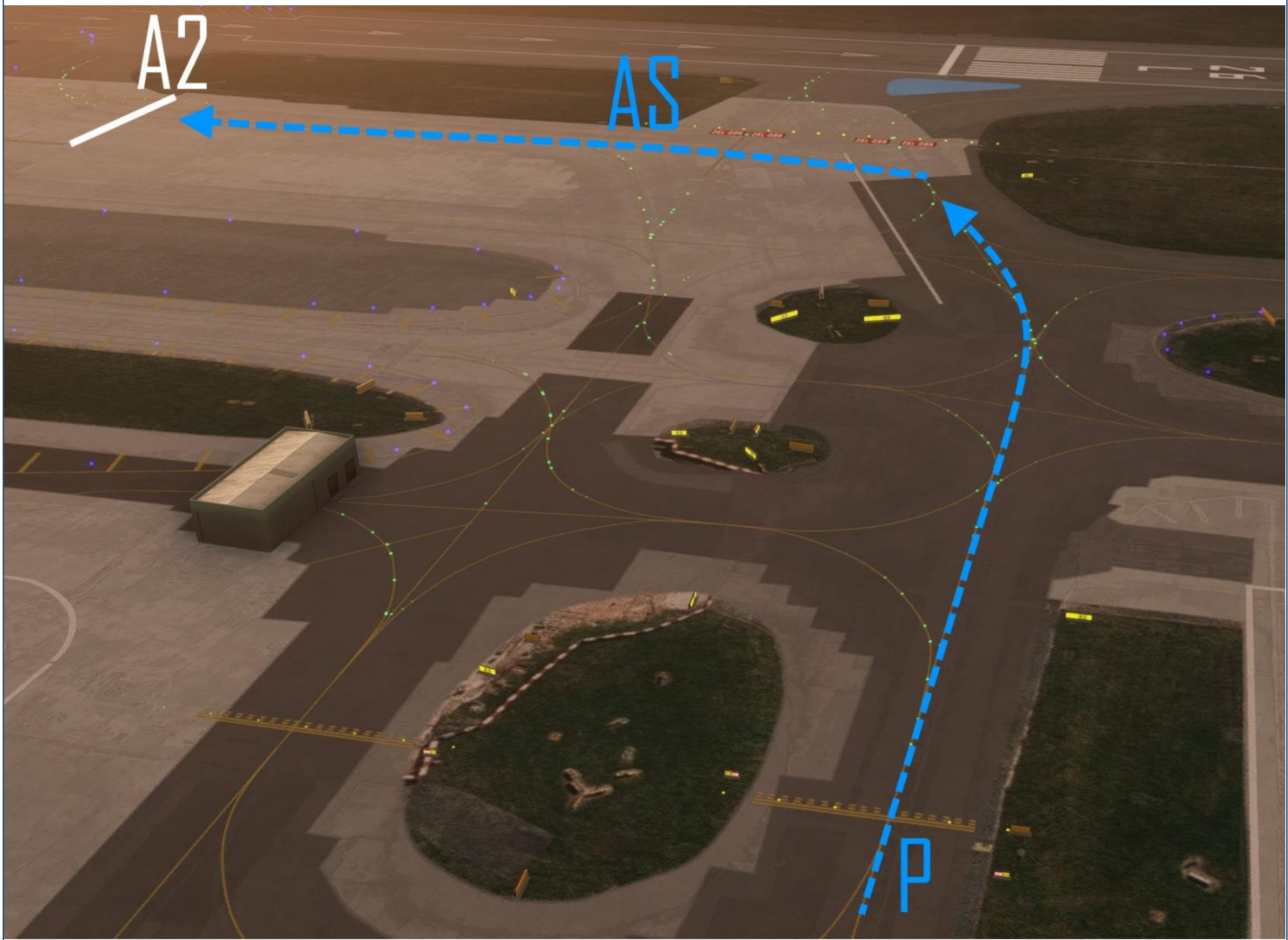
Visualise the continuation of the line you wish to follow and see that it would pass between the PFD and ND, or through your right foot.

It is common practice to taxi 1-2ft to the side of centre, in order to avoid the nosewheel repeatedly striking the series of taxiway or runway lights, which cause an uncomfortable 'thump' that can be heard and felt.

TAXI LT……ON
The taxi light improves your forward visibility and indicates to other aircraft, vehicles and personnel that you intend to taxi.

BRAKE PEDALS……PUSH
Once moving, the brake pedals are depressed to ensure that braking can be felt, giving a sure and tactile confirmation of correct operation.

TAXI ROUTE



PEDS CHECK

During the taxi-out, a brief recap of the departure is performed by the pilots to confirm that any last-minute clearance changes have been accounted for and any adjustments to the FMGC, runway line-up position etc. have been properly prepared for. One structure for running through this systematically is the PEDS check:

PERFORMANCE	Changes to runway in use, thrust setting, line-up point or weather.
ENGINE OUT	Intended route to fly in the event of an engine failure after takeoff.
DEPARTURE	Departure route or Standard Instrument Departure (SID).
STOP ALTITUDE	First cleared altitude correctly set in FCU.

02. TAKEOFF

Picking up where we left off, we're waiting at the A2 holding point, awaiting confirmation from the cabin crew that the cabin is secured for takeoff. Once lined up and cleared for takeoff by ATC, we follow a standardised method of applying power, accelerating and raising the nose to gain lift and get airborne.

TAKEOFF SPEEDS

A series of significant speeds are referred to throughout Jetliner, we'll discuss those that relate to departure here:

100kts Announced when passing 100kts during takeoff acceleration to prompt each pilot to check that the two primary airspeed indicators on the PFD match. Differentiates between what is considered a low or high speed rejected takeoff.

