

FlyByWire Simulations

Documentation

None

None

None

Table of contents

1. Pilot's Corner	3
1.1 Pilot's Corner Overview	3
1.2 Beginner Guide	4
1.3 Airliner Flying Guide	148
1.4 Standard Operating Procedures	174
2. Release Notes	175
2.1 Stable Release v0.7.0	175

1. Pilot's Corner

1.1 Pilot's Corner Overview

Welcome to the Pilot's Corner of the FlyByWire Documentation site.

This section is aimed at sim pilots of all levels and covers topics regarding flying an airliner and especially the Airbus A320neo.

1.1.1 Quick Links

[Beginner Guide](#)

[A320neo Pilot Briefing](#)

1.1.2 Topics

- [Beginner Guide](#)
 - [Airliner Flying Guide](#)
 - [A320neo Pilot Briefing](#)
 - [Standard Operating Procedures](#)
-

Last update: September 23, 2021

1.2 Beginner Guide

1.2.1 Overview

Welcome to the A32NX Beginner's Guide. Although this guide is tailored towards beginners, each topic below may even serve as reminders of proper procedure at different stages of flight for veteran sim pilots.

Each page was reviewed by an A320 type rated pilot and provides accurate information to aircraft operation.

Airline SOP

Please be aware that different airlines may have slightly different procedures at different stages of flight.

For Simulation Use Only

Topics:

[Starting the Aircraft](#)

[Preparing the MCDU](#)

[Engine Start and Taxi](#)

[Takeoff, Climb and Cruise](#)

[Descent Planning and Descent](#)

[Approach and ILS Landing](#)

[After Landing and Taxi to Gate](#)

[Powering Down](#)

[Abbreviations](#)

If you have any issues or feedback with this guide, please file an issue here:

[- FBW Docs Issues](#)

For general questions please visit our Discord:

[- Discord Link](#)

Authors: Awemeter#3110, Cdr_Maverick#6475, Scoopy#1399, Valastiri#8902

Guide reviewed by A320 Pilots.

Last update: August 22, 2021

1.2.2 Starting the Aircraft

This guide will assist you with starting your aircraft. It includes images to assist you with understanding the locations of all buttons and switches.

Disclaimer

The level of detail in this guide is meant to teach a FlyByWire A320neo beginner to start the aircraft correctly.

A *beginner* is defined as someone familiar with flying a GA aircraft or different types of airliners. Aviation terminology and know-how is a requirement to fly any airliner even in Microsoft Flight Simulator.

You will find many great videos on YouTube on how to fly the FlyByWire A32NX.

Check out the FlyByWire YouTube Channel as well: [FlyByWire on YouTube](#)

Chapters / Phases

This guide will cover these chapters in order:

1. [Overhead Panel](#)
2. [Main Panel](#)

Prerequisites

Aircraft is in a cold and dark state at a gate.

[Download FlyByWire Checklist](#)

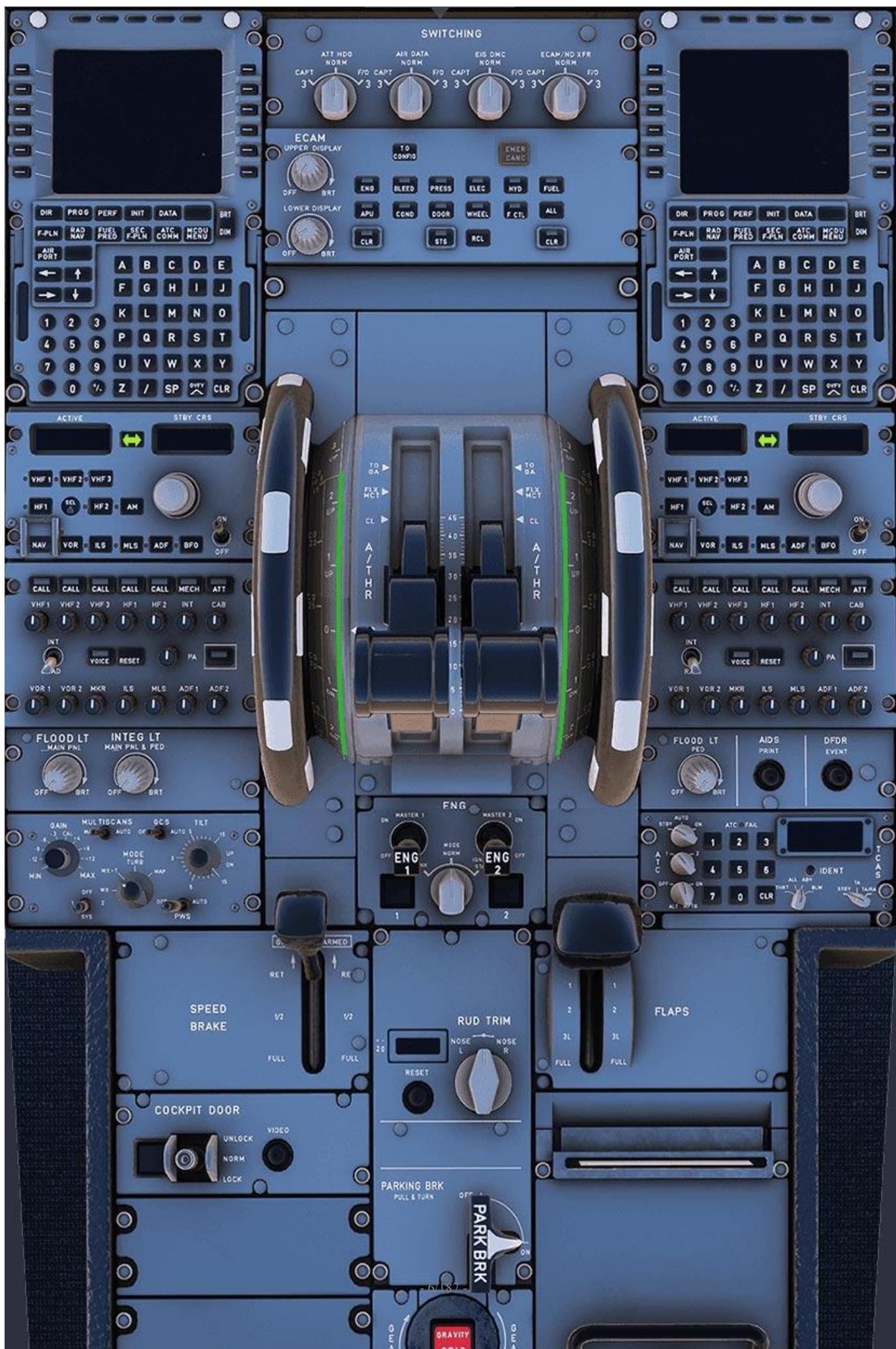
Cockpit Preparation

To start off, we will begin by doing a few pre-checks in all areas of the cockpit to ensure the aircraft is in an normal position before turning on the batteries.

We begin by looking down at the **bottom pedestal**.

- Place the parking brake handle in the `ON` position
- Ensure the speed brakes have been disarmed/retracted
- Flaps are retracted
- Weather radar is switched off
- Engine masters 1 and 2 are in the `OFF` position
- Engine mode selector is set to `NORM`
- Thrust levers are idle

This is how the pedestal should look like:



We then direct our attention to the **main panel** and make sure the following is set:

- Gear lever is down

Then we look up at the **overhead panel**. Make sure the following are in the set position before moving on to starting the aircraft:

- Wiper selectors are in the **OFF** position



Overhead Panel

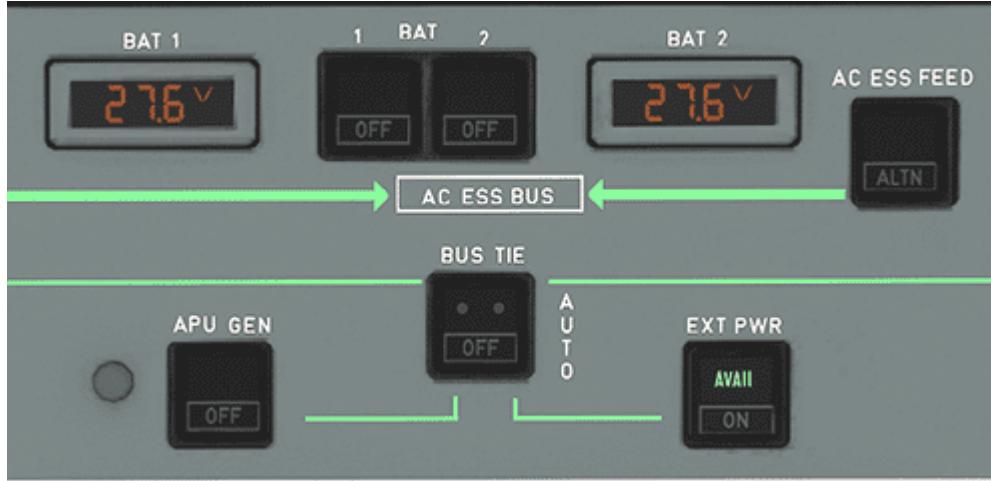
ELECTRICAL SECTION

We begin with turning on batteries **BAT 1 AND 2**. After pushing these buttons, we check to see on both sides that there is voltage. We will also hear chimes indicating the batteries are on.

To give power to the aircraft we will use the "Ground Power Unit". If ground power isn't available we can also use the APU.

Ground Power

If ground power is available, we should see a green **AVAIL** light on the **EXT PWR** button. Push on this button to give power to the aircraft.



APU

If ground power isn't available, we turn on the APU. To do this, we simply push on the **APU MASTER SW** and **START**. The APU should be on within one minute.



After powering the aircraft, we turn on the crew oxygen supply by pushing on the button, diminishing the white **OFF** light.



ADIRS ALIGNMENT

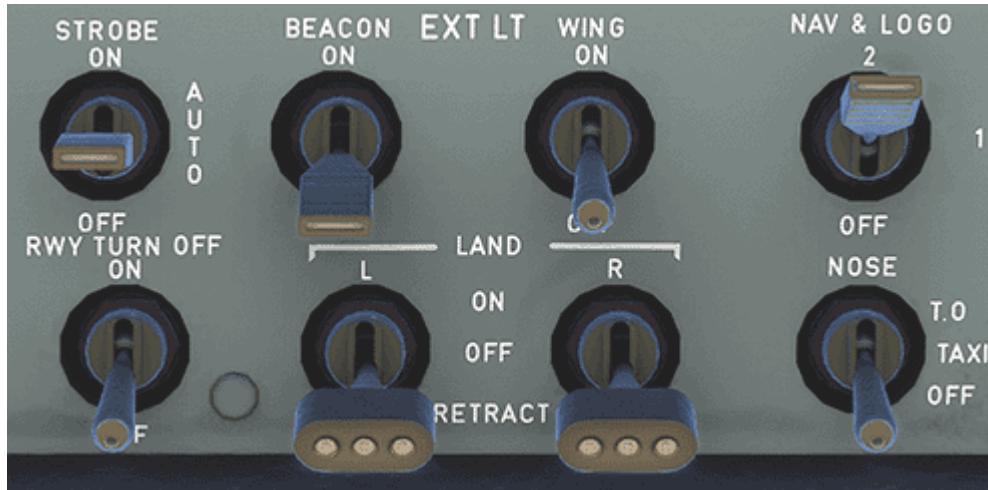
To align the Inertial Reference System (or IRS), we turn the 3 knobs to the **NAV** position. This will then start the IRS alignment for which we can view the progress on the ECAM display.



LIGHTING**Exterior**

To indicate that the aircraft is powered from the exterior, we turn on the **NAV & LOGO** light.

Following this, we set the **STROBE** light to the **AUTO** position.

**Cockpit**

We can turn on a few lights to help with visibility inside if it is too dark inside the cockpit.

- The **DOME** light has 3 settings to choose from. We can set it into the **OFF** position, the **DIM** position, or even the **BRT** position.
- The **OVHD INTEG LT** will allow us to see the outlines of the overhead panel. Turning the knob will adjust its brightness.

Once our lighting is in the correct state:

- Seat belts sign - Set to **ON**
- No smoking sign - Set to **AUTO**

To arm the emergency exit lights, simply put the switch in the **ARM** position. The white **OFF** light to the left of the switch will disappear.

Looking up just a bit we find the **LDG ELEV** knob. This simply means the landing elevation which should be in the **AUTO** position.



Managing the temperatures of the cabin is necessary as well. Simply rotate the 3 knobs as needed.



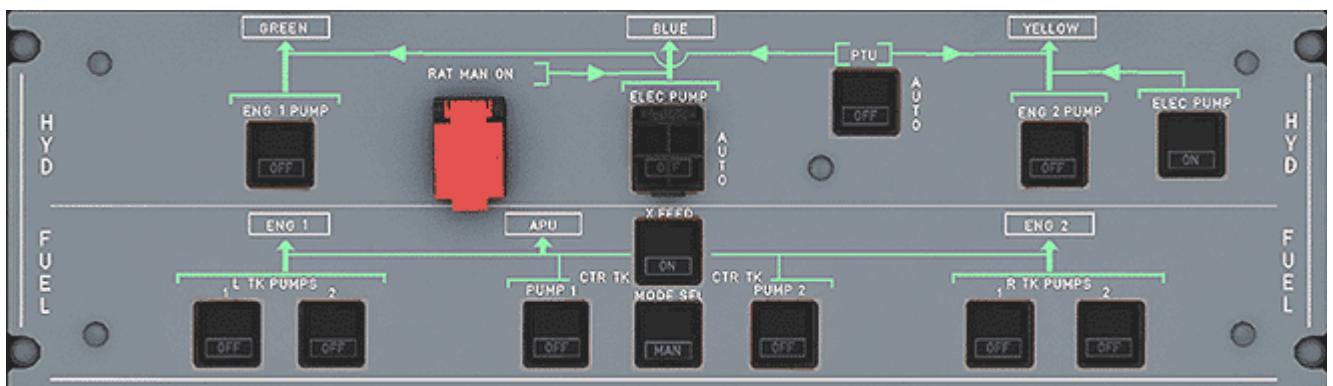
HYDRAULIC AND FUEL SECTION

Looking up at the **hydraulic panel**, we ensure that there are no white lights visible.

⚠ Fire Tests

To perform an APU and Engine fire test, hold down the **TEST** button for each of them for 5 seconds minimum to ensure the lights and aural warnings are working as expected. Checking the ECAM during the test will also show if the ECAM is performing as expected during a fire.

Just below the hydraulic panel, we find the **fuel panel**. Turn on all 6 fuel pumps until the white **OFF** light is no longer visible.

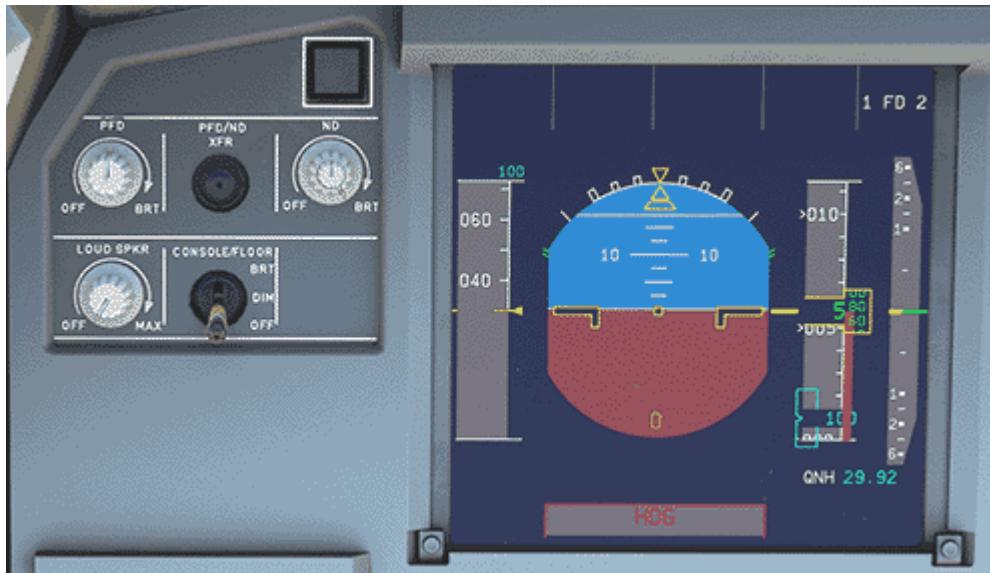


Main Panel

DISPLAYS

The brightness for each display can be adjusted to make them better readable.

For the PFD and ND, the knobs are in the same location. Look left (or right when in first officer seat) of the PFD and find the brightness knobs for them. Simply turn both knobs as required.



For the ECAM upper and lower display, look just in front of the throttles and find the brightness knobs. Just like the PFD and ND knobs, rotate them as required.



For the ISIS display brightness (just left of the upper ECAM), use the **+** and **-** buttons until the brightness is suitable. While we are at the ISIS display, set the current QNH.



RADIO PANEL

Looking down at the **radio panel**, set the **RMP 1** to the active **ATIS** frequency and set the standby frequency to the **ground** frequency.



After setting correct frequencies, locate the `BARO` reference on the **glareshield**. We can set the barometer to either `inHg` or `hPa` by turning the grey inner selector behind the knob. For this flight ensure that we are set to `QNH`. This can be changed by "pushing" on the BARO knob (the tooltip will have an upwards arrow).

i A note on QNH and QFE

Choosing between using QNH and QFE is a little beyond the scope of this guide. In most cases we will be flying using `QNH`.

- **QNH:** Altimeter indicates height above sea level.
- **QFE:** Altimeter indicates height above reference elevation in use (airfield or touchdown). This setting is usually tied to a procedure in use by the airfield, where when on the ground the altimeter will read 0.

Just below the barometer reference, turn on the `FD`. A green light indicates it has been turned on.



ECAM FUEL PAGE

Verify that on the ECAM fuel page that your aircraft has enough fuel for the flight.

If we do not have enough fuel for the flight we can refuel via Microsoft Flight Simulator's hovering menu bar or through the flyPad.



At this point we would have completed 5/7 task on the `Before Start` section on the FlyByWire A32NX checklist.

BEFORE START	
COCKPIT PREP	COMPLETED (BOTH)
GEAR PINS and COVERS.....	REMOVED
SIGNS.....	ON/AUTO
ADIRS.....	NAV
FUEL QUANTITY.....	KG.LB
TO DATA.....	SET
BARO REF.....	SET (BOTH)

This concludes the *Starting the Aircraft* guide.

Continue with [Preparing the MCDU](#).

Last update: August 23, 2021

1.2.3 Preparing the MCDU

This guide will help you prepare the MCDU in the A32NX for your departure. It includes a simple route that you can use to follow along easily and replicate in the simulator.

Disclaimer

The level of detail in this guide is meant to provide a FlyByWire A320neo beginner the ability to adequately program the MCDU to conduct and complete a flight.

A *beginner* is defined as someone familiar with flying a GA aircraft or different types of airliners. Aviation terminology and know-how is a requirement to fly any airliner even in Microsoft Flight Simulator.

You will find many great videos on YouTube on how to fly the FlyByWire A32NX.

Check out the FlyByWire YouTube Channel as well: [FlyByWire on YouTube](#)

The simBrief route used in this guide

[Download simBrief OFP](#)

Prerequisites

Below are a few Prerequisites before programming the MCDU.

Visit [Starting the Aircraft](#) to learn more.

- Make sure the aircraft is powered up.
 - External Power OR APU
- Make sure the ADIRS are set to NAV.
- Have a valid flight plan.
- Ensure IFR clearance has been obtained.

Requesting IFR Clearance

Before departing for the flight, we must obtain an IFR clearance from ATC. The clearance may be obtained from clearance delivery or another specific frequency, depending on the airport and available services.

If you are not flying on network and are using the built in ATC menu, simply find the appropriate selection in the menu and request for IFR clearance.

Clearances will usually provide the following information below. As a pilot you would need to read back the clearance correctly or acknowledge it if using the built in ATC menu.

- Cleared to the destination via specified route in the filed flight plan.
- Initial cleared altitude after departure.
- Assigned SID for departure OR radar vectors
- Assigned departing runway.
- Transponder/squawk code.
- Departure frequency.

Additional reading material: [The CRAFT mnemonic](#)

Chapters / Phases

This guide will cover the following topics:

1. Understanding the MCDU

2. MCDU Programming

- DATA
- INIT A
- FLIGHT PLAN
- SECONDARY FLIGHT PLAN
- RAD NAV
- INIT B
- PERF

3. A32NX simBrief Integration

Understanding the MCDU

During the course of this guide we will be referring to a few key terms which are defined below.

LINE SELECT KEY (LSK)

LSK for short. These keys are on the left and right hand side of the MCDU screen. They are highlighted in the image below.

- Left hand keys are referenced (in descending order) as LSK1L – LSK6L .
- Right hand keys are referenced (in descending order) as LSK1R – LSK6R .

**SLEW KEYS**

These keys are referenced below.



Info

Horizontal Slew Keys

These keys scroll between certain pages i.e. `INIT A` and `INIT B` when the INIT page is selected.

Vertical Slew Keys

These keys scroll vertically on certain pages i.e. `F-PLN` page.

MCDU Programming

D.I.F.S.R.I.P.

Pilots commonly use the acronym above when programming the MCDU. It represents the following flow on the MCDU:

- DATA
- INIT A
- FLIGHT PLAN
- SECONDARY FLIGHT PLAN
- RAD NAV
- INIT B
- PERF

The simBrief route used in this guide - [Available Here](#)

DATA

This MCDU page provides various data for the pilots. It has two pages (accessed by using the horizontal slew keys). It will not be used for this tutorial.

DATA includes the pages below:

- Position Monitor
- IRS Monitor
- GPS Monitor
- A/C Status
- Closest Airports
- Equitime Point
- Waypoints
- NavAids
- Runways
- Routes

INIT A

FROM/TO Field

- Using the keypad type in `EGFF/EGCC`
- Once this is in the scratch pad press LSK1R.
- This following screen would show "company routes". Since there are none stored select `Return` using LSK6L.

FLT NBR

- Using the keypad type in EZY123 and press LSK3L. Feel free to use your own flight number here!
- If you have the Free Text module enabled for your flight, this will enable other users flying the A32NX to send you messages. This will not be covered in this guide.

COST INDEX

[OFP]		N251SB/04 MAY/CWL-MAN						Page 1	
N251SB	04MAY2021	EGFF-EGCC	A20N	N251SB	RELEASE	2105	04MAY21		
OFP 1		CARDIFF-MANCHESTER			WX PROG	0421	0500	OBS	0412 0412
ATC C/S	N251SB	EGFF/CWL	EGCC/MAN	CRZ	SYS	CI 44			
04MAY2021	N251SB	2140/2200	2238/2246	GND	DIST	171			
A320-251N /	LEAP-1A26		STA 2240	AIR	DIST	178			
		CTOT:....		G/C	DIST	124			
MAXIMUM	TOW	79000	LAW 67400	ZFW	64300	AVG WIND	305/024		
ESTIMATED	TOW	66426	LAW 64999	ZFW	63535	AVG W/C	M011		
						AVG ISA	M012		
						AVG FF KGS/HR	2230		
						FUEL BIAS	P00.0		
ALTN						TKOF ALTN		
FL STEPS	EGFF/0220/								

The cost index can be found in the image above.

- Using the keypad type in 44
- Press LSK5L.

CRZ FL/TEMP

N251SB/04 MAY/CWL-MAN										Page 1	
[OFP]											
<hr/>											
N251SB	04MAY2021	EGFF-EGCC	A2ON	N251SB	RELEASE	2105	04MAY21				
OPF 1		CARDIFF-MANCHESTER			WX PROG	0421	0500	OBS	0412	0412	
ATC C/S	N251SB	EGFF/CWL	EGCC/MAN		CRZ	SYS		CI	44		
04MAY2021	N251SB	2140/2200	2238/2246		GND	DIST			171		
A320-251N /	LEAP-1A26		STA 2240		AIR	DIST			178		
		CTOT:.....			G/C	DIST			124		
MAXIMUM	TOW	79000	LAW	67400	ZFW	64300		AVG WIND	305/024		
ESTIMATED	TOW	66426	LAW	64999	ZFW	63535		AVG W/C	M011		
								AVG ISA	M012		
								AVG FF KGS/HR	2230		
								FUEL BIAS	P00.0		
								TKOF ALTN		
<hr/>											
ALTN											
FL STEPS EGFF/0220/											

Input the desired cruise flight level in this field. On our OFP this is listed as 0220 or FL220.

- Using the keypad type in 220
- Press LSK6L

This will input FL220 and the temperature as well.

FLIGHT PLAN

Upon loading the flight plan page there will be three entries. Departure airport, (DECEL), and arrival airport.

Our route for this flight can be found on the 2nd page of the OFP

i Routing Disclaimer

Note, that waypoints, STARs, and SIDs may be called differently due to different nav-databases or different AIRAC cycles between simBrief and the simulator.