V1 Speed at which there is likely now insufficient runway remaining to abort the takeoff and come to a full stop without over-running the runway end.

ROTATE Speed at which the nose is raised in order to increase lift and initiate a climb.

V2 Takeoff 'safety speed'. During the early stages of climbing, the speed must remain above V2, otherwise climb performance will likely be insufficient in the event of an engine failure.

F SPEED Minimum FLAP retraction speed. On large aeroplanes, the flaps at the trailing edge of the wing are accompanied by 'slats' at the leading edge. Both serve to increase wing lift, permitting shorter takeoff and landing distances.

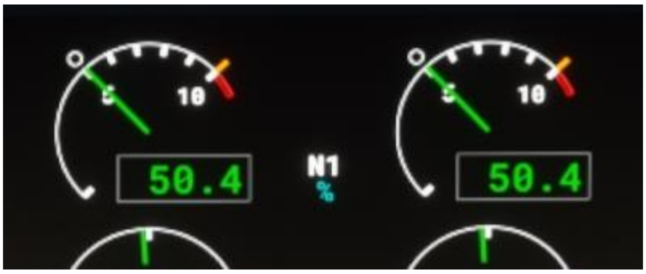
S SPEED Minimum SLAT retraction speed. Once we are above this speed after takeoff, we can set FLAPS ZERO. S and F speeds are displayed on the PFD speed tape when appropriate.

TAKEOFF THRUST

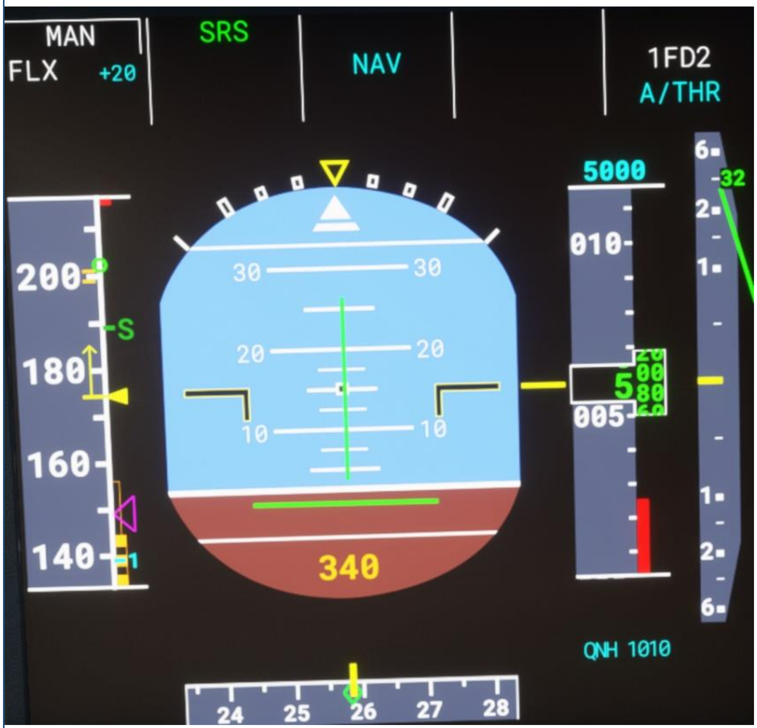
We will use the FLX thrust lever position for this departure, as it is standard practice. Before applying takeoff thrust, we need to check that each engine spools up evenly. It is possible that one engine may gain power more quickly than the other, resulting in uneven thrust between the two engines.

At best, asymmetrical thrust during the takeoff run will result in controllability problems. At worst, it can be strong enough to cause complete loss of directional control and spin the aircraft on the spot. To prevent this hazardous condition, thrust is not increased directly from IDLE to takeoff power, but is first held at 50% N1 until even engine acceleration is confirmed. The small circles along the N1 indication are a representation of the thrust lever positioning.

To set 50% accurately, move the thrust levers forwards until the small circles are placed beside the ‘5’, as shown here:



INITIAL CLIMB



ROTATION

When “ROTATE” is announced, smoothly pull back on the controls and precisely set 15 degrees nose up, as shown here. Target a rotation rate of roughly 3 degrees per second, meaning the manoeuvre should take about 5 seconds. Rotating too quickly risks striking the tail on the ground, whilst an excessively slow rotation eats up runway distance and hampers initial climb performance.

CLIMB POWER

Shortly after takeoff we’ll ask you to move the levers back one step to the CL detent. This will engage the A/THR automatically, indicated by the blue “A/THR” annunciation at the top right changing to white.

03. CLIMB

Now that we are airborne with the AP engaged, some of the more significant aircraft handling techniques and procedures come into play. We'll cover how to control the aeroplane via its automation systems. The SPD, HDG and ALT selector knobs on the FCU can be pushed or pulled in order to change between 'Managed' and 'Selected' modes. In general terms, Managed Mode allows the FMGC to set the targets, in accordance with the route contained in the flight plan. Selected allows the pilot to set a desired value whenever needed.

SPEED CONTROL

In Managed Speed mode, the FMGC controls the speed target in accordance with departure routing, fuel efficiency, flap settings etc. The SPD window in the FCU is dashed (---) when in Managed mode, as shown.

Managed speed can be used throughout the flight in theory, but in practice you will always need to intervene. This may be due to ATC speed requests, adjusting climb rates or traffic sequencing.

The A/THR system can be commanded to target a desired speed by turning and pulling the SPD knob on the FCU.

Turning the knob changes the SPD window from dashes to an airspeed number in knots. Pulling the knob outwards (towards yourself) activates Selected Speed mode and the A/THR will target the displayed speed. The speed target arrow on the PFD will change colour to blue when in Selected Speed.

In most airspace types you will encounter in an airliner, 250kts is the ATC speed restriction when at 10,000ft and below.

LATERAL CONTROL

The HDG knob on the FCU follows the same Managed/Selected logic. Pushing the HDG selector sets lateral guidance into 'NAV' mode, where the AP will follow the flight planned route, as displayed in green on the ND. If a heading adjustment is required, turning the HDG knob to select the desired HDG and then pulling the knob enters HDG mode, where the flight plan route will be disregarded and the specified heading targeted.

Reasons for adjusting HDG include:

- ATC Request
- Weather avoidance
- Enroute traffic separation
- Shortcut

VERTICAL CONTROL

Controlling altitude is achieved with the ALT selector, which is turned to set the required target altitude, whether Managed or Selected modes are to be used.

Managed climbs and descents are very similar to Selected modes, known as "OPEN" modes. When Managed, the AP will take account of altitude constraints which may be present as part of a departure or arrival routing. OPEN modes disregard these constraints. If selecting a target altitude above the aircraft's current altitude, OPEN CLIMB (OP CLB) is engaged. If the target altitude is below the aircraft, OPEN DESCENT (OP DES) is activated instead.

By pulling the ALT knob, either CLIMB power or IDLE is set by the A/THR, according to whether we are to climb or descend. In OP CLB or OP DES the AP uses pitch to achieve and maintain the target speed. For climbing this can be used in an intelligent way, where a lower speed is selected, causing the nose to raise and greatly increasing climb rate temporarily. This is termed a 'Zoom Climb' and can be used to punch through layers of ice, cloud and turbulence in order to give the best possible comfort.

04. CRUISE

Welcome to the rarefied upper atmosphere, where the jetliners get fully into their stride. The cruise in a modern airliner is mostly a monitoring exercise whilst complying with small deviations requested by ATC. We will leave the flight planned route for traffic separation and take a HDG for a short period.

ENROUTE SEPARATION

In today's busy skies it is very common to have to make a handful of small direction and speed changes in order to safely fit between the paths other air traffic. Altitude changes are least desirable, as it can be very wasteful of fuel, particularly having to descend to a lower level and then have climb back up again. Therefore, separation almost always takes the form of small HDG adjustments or to be assigned an enroute speed to maintain.

TRUE AIRSPEED

An airspeed indicator is, in its simplest form, a pressure gauge. Towards the nose of the aircraft, you will find 'Pitot Tubes' which measure the force of the air hitting the nose of the aeroplane. The higher the force, the higher the Indicated Airspeed (IAS) reading.

The airspeed indicator is also fed with 'Static' air, which goes some way to correcting for air PRESSURE changes, such as when climbing to a higher altitude. What static pressure cannot correct for however, is the reduction in DENSITY at altitude. Density refers to the number of air molecules in a given volume, which drops significantly as altitude is increased. This thinner air causes the airspeed indicator to under-read, as there are fewer molecules entering the Pitot tube.

In this lesson, as you have selected an indicated airspeed of 270 'knots' (nautical miles per hour), on the ND you will see that we are in fact travelling through the air much faster than this, at around 440kts. This more accurate indication has been corrected for density electronically and is termed 'True Airspeed' or TAS.

MACH NUMBER

Airliners are designed to be 'subsonic'. This means they always fly at a speed less than the speed of sound. Flying faster than the speed of sound is known as 'supersonic' flight. The speed range between subsonic and supersonic is known as 'transonic'.

When flying at transonic speeds, the airflow begins to become disrupted due to the effects of shockwaves forming on the wings, causing a huge increase in aerodynamic drag.

Once above the speed of sound, the drag begins to reduce again to normal levels. To overcome and accelerate through this transonic region we would need to have an incredible amount of thrust, as was present on Concorde, with accompanying fuel consumption.

The aim in a subsonic airliner is to fly at high speed, to cover distance in minimal time, whilst staying below this high-drag transonic region, for fuel efficiency. As the speed of sound decreases as altitude increases, flight at high altitude brings us nearer to the transonic region. Therefore, an important measure of speed is our relationship to the 'local' speed of sound.

If we were to travel at the speed of sound, we would be flying at a 'Mach Number' of M1.0. Half the speed of sound would be M0.5, and so on. This is the unit of measurement used while at high altitude and we can be assigned a Mach Number by ATC to target, to help fit us around other traffic. It will be demonstrated in-flight how readily we can decelerate, but how it becomes a struggle to regain speed once our Mach restriction is lifted.

DIRECT TO

The provision of a shortcut from ATC is commonplace and allows for a shorter flight time. ATC will give us a Direct to GAI waypoint ("Gaillac"). This is the procedure to enter this into the FMGC:

1. **Push DIR**
2. **Type "GAI", or scroll through list with the arrows**
3. **Top left LSK – Enters GAI as a temporary waypoint**
4. **Bottom right LSK – Activates DIRECT GAI**

05. DESCENT

DESCENT CALCULATION

The high efficiency of today's airliners is largely thanks to the ability to achieve a high altitude, where the thinner air permits the high TAS touched upon in the previous lesson. It is therefore important to try and stay as high as possible for as long as possible. To do this, we calculate our intended Top of Descent (TOD) by following a simple 'rule of thumb':

FLIGHT LEVEL ÷ 3 = MILES TO GO

Example: Cruising at FL360 (36,000ft):
360 ÷ 3 = 120. So, we would ideally start descending when 120 nautical miles (NM) from our destination.