ROUTING:

ROUTE ID: DEF RTE
EGFF/30 BCN1A BCN N864 MONTY MIRSI1A EGCC/05R

EGFF/30 BCN1A BCN N864 MONTY MIRSI1A EGCC/05R

Inputting a SID

SID

Standard Instrument Departure Route

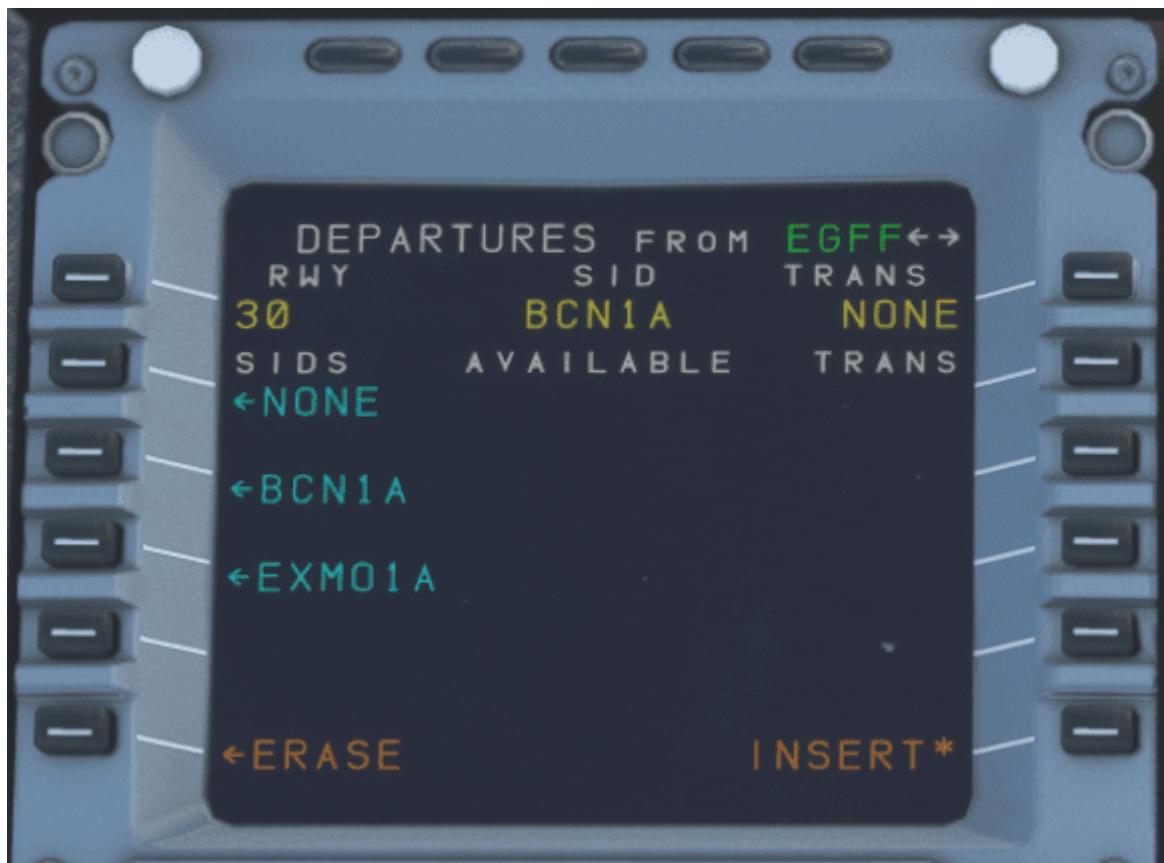
These are procedures that are defined and published that takes a flight from the take-off phase to the enroute phase.

Also see: [SIDS and STARS](#)

To program the Standard Instrument Departure (SID):

- Press LSK1L or EGFF (the departure airport)
- Select **DEPARTURE** shown next to LSK1L
- Select the runway we are departing from. In this case **30** using LSK3L
- On the list of SIDs select the **BCN1A** departure

The MCDU should now show at the top of the screen in yellow what is selected for our departure from EGFF.



- Press **INSERT** using LSK6R to program this into the flight plan.

Our flight plan should now have the associated waypoints for the **BCN1A** SID. We can scroll through the flight plan using the vertical slew keys. The SID terminates at **BCN** and this is where we can begin to fill out the rest of the flight plan.

BCN1A ILS Frequency

When selecting a departure SID that pairs with a LOC/ILS frequency, the respective frequency will be auto-populated in RADNAV provided it is available from the navdata.

Enroute Flight Plan

- Press the LSK that matches the location of **BCN** on the MCDU screen.
- Select **AIRWAYS** using LSK5R.
- Using the keypad type in **N864** (*the airway*) and press LSK1L.
- Using the keypad type in **MONTY** (*waypoint*) and press LSK1R.
- Remember: Airways are on the left and waypoints are on the right.

Planning the Arrival

For the purposes of this guide we will preplan our arrival into EGCC via the **MIRST1A** STAR into 05R.

i **STAR**

Standard Terminal Arrival Route

Similar to the SID, these are procedures that are defined and published that takes a flight from the last point in a route (*in our case MONTY*) to the first point in the approach or the initial approach fix (IAF).

Also see: [SIDS and STARS](#)

Find `EGCC` in green in flight plan OR select `EGCC` in white under `DEST` using the corresponding LSK.

- Select `ARRIVAL` using LSK1R
 - We will be shown the approaches available designated by `Type` `Rwy`.
 - For this guide we will shoot for an ILS to keep it simple.
- Use the vertical slew keys to find `ILS05R` and select it using the corresponding LSK.
- Again use the vertical slew keys to find the STAR for this flight `MIRSI1A` and select it using the corresponding LSK.
- We won't have any vias for this flight. Select `NO VIAS` using LSK2L. On the following page we can choose transitions if available, but for this flight we don't.
 - *Note:* Due to the default MSFS flight plan manager we maybe directed to proceed via the `MCT` waypoint anyways for the arrival.
- Insert this STAR into the flight plan using LSK6R.



Verify the flight plan by using the vertical slew keys to scroll through it.

i Viewing Flight Plan on ND

We can also verify the route looks correct by selecting `Plan` on the EFIS control panel and watching the ND as we scroll through.

⚠ USR Waypoints

One thing to note are the USR waypoints the sim inputs into the flight plan. These are pseudo waypoints the simulator creates to draw the flight plan.

There is a small bug in the simulator where the USR waypoint on arrival may bug out and proceed direct to runway. Please be aware and use selected HDG to mitigate this issue.

SECONDARY FLIGHT PLAN

This page will allow us to input a secondary flight plan. This page is currently inoperable in the A32NX. We will update this portion of the guide when it is usable.

RAD NAV

On this page, we would set any frequencies or identifiers needed for the departure and subsequently later enroute those required for the arrival.

For the purposes of this guide we will be using frequencies in the RADNAV page.

If we would like to have additional navaids for the departure, we can input the runway localizer for runway centerline guidance on the PFD and the initial procedure turn, including the BRECON VOR (BCN) to verify the track enroute to BCN. This is a little bit more advanced than this guide allows for but we will cover how to input frequencies.

VOR

On this departure we have the BCN VOR with a frequency of `117.45`

- Using the keypad type in `117.45` and press LSK1L. This will auto populate the identifier of the VOR when within range.
- We can also set the desired course to track `031` and press LSK2L to input it.

Departure ILS

When selecting the SID earlier in the flight plan section, the A32NX should have auto-populated the ILS/LOC frequency. If it hasn't we can manually insert it for centerline guidance on take off.

Our departure runway is EGFF/30 (runway 30) which has a frequency of `110.7`. When inputting a frequency and we are in range of the ILS it will auto populate the identifier and course. There is no need to fill these fields.

- Using the keypad type in `110.7` and press LSK3 to input it.

Arrival ILS

With an ILS or LOC approach selected, the arrival ILS frequency should be automatically tuned correctly whenever the aircraft is at climb phase or greater and within 250 NM of destination. **Ensure** that we verify the ILS frequency when we reach the arrival phase of the flight - see [Approach and Landing \(ILS\)](#).

Remember our arrival airport/rwy is `EGCC/05R` with ILS05R having a frequency of `111.55`. When inputting a frequency and we are in range of the ILS it will auto populate the identifier and course. There is no need to fill these fields.

- Using the keypad type in `111.55` and press LSK3 to input it.



ADF

This works much in the same way as the examples above.

INIT B

To navigate to the **INIT B** page we first have to select the **INIT** button. Once on **INIT A** use the horizontal slew keys to switch the page to **INIT B**.

On this page, we can input our zero fuel weight (ZFW) and zero fuel weight center of gravity (ZFWCG).

A Important Info

Fuel and payload have to be set in the simulator before ZFW/CG for the end result to be correct. (Unless you want to use the default fuel and weight).

NOTE: It is advisable to **not** use the MSFS Fuel Panel to load fuel or weights.

To learn how see [Load Fuel and Payload](#) in the simBrief integration below.

The A32NX can auto populate this information.

- Press LSK1R to load in the calculated ZFW/ZFWCG into the scratch pad at the bottom of the MCDU.
- Press LSK1R a second time to input the above calculation into the MCDU. (The empty orange boxes should now be filled in by the scratch pad entry).

Now we can add our fuel on board (FOB). The amount we input in this field can be done in one of three ways:

- Indicated FOB on the upper ECAM.
- we can have the MCDU plan the amount of fuel required.
- The amount indicated in the OFP.

Loading Fuel

We can load fuel two ways:

- Via the AOC - [Learn How](#)
- Via the EFB (not covered in this guide)

ECAM FOB

Look at the upper ECAM and note the FOB indicated. Let's say that amount is **3091 KG**. When inputting the block fuel into the MCDU it is referenced in "Tons"

and we should round to the closest decimal point.

- Using the keypad type in **3.1** and press LSK2R.

MCDU Planning

We can choose to have the MCDU provide a recommended amount of fuel for the planned flight.

- Press LSK3R to compute an amount of fuel.

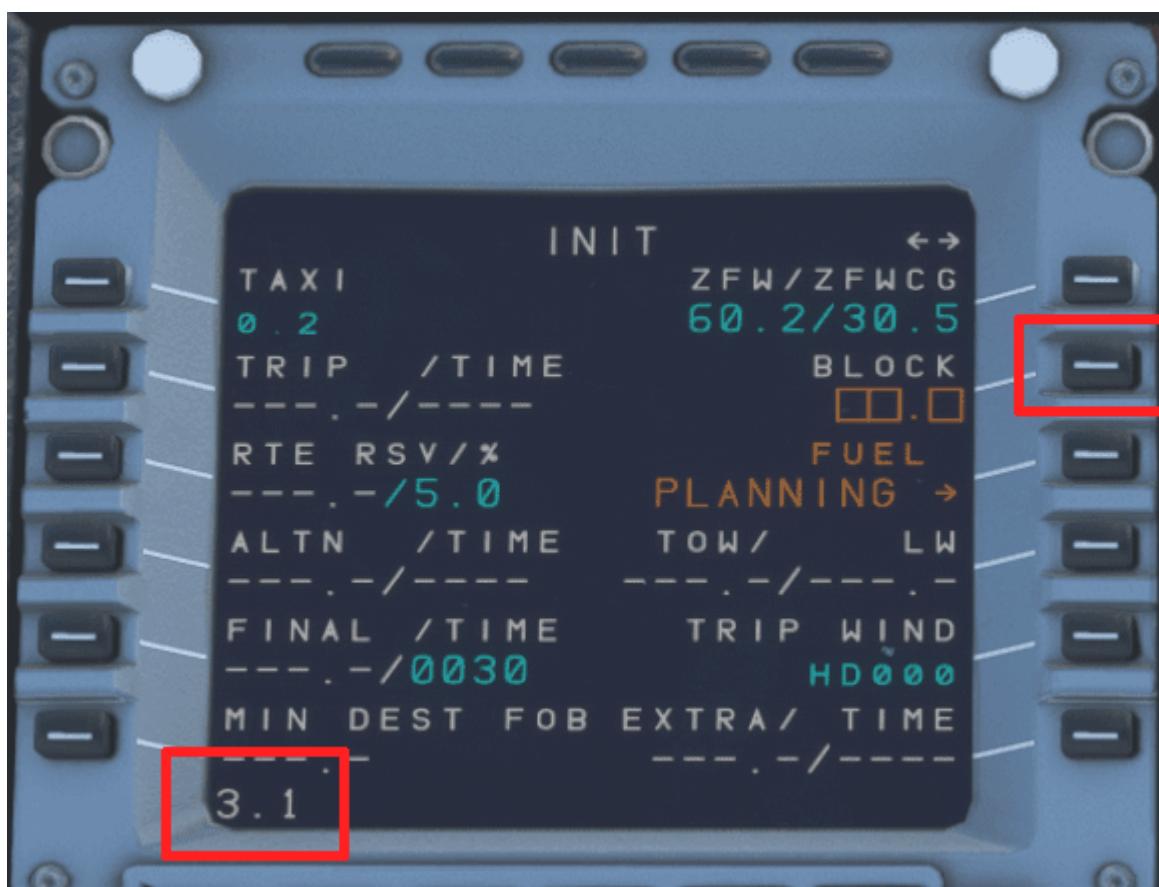
The **Block** field will be populated with a calculated fuel amount.

- Press LSK3R again to confirm the fuel.
- We should load this amount of fuel via the EFB or AOC option.

SimBrief OFP

We can use the planned block fuel stated on the OFP which in this case is **3091 KG**.

- Using the keypad type in **3.1** and press LSK2R
- We should load this amount of fuel via the EFB or AOC option.



PERF

The performance page changes based on the relative stages of flight until we land the aircraft. When programming the MCDU on the ground we start on the take-off performance page.