Example: Cruising at FL210:
210 ÷ 3 = 70NM.

Once descending we can use the same equation in reverse, in order to check our progress:

MILES TO GO x 3 = FLIGHT LEVEL

Example: ATC provide a shortcut and you see from the ND that you have 50NM to go:
50 x 3 = 150, so ideally you would be at FL150. If we are higher than this, increase speed to start a dive. If lower, reducing speed has the opposite effect.

ENERGY MANAGEMENT

The above method roughly calculates our ideal TOD, but as we are not alone in the skies, we will likely have to make some concessions for other air traffic. This typically takes the form of delaying descent to allow another aircraft to pass below us, then having to descend more quickly in order to recapture our intended descent path.

A major technique for doing this is to use Selected Speed to control our descent rate. As was the case for OP CLB, OP DES uses pitch to achieve the target airspeed, so if we select a high SPD target in the FCU, the nose will drop and rate of descent will increase. It may be assumed that this is the purpose for the Speed Brake, however by properly managing your descent using airspeed modulation, we operate much more efficiently whilst saving fuel, time, noise and vibration.

For the end of this lesson, we will manage our own descent profile, without reference to ATC. Passing through waypoints PUMAL, BERGA and MAMUK, look on the ND to judge your distance remaining to Barcelona, shown as 'LEBL' on the screen. Multiply this distance by 3 to get the target Flight Level. We will talk you through the ideal descent path as we pass each of these waypoints.

06. APPROACH

ACCEPT ANY POOR AP APPROACH INTERCEPTION PERFORMANCE AND DISREGARD FD WHEN FLYING MANUALLY

FMGC APPROACH SELECTION

ATC will clear us for the Instrument Landing System ZULU (ILS Z) approach to Barcelona runway 24R. It's important that we correctly set this procedure, otherwise we could inadvertently allow the aircraft to commence an approach to the wrong runway.

1. Push F-PLN
2. Click LSK alongside "LEBL" written in white
3. Select "ARRIVAL"
4. Use the arrow keys to scroll the list of approaches
5. Ensure correct selection of "ILS 24R Z"
6. Click LSK alongside "INSERT"

DECELERATION

As we near our destination, we need to reduce our velocity and start to extend gear and flaps in preparation for landing. Some of this will be dictated by ATC, especially at a busy airport with multiple runways and dense inbound traffic. We do still have a great deal of influence over how efficient and seamless we can make the deceleration and approach interception.

A typical deceleration profile for the A320:

FLIGHT PHASE	SPEED TARGET (KTS)	CONFIGURATION
Below FL100	250	Clean
Approx. 20nm to go	210-220	Clean
Localiser Intercept	180	Flaps 1
Glideslope Intercept	160	Flaps 2
5NM before landing	Landing Speed	Gear DN – Flaps FULL

PFD INDICATIONS

The PFD speed scale displays a range of speeds that are of interest to the airline pilot. The maximum allowable speed for the CURRENT flap setting (VFE) is shown as red/black blocks at the top of the speed tape **(1).**

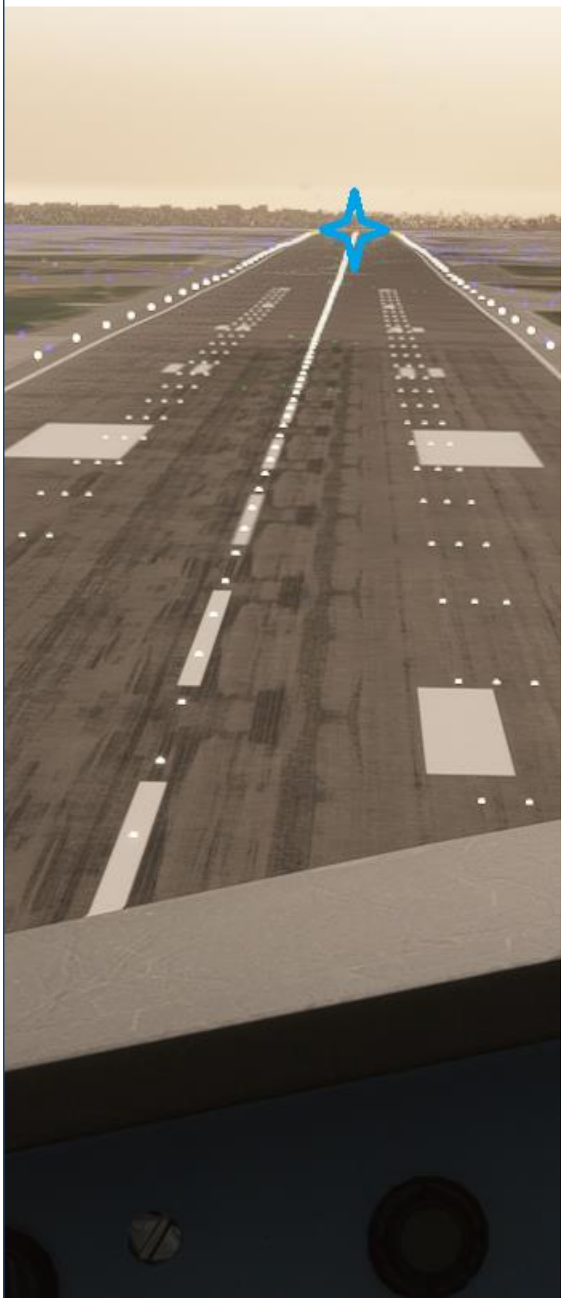
When aiming to extend flaps, we must be flying below the maximum speed for the intended flap setting, otherwise we will cause a flap overspeed and possibly damage the wing. The max speed for the NEXT flap setting (VFE NEXT) is displayed with the amber = sign **(2)**.