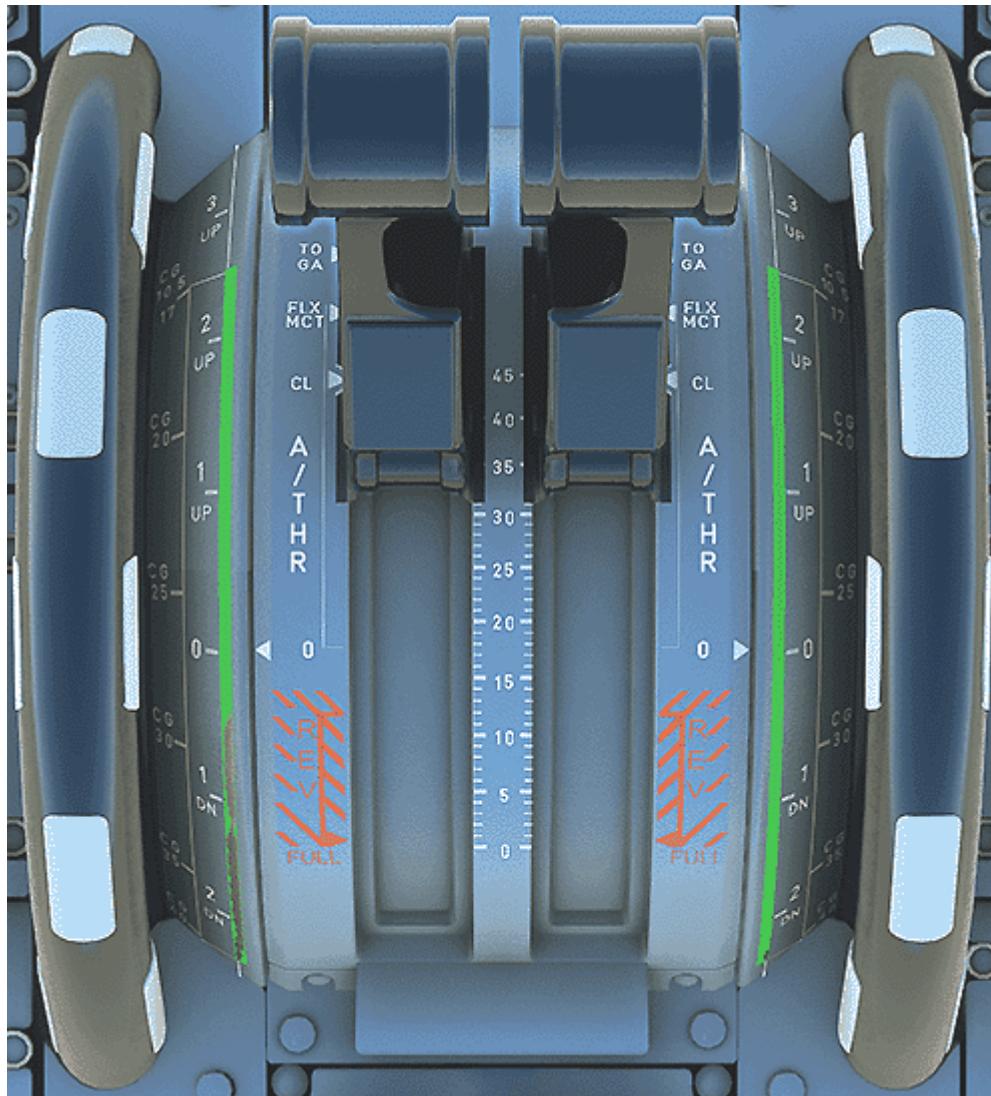
For this flight we will be taking off with a **1+F** flaps configuration.

- Using the keypad type in **1** and press LSK3R

Entry of the THS field is subject to airline SOP and may not be required.

The THS field is where we enter the stabilizer trim for takeoff based on the aircraft's CG. The FUEL PRED page provides an auto-calculated CG of 30.5.

Take a look at your throttle quadrant and look for the CG markings on next to the trim wheel. We need to set a nose down trim of about 0.8.



- Using the keypad type in **/DN0.8** and press LSK3R

Other valid entries for THS include:

- With flaps setting example: **1/DN0.8**
- Nose up example: **/UP0.5**

We can also choose to set a `FLEX TO TEMP` for the flight. The example we are using today is 60 degrees. (This will normally be calculated via a pilot's company EFB or other tools).

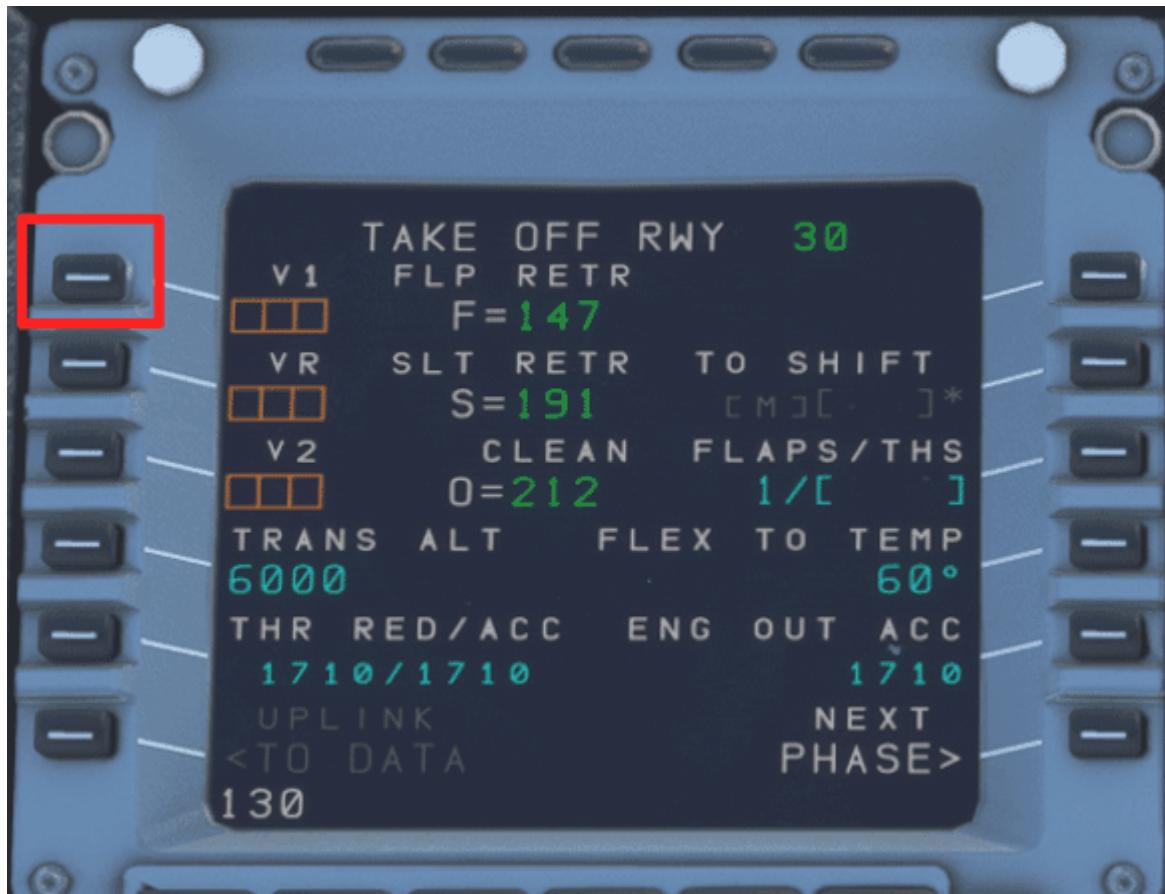
- Using the keypad type in `60` and press LSK4R

Our SID chart mentions that the TRANS ALT for this departure is 6000ft.

- Using the keypad type in `6000` and press LSK4L

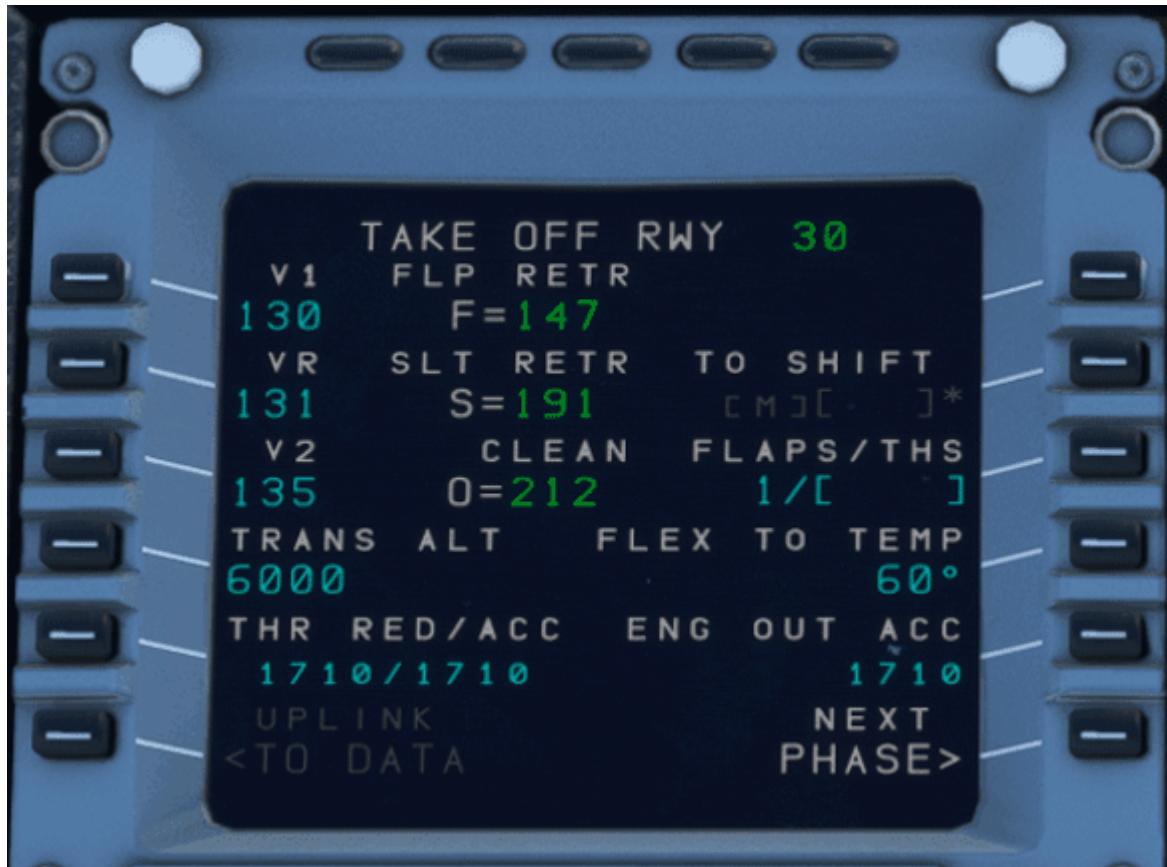
The A32NX can calculate the V-Speeds automatically. To do this simply:

- Press LSK1L to have the calculated V1 speed appear in the scratchpad.



- Press LSK1L again to have 130 inputted into the V1 speed.
- Repeat this procedure for VR and V2.

The performance page should now look like this:



A32NX simBrief Integration

This section has been moved to our dedicated [simBrief Integration](#) feature guide.

After setting up the MCDU continue with [Engine Start and Taxi](#)

Last update: September 22, 2021

1.2.4 Engine Start and Taxi

This guide will explain the correct procedures to accomplish a pushback with engine start and perform a safe taxi to the departure runway.

Disclaimer

The level of detail in this guide is meant to get a FlyByWire A320neo beginner safely from the terminal to the runway hold short point.

A *beginner* is defined as someone familiar with flying a GA aircraft or different types of airliners. Aviation terminology and know-how is a requirement to fly any airliner even in Microsoft Flight Simulator.

You will find many great videos on YouTube on how to fly the FlyByWire A32NX.

Check out the FlyByWire YouTube Channel as well: [FlyByWire on YouTube](#)

Prerequisites

- BEFORE START checklist completed
- IFR clearance obtained
- The aircraft is secure
- APU MASTER SW - Set to ON and the APU is available
- Beacon light - Set to ON

At this time we may request for clearance to push and start from ATC.

[Download FlyByWire Checklist](#)

Chapters / Phases

This guide will cover these chapters:

1. [Pushback](#)
2. [Engine Start](#)
3. [After Engine Start](#)
4. [Flight Controls Check](#)
5. [Taxi](#)
6. [General Resources](#)

Pushback

There are several options available to you in MSFS to achieve a successful pushback.

- The flyPad (EFB) ground control screen
- MSFS built in ATC pushback controls
- Third party pushback addons

BEFORE PUSHBACK

Once all passengers have boarded and secured we are ready to begin pushback.

Ensure:

- All doors to the aircraft are armed and secure.
- EXT power has been disconnected.
- APU BLEED - Set to ON

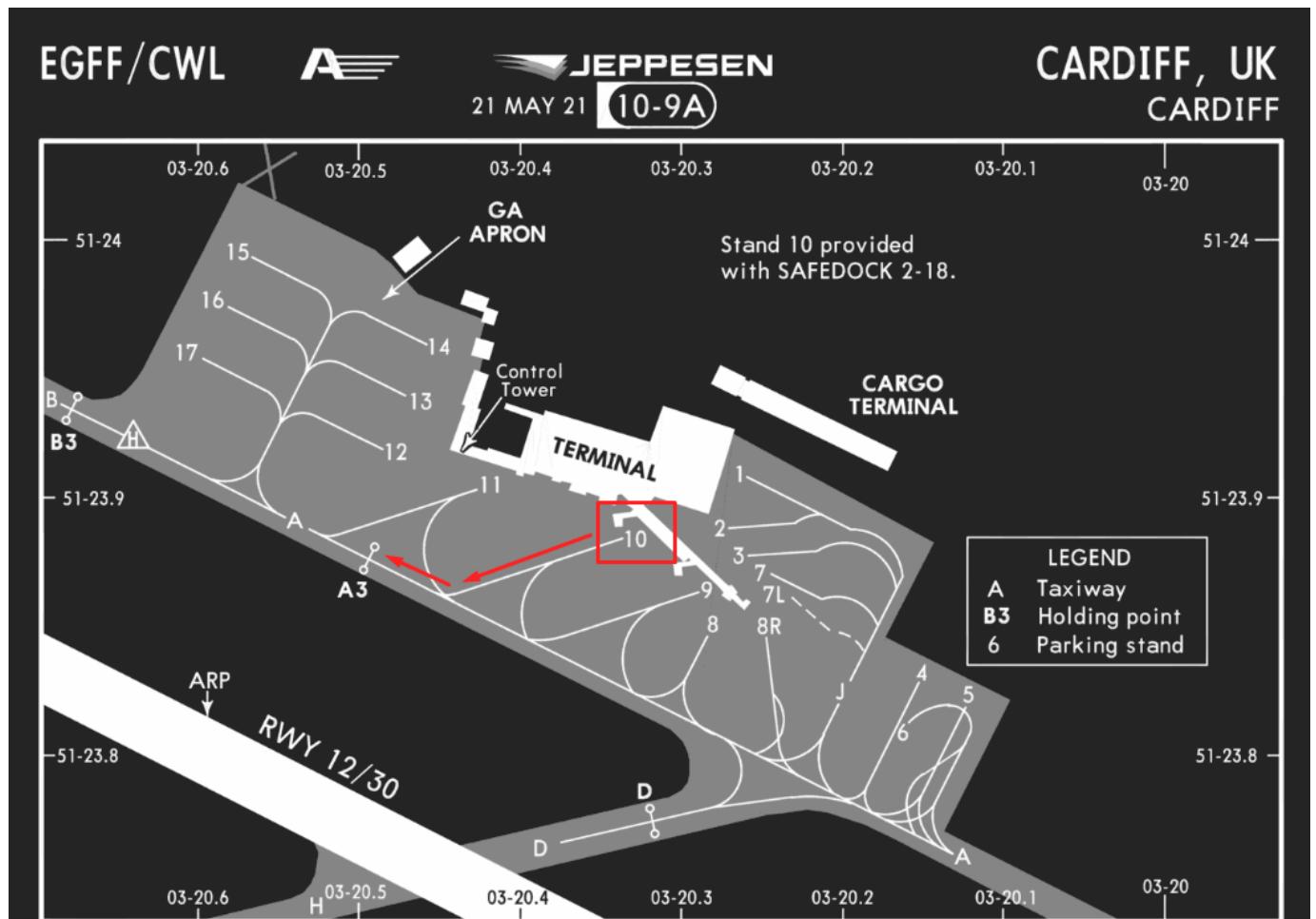
PUSHBACK CLEARANCE

For this guide we will assume you are parked at gate 10 at EGFF (Cardiff).

Contact ground ATC and inform them you are ready for push and start. If you are on a network such as VATSIM, a typical response from ground would give you clearance for your request and a direction to face (or any direction). At EGFF you could expect the following push and start clearance from ground:

"Your Aircraft Callsign, ground. You are clear to push and start onto Alpha 3 facing east."

At this point we may begin pushback away from the terminal onto the taxiway Alpha 3.



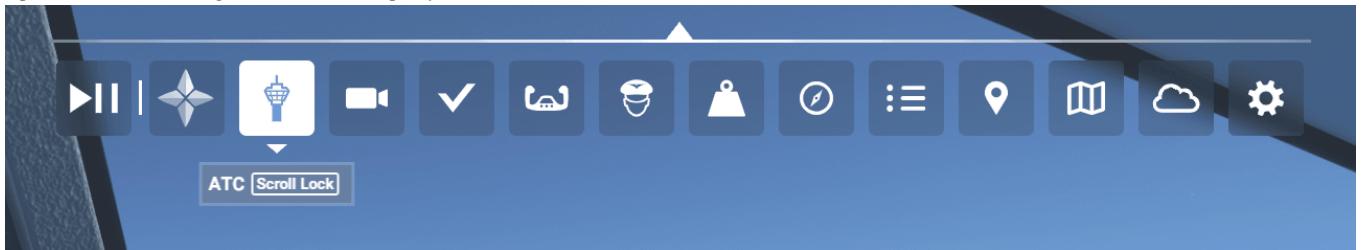
Copyright © 2021 Navgraph / Jeppesen

"Navgraph Charts are intended for flight simulation use only, not for navigational use."

HOW TO USE MSFS PUSHBACK

For the purposes of this guide we will use the default MSFS pushback controls built into ATC.

1. Open the ATC menu using the toolbar at the top of your screen.



2. Locate GROUND SERVICES and select it.

3. Select REQUEST PUSHBACK.

- You should hear your virtual pilot request pushback and ATC respond confirming. At this time the pushback tug should slowly make its way to your nose wheel.
- You will notice a slight "jerk" as it connects with your nose wheel. Verify NWS STRG DISC is listed on the ECAM memos.

4. Release your parking brake.

5. In the ATC window use REQUEST PUSHBACK STEER TO THE LEFT OR REQUEST PUSHBACK STEER TO THE RIGHT to turn the aircraft.

6. Select REQUEST PUSHBACK STOP to end pushback when you are satisfied with your position on the taxiway.

i Steering Commands

Please note when selecting other option this will "steer" the tail towards the specified direction.

For example, if your external camera is directly behind the aircraft and you request STEER TO THE LEFT the tail of your aircraft will be "steered" to the left.

Engine Start

Once we are clear of the terminal and/or the ground crew has notified the flight crew it is clear to start engines, we can proceed with the following steps.

Start the chronometer above the ND to help monitor the start up time of the engines.



Using the Chronometer

The chrono button has three states depending on how many times you have pushed the button:

1. First Push - Starts the timer on the ND
2. Second Push - Stops the timer on the ND
3. Third Push - Removes the timer from the ND

Time is represented as *minutes' seconds*" i.e. 04'41" equates to 4 minutes and 41 seconds.

Use Cases

There are a few different reasons pilots use the chronometer on the ND:

- Engine startup times.
- Duration of flight.
- Certain procedures such as a visual pattern or circling approach.

Location on the ND:



For this guide will begin by starting engine 2.

Differing airline SOP may have a different engine start order

Start Engine 2

1. Set the **ENG** mode selector to **IGN/START**
 - Flight crew should hear the packs turn off.
 - The lower ECAM should automatically display the engine parameters screen.
2. Set **ENG 2 Master** to the ON position.
 - Pay attention to the ECAMs and note engine parameters as ENG 2 starts up.
 - The engine should take roughly 1 minute to complete its start up sequence - use the chronometer started earlier to time this.

Engine 2 will have successfully started when the following applies (at ISA sea level):

- N1 is at roughly 19%
- N1 reported **AVAIL**
- N2 is at roughly 68%
- EGT settles at about 520°C
- FF is at roughly 290 kg/h

Start Engine 1

1. Set **ENG 1 Master** to the ON position.
 - Pay attention to the ECAMs and note engine parameters as ENG 1 starts up.
 - The engine should take roughly 1 minute to complete its start up sequence - use the chronometer we started earlier to time this.

Engine 1 will have successfully started when the following applies (at ISA sea level):

- N1 is at roughly 19%
- N1 reported **AVAIL**
- N2 is at roughly 68%
- EGT settles at about 520°C
- FF is at roughly 290 kg/h

After Engine Start

Complete the after start flow:

- Set the **ENG** mode selector to **NORM**
- **FLAPS** - **Set**
 - As defined in the MCDU Preparation guide.
 - Note: If taxiing in icing conditions with rain, slush or snow:
 - Maintain the flaps retracted until the aircraft reaches the holding point of the takeoff run. This action prevents contamination of the slats/flaps mechanism.
- **GROUND SPOILERS** - **Arm**
- **APU BLEED** - **Set to OFF**
- **APU MASTER SW** - **Set to OFF**
- **ANTI ICE** - **As required**
 - Consider when temperatures are less than 10C and visible moisture.
- **PITCH TRIM** - **Check**
- **RUDDER TRIM** - **Zero**

Perform the AFTER START checklist.

AFTER START	
ANTI ICE.....	AS RQRD
ECAM STATUS.....	CHECKED
PITCH TRIM.....	% SET
RUDDER TRIM.....	ZERO

Flight Controls Check

Airlines may perform the flight controls check at different points depending on their SOP. Most notably the common instances are:

- After completing the AFTER START checklist and before taxi.
- During taxi out.

PERFORMING A FLIGHT CONTROLS CHECK

Using the ECAM control panel press the **F/CTL** button to switch the lower ECAM to the flight controls. Ensure all flight controls are displayed in green.

The **F/CTL** ECAM page displays a white scale and green index for the following positions:

- Left and right ailerons position
- Left and right elevator position

Fully deflect the sidestick in all directions and observe that the full range of motion is reflected on the ECAM page. Note the upward arrows in the **SPD BRK** area when moving the ailerons and ensure those are displayed when deflecting the side stick.

Move the rudders and pay attention to the rudder symbol to ensure it moves all the way to the left or right.

Sidestick right full deflection:



Taxi

Taxi Speed + Engine Thrust

The A32NX is perfectly capable taxiing with idle thrust and even gradually accelerate. In certain situations it may be required to provide some thrust to begin rolling.

Standard behavior is to allow the aircraft to reach 30kts and apply brakes to 10kts. Repeat as necessary.

Having charts or diagrams of the airport you are currently in will help you navigate efficiently and safely. There are many resources and applications available online that are either free or paid which you can utilize.

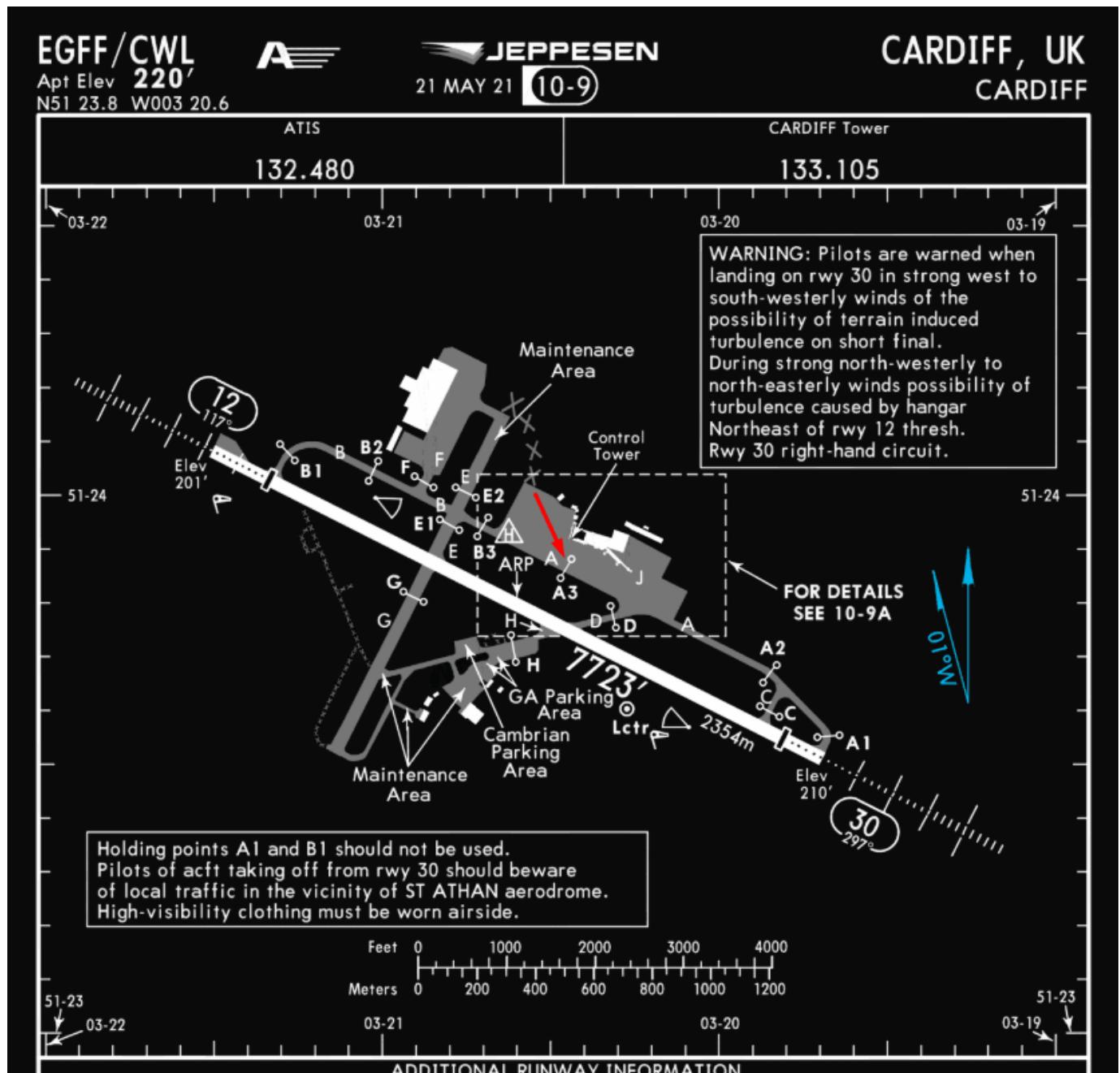
For additional information on signs and markings on the ground please see [General Resources](#) below.

TAXI CLEARANCE

After having successfully started the engines we can contact ATC to request taxi clearance. As per our routing in the [Preparing MCDU Guide](#) we should be expecting a takeoff from runway 30. As such a sample taxi clearance may be as follows:

"**Your Aircraft Callsign**, ground. Runway 30, taxi via Alpha, hold short of 30 on Alpha 2."

Referencing the airport chart below, the aircraft should be sitting on the Alpha taxiway near the Alpha 3 holding point. Luckily today our clearance is quite simple and we only have to taxi straight ahead and hold at Alpha 2.



Copyright © 2021 Navgraph / Jeppesen

"Navgraph Charts are intended for flight simulation use only, not for navigational use."

Make sure to pay attention to any warnings or notices on the respective taxi chart beforehand so you are aware of any important information while performing your taxi.

Once we have the routing from ATC and have read back the taxi clearance, we are now free to taxi to the runway.