In Selected Speed, we see a blue speed target **(3).** Once we have landing flaps set and we push the SPD knob for Managed Speed, the target will become magenta.

Before intercepting the ILS approach, we must ensure we are referencing the correct runway. Each runway's localiser **(5)** has an identifier code of three letters **(4)**, which is checked before commencing the approach.

LANDING TECHNIQUE

Whilst airliners are developed to be as easy as possible to handle, the greater speeds and inertia give rise to some extra considerations in order to achieve a respectable landing. A crucial factor in getting to grips with landing an airliner is to have disciplined control over your vision.



This means that when reaching roughly 50ft above the runway, move your gaze to the far end of the runway and hold it there until touchdown.

This allows you to employ your peripheral vision in order to judge your height and gives a clearer indication of your descent rate, in order to correctly modulate your flare. This may not feel natural at first, but once practiced it will optimise your vision during this critical phase of the flight, where smooth and timely control inputs are required in order to make small adjustments.

Peripheral vision is of course restricted when flying a simulator on a 2D display, with limited width. The principle remains however, as moving your vision away from the touchdown markers greatly enhances your reaction time.

Rather than always flaring at the same height and with the same inputs, judging each landing individually allows you to be hugely adaptable to tailwinds, sloped runways, steep approaches and turbulence, giving you the edge that's needed to manage the almost unlimited variables involved.

After main gear touchdown, the landing roll isn't over yet. Smoothly allow the nosewheel to lower itself onto the centreline, rather than permitting it to slam down onto the tarmac. This may need a small nose-up input on the stick, but be careful not to increase pitch, or you risk a tail-strike, which has most occurrences during the landing phase, rather than at takeoff.

07. TAXI-IN

SET YOUR GROUND AIRCRAFT TRAFFIC DENSITY TO ZERO IF YOUR STAND IS OCCUPIED

Once slowed to taxi speed and vacated the runway, we need to configure the aeroplane so that we are ready to pull onto stand and shut down the engines. We will follow our ATC assigned taxi route to stand 104, as shown here:

08. ENGINE FAILURE

One of the most critical failures you can experience in a heavy jet is the loss of an engine just as you begin climbing away from the runway. This is considered as more urgent than a failure at high altitude as you need to handle the aeroplane in a particular way in order to be able to safely climb above any obstacles ahead, carefully balancing the rudder control to stop any yaw.

The scenario we will explore is an Engine Failure at Takeoff, an 'EFATO'. This is a very common exercise that professional pilots must complete during their bi-annual simulator check-ride.

The most immediate concern after having suffered an engine failure is the regaining of directional control. With takeoff thrust being supplied by just one of the two engines, the asymmetric forces will cause the aircrafts nose to move towards the side of the failed engine. In this scenario we will fail the left engine, which will cause the nose to swing to the left. Apply right rudder to stop this movement, being cautious not to over-correct.

Once safely climbing, ensure not to neglect the raising of the landing gear, as this is fundamental to achieving the required climb performance.

Set a pitch attitude of 12.5 degrees nose up (as shown) and maintain this until we level off for acceleration. Don't chase the sideslip indicator or use the AP as these are not accurately implemented in MSFS currently for engine failure handling.

09. EMERGENCY DESCENT

As we are flying at such great heights, the aircraft cabin needs to be pressurised in order to maintain an air pressure which is comfortable for the crew and passengers. If the pressurisation system were to fail, perhaps by system fault or fuselage damage, then swift and decisive action is required in order to descend as quickly as possible into thicker, breathable air.

At the cruising altitudes of our A320, the Time of Useful Consciousness (TUC) is only around 12 seconds. If you were to remain without oxygen supply for longer than this, your cognition and performance would have likely already deteriorated enough for you to be unable to control the aeroplane. Therefore, the first action for all on board is to don their own oxygen mask.

The 'first pass' of the FCU selections has the simple purpose of initiating a descent to a lower altitude, turning off the route and controlling the speed. Nothing exact is set at this stage, only a TURN + PULL of the FCU knobs to get the emergency descent underway.

We check that the PFD displays the expected Flight Mode Annunciations (FMAs), confirming that we have made reasonable selections.

The ENG MODE SEL is set to IGN (Ignition) in order to reduce the risk of engine 'flameout' during the descent.

When it comes time to refine the FCU selections, set an altitude of 10,000ft. This is of course on the condition that there is no high terrain in the area ahead, which may need avoiding before 10,000ft can be achieved safely. We will contact ATC as soon as practicable, as they may have to assign a HDG so that we descend through the flight paths of other aircraft below us.

We will likely be requested to enter a squawk code of 7700, which has the purpose of 'unfiltering' our aircraft from the various ATC centres in the area, so we appear on all ATC radar displays, as we will be entering several airspace zones rapidly and without clearances. Enter 7700 into the transponder (XPDR) using the keys on the unit.

1 - OXY MASK............ON

2 - SEAT BELTS........ON

3 - FCU.......FIRST PASS

4 - PFD........CHECK FMA

5 – ENG MODE SEL...IGN

6 - FCU................REFINE

10. RTO

ENSURE THAT AUTOBRAKE MAX IS SET BEFORE COMMENCING THE TAKEOFF ROLL

There is an almost endless number of reasons why you may have to abort a takeoff. An untimely system fault, stray vehicle or ATC request are amongst the most common. As decision time is minimal, it is important to have the Rejected Takeoff (RTO) procedure ready for execution at any moment between applying takeoff power and V1.