MOVING THE AIRCRAFT

Exterior Lights:

- RWY TURN OFF - Set to ON
- NOSE - Set to Taxi



Before Moving Safety Check:

- Verify the ground crew is safely away.
- Look to the left and right to ensure clearance from other aircraft or vehicles.
- Release the parking brake.
- Brakes pressure - [Check at Zero](#)



At this point the aircraft may start rolling. Depending on the weight of the aircraft we may need to add a little power to the engines to get going. Increase power to roughly ~25-30% N1. Be mindful that we are not blasting N1 towards or around the terminal.

- Leave a bit of thrust on and perform a quick brake check to ensure hydraulics and brakes are fully functioning.
 - We don't need to come to a complete stop but merely check the brake pressure status when performing the brake check.
- If an arc is shown above the brake temperature on the WHEEL SD page on the lower ECAM, turn the brake fans on.

If it is required to perform a sharp turn immediately we may need more than ~25-30% N1 and should set the thrust accordingly. Try not to perform the brake check while in a turn as we don't want to come a complete stop while turning.

DURING TAXI

While underway to the runway perform the following as part of the taxi flow:

- Use the tiller (currently not implemented) or rudder pedals to steer the aircraft.
- Perform a [flight controls check](#) (if you haven't already).
- Verify the ATC clearance for departure.

It is important to verify and confirm the information in the MCDU as we taxi. This is increasingly important if the ATC clearance changes enroute to the runway.

Takeoff Data/Conditions

In case of a runway or takeoff data change, perform the following:

- FINAL TAKEOFF DATA - Confirm or Recompute
- FMS TAKEOFF DATA - Check/Revise as RQRD
- REVISED FMS TAKEOFF DATA - Crosscheck
- F-PLN (RUNWAY) - Revise
- FLAPS lever - As Appropriate *Select takeoff position*
- V1, VR, V2 - Reinsert
- FLX TO temperature - Reinsert

AFS/Flight Instruments

Perform the following:

- F-PLN (SID, TRANS) - Revise or Check
 - Check to ensure that the ATC clearance agrees with the flight plan if we are departing using NAV mode.
- INITIAL CLIMB SPEED AND SPEED LIMIT - Modify or Check
- CLEARED ALTITUDE ON FCU - Set
- HDG ON FCU - If Required, Preset
 - If ATC requires a specific heading after takeoff, preset the heading on the FCU. NAV mode will be disarmed and RWY TRK mode will keep the aircraft on the runway track.

This is the FCU (more details are provided in the [Take off, Climb, and Cruise Guide](#)):



- BOTH FD (*flight directors*) - Check on
- PFD/ND - Check
- TAKEOFF BRIEFING - Confirm
- RADAR (if required) - On

The current implementation of the weather radar in MSFS will show precipitation along the route. Additional functions are unavailable at this time however we should set the Radar to Sys 1 if required for departure.

- PREDICTIVE WINDSHEAR SYSTEM - Auto

Currently this only clears the warning on the ECAM and does not provide a function in the sim. We should perform this action regardless.

The weather panel is located on the bottom left of the lower pedestal and looks like the following:



- ATC code/mode - Confirm/Set for Takeoff
- TERR ON ND - As RQRD
- AUTO BRK MAX pb-sw - On



i Getting Ready for Take off

At this point in the guide you should have performed many of the essential flow items before you line up at the runway. The next guide [Take off, Climb, and Cruise](#) will instruct you on performing your final checks and before take off checklist.

For additional information: See the sections below for extended taxi information and visit the [General Resources Section](#) on this page to help you understand the different signs and elements found on the ground at an airport.

Speed While Taxiing

Pay attention to the ground speed (visible on the ND) while taxiing.

- **Straight Line**

Anything up to 30kts is reasonable, but some airports may carry their own local restrictions that should be noted. This is not an absolute rule and is usually typical SOP for airlines in a straight line.

- **90° (Sharp) Turns**

A good speed would be around 10kts. This provides safety for the flight crew as they perform their safety demonstration/checks.

- **Regular Turns**

Around 15kts is an acceptable speed with a similar concept to providing safety as described above.

Handy Tips While Taxiing

- **Maintaining Center Line**

We can use the grey vertical bar in between the PFD and ND as a reference point and keep the taxi line in between the two screens.

- **Turning**

Using the same bar mentioned above try to "over steer" (keep the nose wheel slightly ahead of the line while we turn). This helps keep the aircraft centered while performing a turn.

Slow down while turning!

Crossing a Runway

When approved to cross a runway (active or not) perform the following actions:

- Look out the windows and visually ensure that there are no visible aircraft to the left and right.
- Turn on extra lights to ensure the aircraft is visible when crossing:
 - Strobe lights - Set to ON
- Inform ATC we have vacated the runway if required.

Warning

Never cross a runway without express permission from ATC and providing a read back of said instructions. Always ensure maximum safety when crossing.

General Resources

This section provides you with information on understanding the different signs and markings you may see while taxiing at the airport.

AIRPORT SIGNAGE AND MARKINGS

Scenery / Accuracy Issues

Please be aware that the default scenery or 3rd party sceneries may not be entirely accurate with the posted signage on the ground. However, this guide will explain how to read and understand them.

FAA Quick Reference Guide

The FAA has a handy guide available for download that contains images of all the pertinent signs you may encounter, their purpose, and location at the airport.

[Download FAA Guide](#)

There are two types of signage at airports - operational guidance signs and mandatory instruction signs.

Operational Guidance Signs**Location Signs**

- These signs are yellow text on a black background. Typically, indicates a specific taxiway or runway your aircraft is on or entering.

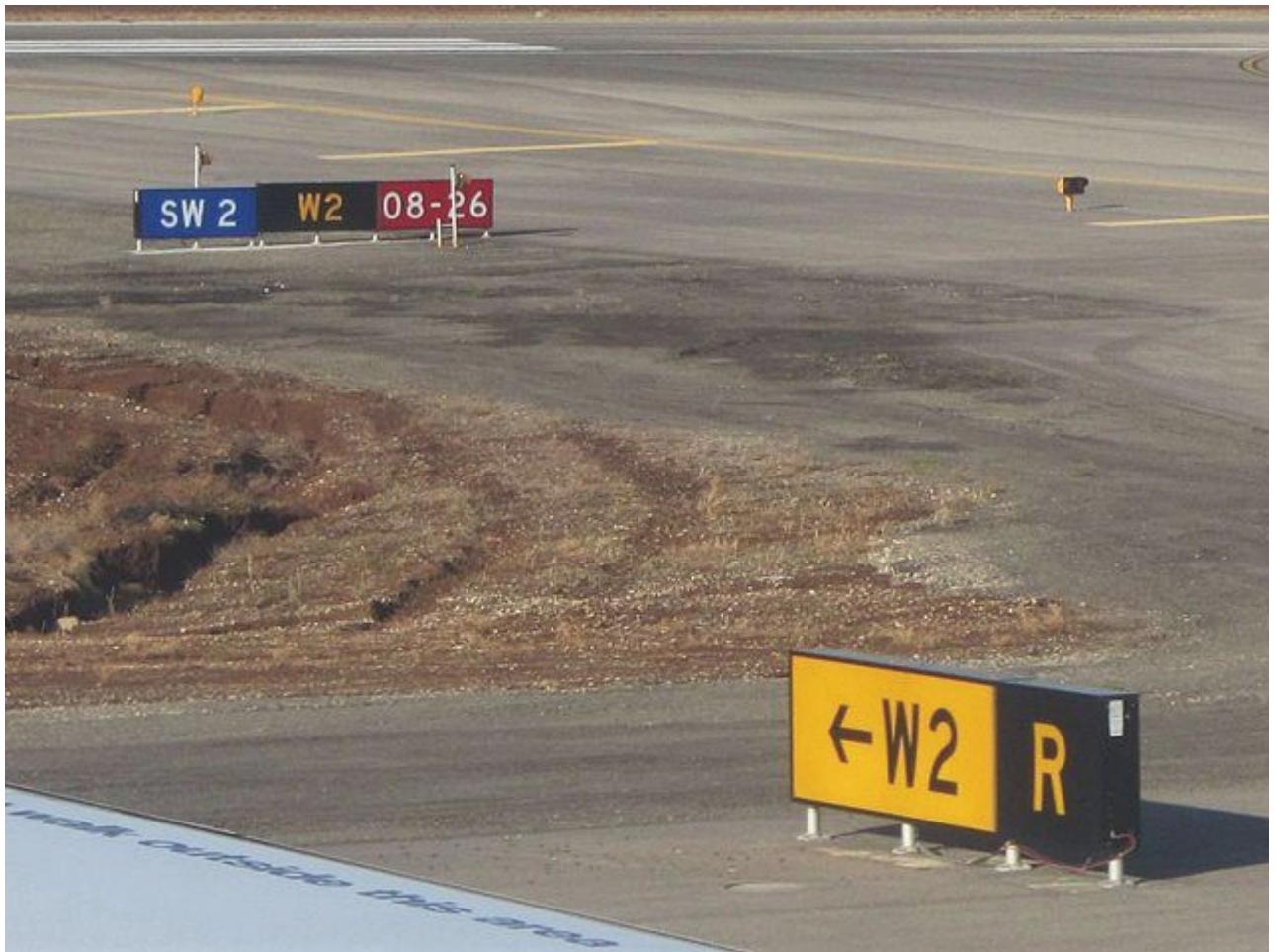
Direction/Runway Exit Signs

- Black text on a yellow background. These will have an arrow indicating direction to turn which helps pilots identify what taxiways they are approaching or runway exits towards a specified runway.



Stop Bar Signs

- White text on a blue background. These are non-standard signs that may appear at some airports usually indicating which taxiway a stop bar is positioned. Airports usually use more conventional traffic signs you may see on the road such a regular stop sign. See the [FAA Guide](#) for samples.



Mandatory Instruction Signs

Runway Signs

- White text on a red background. These signs inform pilots that a runway intersection is ahead.

Holding Position Signs / Markings

There are typically three very important holding position signs / markings that appear on the ground at airports. At various airports that operate with low visibility these positions are also paired with a line of red lights across a taxiway to help visually indicate the holding positions.

1. Runway Holding Position

- Two sets of solid yellow lines and two sets of dashed yellow lines indicate a holding position for a runway ahead. These **must never be crossed** without express permission from ATC.



"Holding position markings pattern A ahead of a crossing runway" by Claudio Henrichs CC BY-SA 2.0

2. Taxiway Holding Position

- Single dashed yellow line. If this is present along your taxi route it will indicate a position that ground control may request you stop and hold short prior to another taxiway.



3. ILS Critical Area

- Solid yellow lines that look like a railroad or ladder. These are another form of hold short point but indicate a critical area where your aircraft would violate the ILS approach airspace while on the ground.



TAXIWAY LIGHTING

Taxiway lighting helps the flight crew and ground crew navigate the airport at night or in low visibility and stop at the appropriate locations as given by ATC.

There are usually two types of lighting on taxiways - centerline and edge. Depending on the airport operator the lighting may differ if the airport operates in low visibility conditions.

- Centerline lighting is green on the principal taxiways located along the taxiway centerline. These lights can alternate between green and yellow when a taxiway crosses a runway or highlight a "lead-off" taxiway from a runway to join a taxiway.
- Edge lighting is typically blue and characteristically appears at the edges of a taxiway. Spacing can range from 50 - 200ft apart usually condensing in distance when approaching an intersection.



John Murphy, CC BY-SA 2.0

This concludes the *Taxi*.

Continue with [Takeoff, climb and cruise](#)

Last update: September 3, 2021

1.2.5 Takeoff, Climb and Cruise

This guide will explain the correct procedures to accomplish takeoff, climb and establish cruise altitude.

Disclaimer

The level of detail in this guide is meant to get a FlyByWire A320neo beginner safely up in the air and to cruise level under normal conditions while simplifying details which are not (yet) important for a beginner.

A *beginner* is defined as someone familiar with flying a GA aircraft or different types of airliners. Aviation terminology and know-how is a requirement to fly any airliner even in Microsoft Flight Simulator.

Further reading: [A320 Autoflight](#)

Also you will find many great videos on YouTube on how to fly the FlyByWire A32NX.

Check out the FlyByWire YouTube Channel as well: [FlyByWire on YouTube](#)

MSFS Start from Gate or Runways

Microsoft Flight Simulator allows you to start your flight from cold & dark at a gate or directly from the runway with the aircraft ready for takeoff.

For this guide we assume you started cold & dark at the gate and taxied to the runway holding point as per the previous chapters of this beginner guide.

If you did start on the runway you can skip the first part (Lineup) and directly continue reading [Takeoff](#).

Prerequisites

Aircraft is in TAXI state as per previous chapters

[Download FlyByWire Checklist](#)

Chapters / Phases

This guide will cover these phases:

1. [Lineup](#)
2. [Takeoff](#)
3. [Initial climb](#)
4. [Climb](#)
5. [Cruise](#)

Base Knowledge About the Airbus A320 for Flight

This list is focussed on differences to other non-Airbus airliners a user might be used to.

• Fly-by-wire system

Traditional mechanical and hydro-mechanical flight control systems use a series of levers, rods, cables, pulleys and more, which pilots move to adjust control surfaces to aerodynamic conditions. Their "hands on" design gives pilots a direct, tactile feel for how the aircraft is handling aerodynamic forces as they fly. On the other hand, mechanical systems are also complicated to operate, need constant monitoring, are heavy and bulky, and require frequent maintenance.