Once a decision to stop has been made, “STOP” will be announced and you must immediately set the thrust levers to IDLE. If your hardware allows, also engage thrust reversers in order to maximise deceleration, but remember to stow them again once stopped.

The autobrake system will be set to MAX mode for you. If an RTO is detected, it will automatically apply maximum wheel braking and extend the spoilers, giving you the decelerative forces needed to slam to a stop in the minimal distance.

Rather than over-running the runway end, most ‘runway excursions’ occur by leaving the side of the runway, so ensure that directional control is not neglected, particularly in the case of a tyre blowout or engine failure.

A typical pre-departure emergency brief would include the RTO procedure and would take a form similar to this:

“Below 100kts during the takeoff roll we will consider stopping for anything. Above 100kts we will only stop for an ECAM, engine problem or obvious reason to stop. In which case I will call STOP, close the thrust levers, set MAX reverse and monitor the autobrake. Once we come to a stop, I will cancel reverse, set the parking brake and announce “Attention, Crew at Stations.”

Announcing “Attention, Crew at Stations” over the PA after the stop indicates to the cabin crew that they should consider that an evacuation is a possibility, but that they are to await further instructions.

If an evacuation is deemed necessary, such as in the case of a fire or catastrophic damage, a ‘read and do’ evacuation checklist will be performed, ensuring that the engines are shut down and the area around the aircraft is as safe as possible, before initiating the evacuation of passengers and crew.

11. MANUAL HANDLING

Whilst the advanced automation systems of a modern airliner are of huge benefit, the underlying skills of the pilot must not be compromised, as an unexpected situation may occur at any moment, requiring confident and accurate manual flying control.

As you have already seen by progressing to this point in Jetliner, it is very much a myth that airliners ‘fly themselves’. Manual handling plays a part in every flight, where the taxi to the runway, takeoff roll, initial climb and final moments before landing are all done by hand, except where an Autoland is necessitated due to very low visibility. Today we will hone your skills in the clean and clear air over the Öresund strait, which lays between Denmark and Sweden.

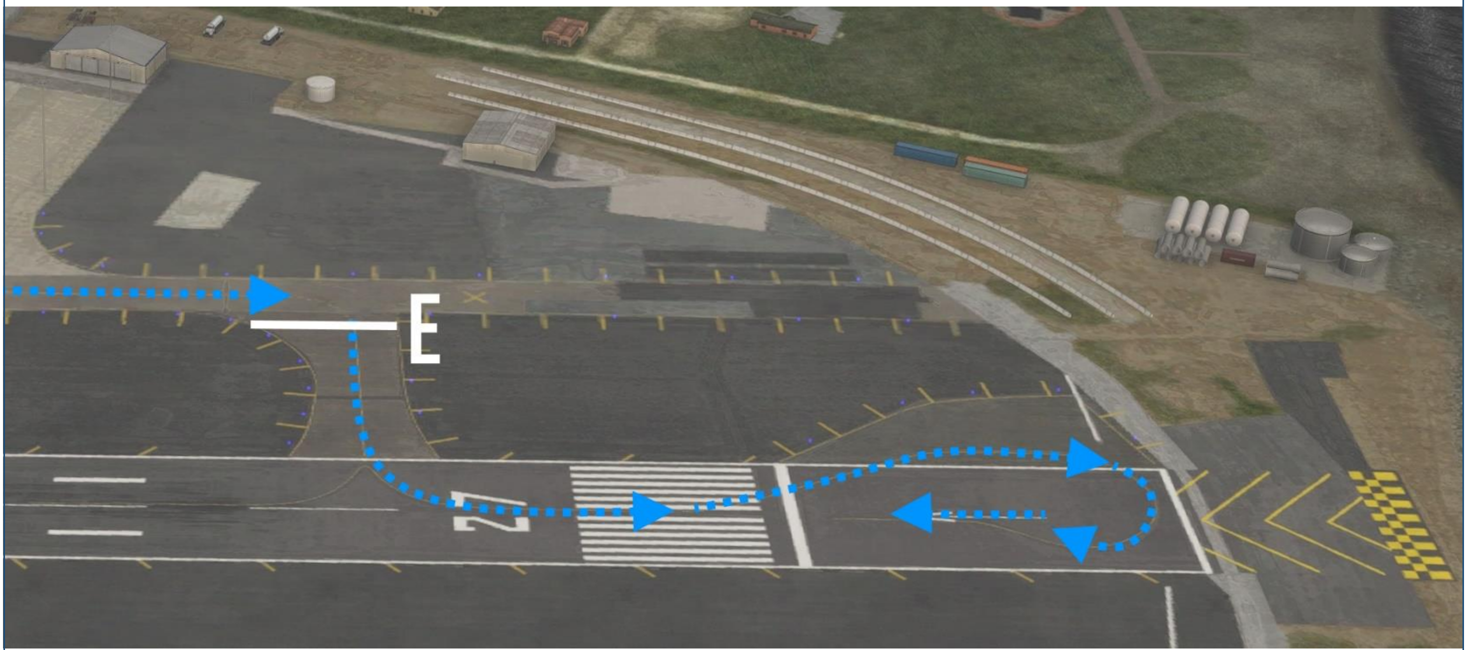
We will cover flying straight and level, a simple climb and turning before complicating your task by combining rate of descent, heading changes and altitude level-offs. This requires a keen eye on the instruments and smooth handling to get the best results.

Later in the exercise, we will disengage the A/THR, leaving you fully in control. The Airbus fly-by-wire design offers a helping hand throughout, assisting with elevator trim and holding bank angles etc. but remember to keep a close eye on the PFD to spot any emerging deviations and make small corrections in a timely manner to maximise accuracy.