In fly-by-wire systems when the pilot moves flight controls, those movements are converted into electronic signals, which are then interpreted by the aircraft's Electrical Flight Control System (EFCS) to adjust actuators that move flight control surfaces. Computers also monitor sensors throughout the aircraft to make automatic adjustments that enhance the flight.

Because fly-by-wire is electronic, it is much lighter and less bulky than mechanical controls, allowing increases in fuel efficiency and aircraft design flexibility, even in legacy aircraft. And to prevent flight critical failure, most fly-by-wire systems also have triple or quadruple redundancy back-ups built into them. source: [BAE Systems](#)

See also: [Fly-by-wire Wikipedia](#)

• Autotrim

The A320 has a feature called "Autotrim", which makes it unnecessary to hold the sidestick or use the trim wheel for holding the current pitch. This system is always active, even when the **Autopilot** is off (in Normal Law which means under normal circumstances with a fully functional aircraft).

• Autothrust

The A320 has **Autothrust** which is similar to Autothrottle (e.g., in a Boeing), but it does not move the thrust levers. Basically the thrust levers are only moved by the pilot and never move on their own. The thrust levers act as a maximum allowed power setting for the autothrust system. During normal flight (after takeoff) the levers stay in the CL climb detent, and the Autothrust system will set engine power accordingly.

• Autopilot

The A320's **Autopilot** system works a bit differently from other manufacturer's systems. The A320 FCU controls allow setting certain values and then push or pull the knobs. Pushing usually means automatic control (Managed Mode) and pulling will use the manually selected value (Selected Mode).



Microsoft Flight Simulator knobs

In Microsoft Flight Simulator pushing is clicking the knob "UP" and pulling is clicking the knob "DOWN"



• Flight phases

The A320 uses flight phases to manage different parts of a flight. These are preflight, takeoff, climb, cruise, descent, approach, go around, done. They match the PERF pages in the MCDU (see [Preparing the MCDU](#)).

• Protections

The A320 includes many protections for the pilot which make it nearly impossible to stall or overspeed the aircraft. It's beyond this beginner-guide to go into details (Normal law, Alternate Law, ...)

1. LINEUP

Situation:

- ATC (Ground or Tower) has instructed us to hold at a runway holding point and wait until we are cleared to "line up" or "take off".
- Aircraft is still in TAXI state (see previous chapters) and parking brakes are set.



Typically, it is here at the latest that we are asked to switch to Tower ATC frequency for takeoff clearance.

While approaching the runway holding point or at the latest at the runway holding point the "**Before takeoff checklist**" needs to be completed.

Before takeoff checklist

The "Before Takeoff" checklist is divided into two parts:

- **"Down to the line"** (or "Above the line") means **before** "ATC Takeoff Clearance".
- **"Below the line"** means **after** T.O. clearance (when lined up) but before starting the roll.

BEFORE TAKEOFF	
FLIGHT CONTROLS.....	CHECKED (BOTH)
FLT INST.....	CHECKED (BOTH)
BRIEFING.....	CONFIRMED
FLAP SETTING.....	CONF ____ (BOTH)
V1. VR. V2/FLX TEMP.....	____ (BOTH)
ATC.....	SET
ECAM MEMO.....	TO NO BLUE
- AUTO BRK MAX	
- SIGNS ON	
- CABIN READY	
- SPLRS ARM	
- FLAPS TO	
- TO CONFIG NORM	
TAKEOFF RWY.....	CONFIRMED (BOTH)
CABIN CREW.....	ADVISED
TCAS.....	TA OR TA/RA
ENG MODE SEL.....	AS RQRD
PACKS.....	AS RQRD

Preparation and "Down to the line" Checklist pre-T.O.-clearance

The following steps from TAXI setup need to be done and checked:

- Check OVHD panel: APU off, no lights visible under normal circumstances
(exception: Pack 1+2 might be OFF if part of procedure)



2. Check Flight Controls

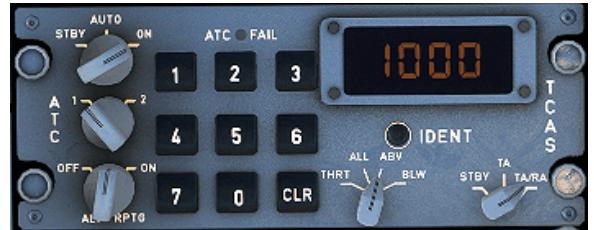
3. Check Flight Instruments



4. Check correct FLAPS setting (must be in line with PERF TAKE OFF page)
5. Check V_1 , V_R , V_2 speeds and also, if required, FLX temperature setting (PERF TAKE OFF page)
6. Check Squawk

- check squawk ID number
- Set to AUTO or On
- Set ALT RPTG to ON

7. Check COM frequency
- Tip: set the standby frequency of COM 1 to the Departure frequency to be able to quickly change after takeoff



8. Check ECAM - no blue writing should be visible for these:
- AUTO BRK MAX
- SIGNS ON
- CABIN READY
- SPLRS ARM
- FLAPS TO
- TO CONFIG NORMAL

9. Press T.O. Config button below the ECAM to check takeoff configuration (last blue text "TEST" should disappear)

10. Check radar panel:

- Set Weather Radar to Sys 1 to show weather on ND
- Check if Predictive



Windshear Alerts (PWS) is set to AUTO (should have been set to AUTO during TAXI)

Entering Runway

Before we start rolling we visually check that no other aircraft is on final approach. We can also use TCAS on the ND to check for aircraft in the vicinity.

If everything is clear we release the parking brake and slowly roll onto the runway in the direction of takeoff and come to a stop on the runway's center line.

There is also a *rolling start* where we would not stop but directly apply thrust for takeoff once we are straight on the runway. But, as a beginner, a full stop is recommended, so we can double-check everything.

When we reached our starting point we stop and set the parking brakes.



If we were only cleared to "line up" we wait here until we get clearance to *take off*.

This concludes *Lineup*.

2. TAKEOFF

Situation:

- Aircraft is on runway and fully setup for takeoff as per previous chapters.

Preparation and "Below the line" Checklist post-T.O.-clearance

After ATC (Tower) gives clearance to "line up" or "take off" we are allowed to enter the runway.

- To "line up" means that we roll onto the runway and stop at our starting point. We **MUST** wait for ATC to give us "takeoff clearance" before we can continue.
- "Cleared for takeoff" means we are allowed to actually start the takeoff when aligned with the runway.

Shortly before we start our takeoff roll we do the following steps:

- Check **PACKS** as required
(some airlines take off with Packs **OFF** to allow more power to thrust and save fuel - not necessarily required)
- Turn on landing lights (**LAND**) and check if **STROBE** light is in **AUTO** or **ON**



The correct switch settings are:

- **RWY TURN OFF** It is **ON** - **NOSE** light is at **T.O.** (T.O. = takeoff)
- **LAND** lights are both **ON**
- **STROBE** is on **ON** or **AUTO**
- **BEACON**, **NAV & LOGO** should have been on during taxi already
- **WING** is **OFF**. It is usually only on for wing inspection and to detect ice accretion on the wing

i Lights at Takeoff

Setting the **RWY TURN OFF** light to **ON**, the **LAND** lights to **ON** and the **NOSE** light to **T.O.** minimizes bird strike hazard during takeoff.

- Check **ENG MODE SEL** as required (should be on **MODE NORM**)
- Set **TCAS** to **TA** or **TA/TR** and traffic to **ALL** or **ABV**

A typical standard takeoff follows these steps:

i **Airline SOPs**

Some airline's SOPs (standard operating procedures) might have a different order for these steps.

1. Release parking brake and hold down manual brakes.
2. Apply thrust slowly to about 50% thrust until both engines are stabilized (N1 stays constant at around 50%) while still holding the brakes.
3. Push sidestick forward half the way to put pressure on the front gear



4. Release brakes and apply FLX/MCT or TO GA power.
(depending on if have configured a FLEX temperature, and the runway is long enough for a FLEX start)



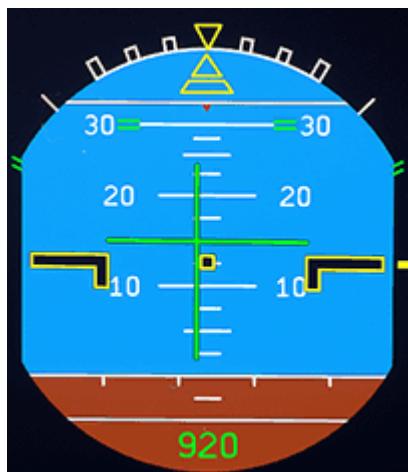
5. The PFD Flight Mode Annunciator (FMA) now shows several things which we should check when aircraft starts rolling:



From the left:

- Thrust: set to MAN FLX +60
- Vertical guidance:
 - Active (green): SRS (pitch guidance to maintain $V_2 + 10$)
 - Armed (blue): CLB mode (is next after SRS is done)
- Lateral guidance:
 - Active: Rwy (automatic runway axis follow up through ILS use)
 - Armed: NAV (navigation guidance according to HDG knob)
- Autopilot, Flight Director, Autothrust:
 - Autopilots are off
 - Flight Director 1 and 2 are ON
 - A/THR (Autothrust) is armed (not active yet)

Vertical and lateral guidance are **only shown** via Flight Director as we have not turned on the **Autopilot** yet and need to be followed manually by the pilot.



6. Keep the aircraft on the center line while accelerating down the runway.

i V-Speeds

There are three important speeds for takeoff which we have configured earlier when programming the MCDU's PERF page for takeoff. These are shown on the PFD's speed tape.

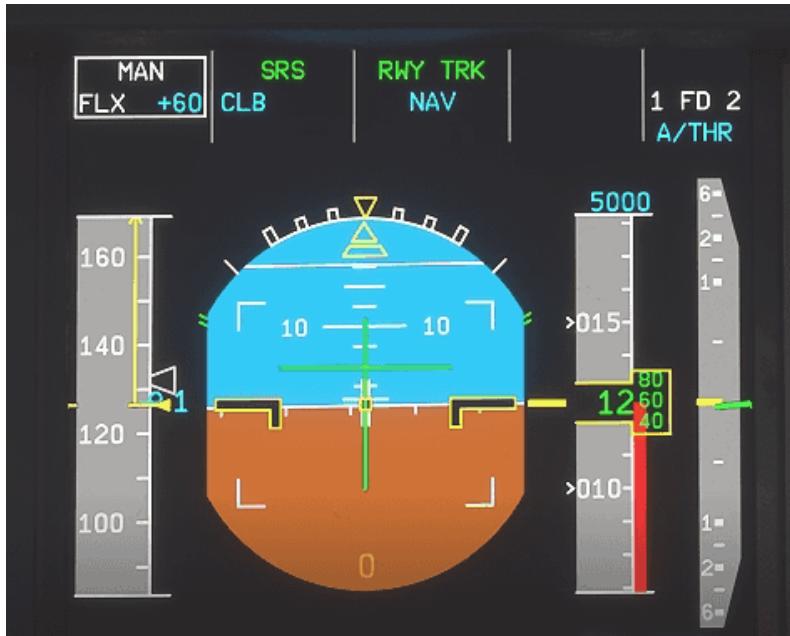
V₁: The speed beyond which takeoff should no longer be aborted. V₁ is depicted as a cyan "1" next to the speedband in the PFD.

V_R: Rotation speed. The speed at which the pilot begins to apply control inputs to cause the aircraft nose to pitch up, after which it will leave the ground. V_R is depicted as a cyan circle next to the speedband in the PFD.

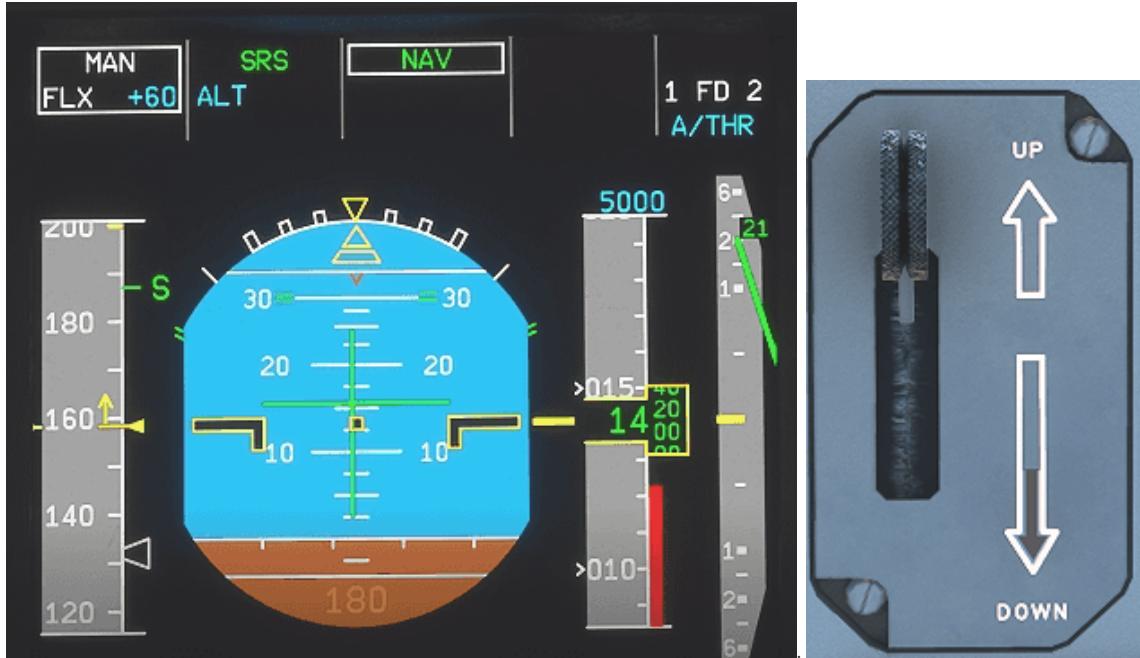
V₂: Takeoff safety speed. The speed at which the aircraft may safely climb with one engine inoperative. V₂ is depicted by a magenta triangle next to the speedband in the PFD.