12. CHALLENGE

We have covered a wide range of topics on our journey so far. Now it's time to prove what you've learned and put them into practice by departing one of the world's most notoriously challenging airports – Gibraltar (LXGB).

With unique geography giving rise to precarious wind conditions, Gibraltar can make for very hazardous conditions. Whilst landing at 'GIB' is complex enough, departing also requires respect and careful handling, making it an ideal location to show off your abilities. After taxiing forwards and holding at E (Echo), you will enter the runway and 'backtrack' to the full length, to maximise takeoff distance available.



As GIB has a very short runway, we will need to get max performance from our A320 in order to safely get airborne with our relatively high fuel load. We will perform a Flaps 3 takeoff, as this will shorten the ground run of the departure, at the expense of slightly reduced initial climb performance.

Once safely climbing away and passing 1000ft, manually fly a left turn towards HDG180, lowering the nose to allow an acceleration above F speed, permitting us to set Flaps 1. Once above S speed, set Flaps Zero and level off at 4000ft. Enter direct to PIMOS waypoint and continue the departure with the AP now available. **Good luck!**

MISSION ACCOMPLISHED

...or is it?

Getting to grips with the A320 is just the beginning. Jetliner has introduced you to the techniques and skills that are applicable to any modern passenger jet. You will still use zoom climbs, manual handling, 3x distance and so on in whatever airliner you choose to specialise in for your future virtual journeys. We hope that Jetliner has opened the door to many years of realistic and authentic flying experiences.

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ABBREVIATIONS

Aviation is awash with abbreviated terms. This list will help you navigate a selection of the most common and useful to know abbreviations that will come up from time to time.

AAL	Above Airfield Level
ACARS	Aircraft Communications and Reporting System
ADF	Automatic Direction Finding
AI	Attitude Indicator
ADS	Automatic Dependent Surveillance
AB/AFB	Air Force Base
AGL	Above Ground Level
AGNIS	Azimuth Guidance Nose in Stand
AIAA	Area of Intense Aerial Activity
ALS	Approach Lighting System
AMM	Aircraft Maintenance Manual
AMSL	Above Mean Sea Level
APU	Auxiliary Power Unit
ASDA	Accelerate Stop Distance Available
ASI	Airspeed indicator
ASU	Air Start Unit
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATPL	Airline Transport Pilots Licence (UK)
ATR	Airline Transport Rating (USA & Canada)
BALS	Basic Approach Light System
BC	Patches
BR	Mist
C/S	Callsign
CAA	Civil Aviation Authority
CAS	Calibrated Airspeed
CAT	Clear Air Turbulence/Approach Category
CAVOK	Cloud and Visibility OK
CB	Cumulonimbus
CDA	Continuous Descent Arrival
CDI	Course Deviation Indicator
CDL	Configuration Deviation List
CG	Centre of Gravity
CGL	Circling Guidance Lights
CLL	Centreline Lights

CPDLC	Controller-Pilot Datalink Communications
CPL	Commercial Pilots Licence
CRM	Crew Resource Management
CTR	Control Zone
CVR	Cockpit Voice Recorder
CWY	Clearway
DA	Decision Altitude
DCL	Departure Clearance
DER	Departure End of Runway
DFDR	Digital Flight Data Recorder
DH	Decision Height
DME	Distance Measuring Equipment
DST	Daylight Savings Time (Summer)
DU	Dust
DZ	Drizzle
EAS	Equivalent Airspeed
EASA	European Aviation Safety Agency
EAT	Expected Approach Time
ECAM	Electronic Centralised Aircraft Monitoring
EFATO	Engine Failure at Takeoff
EFB	Electronic Flight Bag
EFIS	Electronic Flight Instrument System
EGPWS	Enhanced GPWS
EGT	Exhaust Gas Temperature
EICAS	Engine Indicating and Crew Alerting System
ELT	Emergency Locator Transmitter
EPR	Engine Pressure Ratio
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETOPS	Extended Range Twin Operations
ETP	Equal Time Point
EVS	Enhanced Vision System
EWH	Eye to Wheel Height
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FALS	Full Approach Lighting System
FANS	Future Air Navigation System
FAP	Final Approach Point
FAR	Federal Aviation Regulation
FBL	Feeble/Light
FCU	Flight Control Unit
FD	Flight Director
FG	Fog
FL	Flight Level

FMGC	Flight Management and Guidance Computer
FMS	Flight Management System
FT	TAF with validity >12hrs
FU	Smoke
FZ	Freezing
GA	Go-Around
GMT	Greenwich Mean Time
GNSS	Global Navigation Satellite System
G/S	Glideslope
GPU	Ground Power Unit
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GR	Hail
GS	Small Hail/Ground Speed
H24	Applies 24hours
HDG	Heading
HG	Mercury
HIALS	High Intensity Approach Light System
HJ	Applies only in Daytime
HN	Applies only at Night
HP/hP	Holding Pattern/Hectopascals
HOT	Holdover Time
HSI	Horizontal Situation Indicator
HUD	Head Up Display
HURCN	Hurricane
HZ/Hz	Haze/Hertz
IAF	Initial Approach Fix
IAS	Indicated Airspeed
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IF	Intermediate Fix
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IM	Inner Marker
IMC	Instrument Meteorological Conditions
INOP	Inoperative
INS	Inertial Navigation System
IR	Instrument Rating
IRS	Inertial Reference System
ISA	International Standard Atmosphere
ITCZ	Inter Tropical Convergence Zone
KM	Kilometres
KT	Knots

LCTR	Locator. Shorter range NDB.
LDA	Landing Distance Available
LIAL	Low Intensity Approach Lighting
LMT	Local Mean Time
LNAV	Lateral Navigation
LOC	Localiser
LT	Local Time
LTNG	Lightning
LTS	Lower Than Standard
LVO	Low Visibility Operations
LVP	Low Visibility Procedures

MA	Missed Approach
MAPt	Missed Approach Point
MATZ	Military Air Traffic Zone
MBST	Microburst
MCDU	Multifunction Control and Display Unit
MDA	Minimum Descent Altitude
MDH	Minimum Descent Height
MEA	Minimum Enroute Altitude
MEHT	Minimum Eye Height
MEL	Minimum Equipment List
MMEL	Master MEL
METAR	Meteorological Aerodrome Report
MFA	Minimum Flight Altitude
MGA	Minimum Grid Altitude
MHA	Minimum Holding Altitude
MI	Shallow
MIALS	Medium Intensity Approach Light System
MISAP	Missed Approach Procedure
MLW	Maximum Landing Weight
MLS	Microwave Landing System
MNPS	Minimum Navigation Performance Specifications
MOC	Minimum Obstacle Clearance
MORA	Minimum Off Route Altitude
MPS	Meters Per Second
MRA	Minimum Reception Altitude
MROT	Minimum Runway Occupancy Time
MSA	Minimum Safe Altitude
MSL	Mean Sea Level
MTCA	Minimum Terrain Clearance Altitude
MTOW	Maximum Takeoff Weight
MVFR	Marginal VFR
MZFW	Maximum Zero Fuel Weight

NADP	Noise Abatement Departure Procedure

NALS	No Approach Light System
NAVAID	Navigational Aid
NCD	No Cloud Detected
NDB	Non-Directional Beacon
NM	Nautical Mile
NOSIG	No Significant Change
NOTAM	Notice to Airmen
NPA	Non-Precision Approach
NSC	Nil Significant Cloud
NSW	Nil Significant Weather
NTZ	No Transgression Zone
OAT	Outside Air Temperature
OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OCNL	Occasional
OEI	One Engine Inoperative
OFP	Operational Flight Plan
OM	Outer Marker
OTS	Other Than Standard
OVC	Overcast
PALS	Precision Approach Lighting System
PANS	Procedures for Air Navigation Services
PAPI	Precision Approach Path Indicator
PAX	Passengers
PBN	Performance Based Navigation
PCL	Pilot Controlled Lighting
PCN	Pavement Classification Number
PDC	Pre-Departure Clearance
PDG	Procedure Design Gradient
PFD	Primary Flight Display
PIC	Pilot in Command
PL	Ice Pellets
PN	Prior Notice Required
PO	Dust/Sand Whirls
POB	Persons on Board
PRFG	Partial Fog
PRNAV	Precision Area Navigation
PROB	Probability
QDM	Magnetic Heading to Station
QDR	Magnetic Bearing from Station
QFE	Air Pressure at Airfield Level
QFU	Magnetic Orientation of Runway
QNH	Air Pressure at Sea Level
QRH	Quick Reference Handbook

RA	Rain
RAIL	Runway Alignment Indicator Lights
RAIM	Receiver Autonomous Integrity Monitoring
RASN	Rain and Snow
RCLL	Runway Centreline Lights
RCLM	Runway Centerline Markings
REDL	Runway Edge Lights
REIL	Runway End Indicator Rights
RENL	Runway End Lights
RET	Rapid Exit Taxiway
RFFS	Rescue and Fire Fighting Services
RTIL	Runway Threshold Identification Lights
RMI	Remote Magnetic Indicator
RMK	Remark
RNAV	Area Navigation
ROC	Rate of Climb
ROD	Rate of Descent
RSC	Runway Surface Condition
RTIL	Runway Threshold Identification Lights
RVR	Runway Visual Range
RVSM	Reduced Vertical Separation Minima

SA	Sand
SAR	Search and Rescue
SCT	Scattered
SEV	Severe
SELCAL	Selective Calling
SFC	Surface
SG	Snow Grains
SH	Showers
SI	International System of Units
SID	Standard Instrument Departure
SIGMET	Significant Meteorological Information
SIGWX	Significant Weather
SKC	Sky Clear
SLP	Speed Limiting Point
SM	Statute Miles
SMC	Surface Movement Control
SNOCLO	Airport Closed due to Snow
SOP	Standard Operating Procedure
SQ	Squall
SRA	Surveillance Radar Approach
SS	Sandstorm
STAR	Standard Terminal Arrival Route
SWY	Stop way

TA	Transition Altitude
TAF	Terminal Area Forecast
TAS	True Airspeed
TCAS	Traffic Alert and Collision Avoidance System
TCH	Threshold Crossing Height
TCU	Towering Cumulus
TDO	Tornado
TDZ	Touchdown Zone
TECR	Technical Reason
TEMPO	Temporary
TL	Transition Level
TS	Thunderstorm
U/S	Unserviceable
UAV	Unmanned Aerial Vehicle
UNREL	Unreliable
UTC	Coordinated Universal Time
VA	Volcanic Ash
VASI	Visual Approach Slope Indicator
VC	Vicinity
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VMCA	Minimum Control Speed (Approach)
VOLMET	Weather reports for aircraft inflight
VOR	VHF Omnidirectional Range
VPT	Visual Manoeuvre with Prescribed Track
VRB	Variable
VV	Vertical Visibility
WEE	Whichever is Earlier
WEL	Whichever is Later
WGS-84	World Geodetic System 1984
WIP	Work in Progress
WKN	Weakening
WS	Windshear
WTH	Wheel to Threshold Height
WX	Weather
WXR	Weather Radar
XPDR	Transponder