On a long enough runway V₁ (depicted by "1") and V_R (depicted by "o") are often very close together and can't be clearly distinguished on the PFD speed tape.

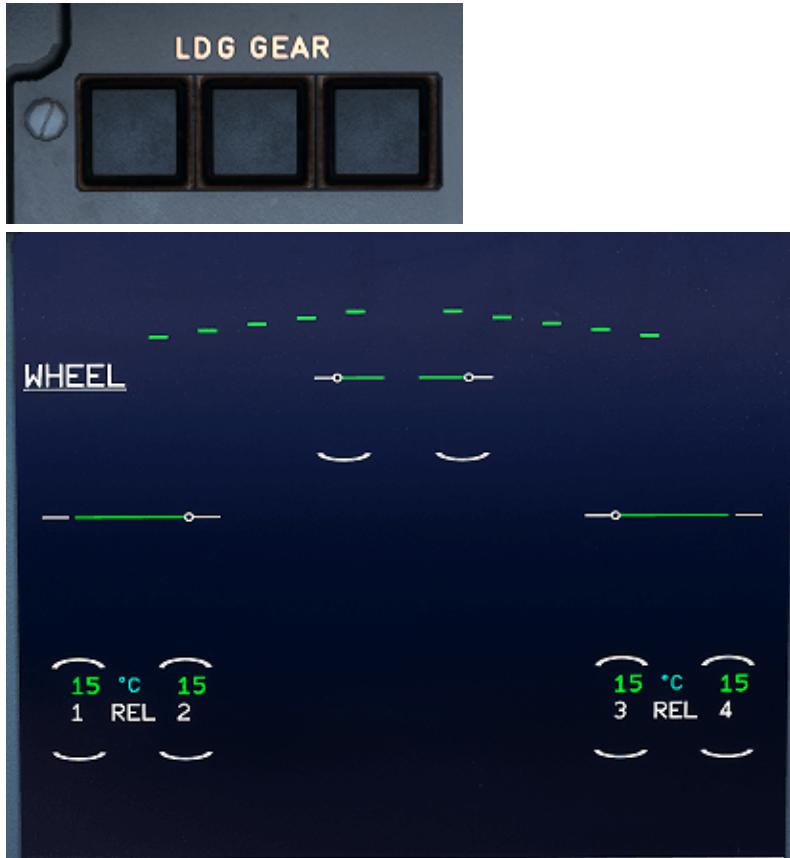
- At about 80 knots slowly release the forward pressure on the sidestick until about 100 knots when the sidestick should be in neutral position.
 - The throttle hand remains on the thrust levers until reaching V_1 to be able to quickly abort the start. Remove the hand from the thrust levers at V_1 to avoid accidentally aborting after V_1 .
 - At V_R apply smooth positive backward stick movement on the sidestick and aim for a rotation rate (pitch rate) of 3 deg/sec for about 5 seconds (15° - 18° pitch attitude). Once airborne follow the flight director's guidance for pitch attitude.
- Tip: Count one-one thousand, two-one-thousand, etc. and hit 15 deg at five-one-thousand - practice this.



- Once we have confirmed "positive climb" we retract the landing gear.



- We confirm that the landing gear is up by looking at the landing gear annunciators, and the lower ECAM Wheels page.



This concludes *Takeoff*.

3. INITIAL CLIMB

Situation:

- Aircraft has left the ground and is climbing at about 15°.
- Gear is up.
- Thrust levers are in FLX MCT or TO GA detent.
- Flaps are still in T.O. position.

After takeoff the aircraft will use `FLX/MCT` or `TO GA` thrust until thrust reduction altitude is reached (typically ~1500ft above runway, this is part of the MCDU setup)

After reaching thrust reduction altitude the `PFD FMA` now shows a flashing *LVR CLB* message to instruct the pilot to move thrust levers to the `CL` detent.

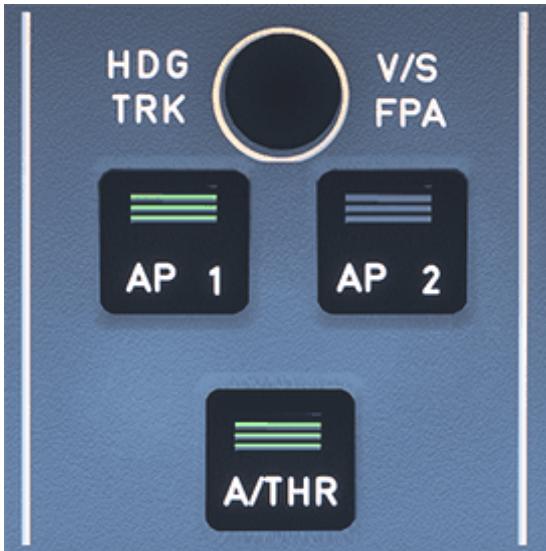
Pull the throttle back into the CL detent.



This activates the **Autothrust** system (FMA shows **A/THR** in white now). In the A320 (and most Airbus models) we will not touch the thrust levers again before final approach and landing (under normal flight conditions).

The aircraft will now climb to the altitude selected in the FCU (in our case 5.000ft).

Activate the Autopilot at this point by pressing the AP1 button on the FCU.



The FMA now shows AP1 in white in the upper right corner.

FCU Autopilot Controls

The FCU (Flight Control Unit) shows three important values:

- SPD "---" : means the **Autopilot** is in Managed Speed mode (e.g. 250knots <10.000ft, 290kts above). If we pull the SPD knob we can select a speed which the **Autopilot** will then apply.
- HDG "---" : means the lateral navigation is in Managed HDG Mode and the **Autopilot** follows the planned route. Dialing the HDG knob will let us select a heading and by pulling the knob we tell the **Autopilot** to fly this heading (Selected Heading Mode).
- ALT "5000" : means the selected altitude is 5000ft

When reaching S-speed retract flaps.

S-speed is signified with an S next to the speed band in the PFD.

Flaps during takeoff and climb

Depending on the start configuration there will be different markers next to the speedband in the PFD to show when to retract flaps:

- CONF-2 (Flaps position 2): At "F" and positive speed trend
- CONF-1+F (Flaps position 1): At "S" and positive speed trend

We always retract flaps by only one step at a time. So when we took off with FLAPS 2 (CONF-2) we retract FLAPS at "F" to FLAPS 1. Then at "S" we retract them to FLAPS 0.



Now we turn off the TAXI and RWY TURN OFF lights. We do this as they are sitting on the front gear and are now within the gear housing getting hot.



Lastly we disarm the SPEED BRAKE and turn on the PACKS if we turned them off for takeoff.

Now complete the "After takeoff checklist"

- Landing gear up
- Packs on
- Flaps retracted
- Check Baro setting: above transition altitude (defined in the ECAM PERF page) set it to STD by pulling the baro knob. A flashing baro value in the PFD will remind us in case we forgot.

AFTER TAKEOFF / CLIMB	
LDG GEAR.....	UP
FLAPS.....	RETRACTED
PACKS.....	ON
BARO REF.....	SET (BOTH)

This is usually a good time to contact ATC Departure to check in with your current altitude. In most cases ATC will now give us a higher climb altitude. If we did not receive a higher altitude we have to level off at the previously cleared altitude (cleared by ATC or navigational charts). If we have the **Autopilot** activated it will level off automatically at the Selected Altitude.

This concludes the *Initial Climb*.

4. CLIMB

Situation:

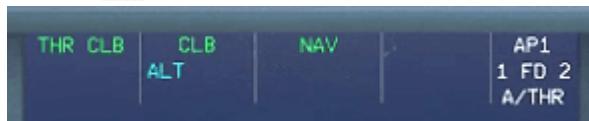
- Aircraft is climbing to or is at our initially cleared climb altitude.
- *After takeoff checklist* is completed.
- ATC has given us clearance for further climb.

Dial the newly cleared altitude into the FCU. (e.g., 12000ft)



The aircraft will now continue climbing while managing thrust and pitch level. The **Autopilot** ensures that the aircraft stays at the Selected or Managed Speed setting and climbs to the new altitude while managing thrust automatically.

The PFD's **FMA** now shows:



Thrust level is **THR CLB**, vertical mode is **CLB** (ALT mode armed), lateral mode is NAV.

Typically, the climb to the flight plan's cruise level (e.g., FL210) happens in several steps (step climbs). Each to be instructed and cleared by ATC.

Passing 10,000ft

Turn off landing lights and when the aircraft is stable (weather, no turn, etc.) you can turn off the seatbelt signs. The aircraft will now accelerate to CLB speed (defined in **MCDU PERF CLB** page).

Repeat the climb process above until cruise level (e.g. FL210) is reached.

MCDU and PFD at cruise level



This concludes the *Climb*.

5. CRUISE

Situation:

- Aircraft has leveled off at planned cruise level.
- Speed is cruise speed as per ECAM PERF CRZ page.
- **Autopilot** is ON.
- Speed is in Managed Mode.

This is usually the quietest time of the flight. It allows time to double-check the systems by going through all ECAM pages, etc.

Regular ATC frequency changes with altitude and position check-ins are common.

Here are some **typical activities** which might happen during cruise mostly on request from ATC or other circumstances like weather, traffic, etc.

- **Altitude change (also called flight level change)**

Like before during climb set your new altitude in the FCU and push the ALT knob. The aircraft will descent or climb to the new altitude automatically.

- **Course change with Selected Heading** (given or cleared by ATC)

Dial heading knob to the desired heading and pull knob for Selected Heading Mode. The aircraft will automatically change course to the new heading. If you want the aircraft to follow the planned route again you can push the knob for Managed Heading Mode.

- **Direct course to a waypoint (DIR TO)**

ATC regularly instructs us to go "direct to (waypoint) XYZ". Use the ECAM DIR page to select the waypoint from the flight plan's list of waypoints. In rare cases it is a waypoint not in the current flight plan then you can enter a new waypoint in the MCDU and put it into the upper left entry field. Select DIRECT* on the right bottom to execute the change.



- **ATC requests specific speed**

Sometimes ATC requests a specific speed to keep separation between aircraft. Pull the speed knob to switch to Selected Speed Mode. The current speed will be preselected. Dial to the desired speed. The aircraft will immediately begin to target the new speed by either increasing or decreasing thrust.

At some point (200-300NM from destination) we would start with descent-planning and setting up the aircraft for descent and approach.

Descent, Approach and Landing will be covered in later chapters of this beginner guide.

This concludes the *Cruise*.

Continue with [Descent Planning and Descent](#)

1.2.6 Descent Planning and Descent

This guide will explain the correct procedures to plan and fly a descent from cruise altitude through STAR and Instrument Approach up to the final approach.

The actual final approach (ILS approach) will be covered by a separate chapter.

Disclaimer

The level of detail in this guide is meant to get a FlyByWire A320neo beginner safely from cruise level down to the ILS glideslope.

A *beginner* is defined as someone familiar with flying a GA aircraft or different types of airliners. Aviation terminology and know-how is a requirement to fly any airliner even in Microsoft Flight Simulator.

Also you will find many great videos on YouTube on how to fly the FlyByWire A32NX.

Check out the FlyByWire YouTube Channel as well: [FlyByWire on YouTube](#)

Prerequisites

Aircraft is in `CRUISE` state and phase as per previous chapters

[Download FlyByWire Checklist](#)

Chapters / Phases

This guide will cover these phases:

1. [Descent and Approach Planning](#)
2. [Starting the Descent](#)
3. [Flying the STAR and Approach](#)
4. [Intercepting ILS](#)

Base Knowledge: Route, Star and Approach

• Basics

As we have learned in previous chapters a flight route begins with an origin airport and a SID to safely guide the aircraft away from the airport to the first waypoint on their actual route. Similar to a SID the arrival to an airport is done via a STAR (Standard Terminal Arrival Route) and an IAP (Instrument Approach, often APPR) to safely bring the aircraft into a position to land on the destination airport safely and with as little ATC communication as possible.

• STAR

A Standard Terminal Arrival Route (STAR) ensures safe and efficient traffic from the last en-route waypoint to the initial approach fix (IAF) of the Instrument Approach (IAP). It separates aircraft, avoids conflicts and helps with noise abatement through specific routing, levels/altitudes, speed restrictions and checkpoints often with holding areas.

One main objective is, to do this with a minimum of communication between the ATC controller and the pilot. As the STAR is part of the flight plan a pilot can simply continue from the normal route into the STAR if ATC has not given any other instructions. Sometimes ATC might give an explicit clearance for the STAR or change the STAR to manage traffic and landing situation (different runways, etc.).

Often a STAR contains a clearance point which mustn't be passed without explicit clearance by ATC. If clearance is not given then a holding must be flown as described in the charts.

Please also have a look at our airliner guide's SIDs and STAR section [SIDs and STARS](#)

Find a good overview over charts in our airliner guide: [Reading a Chart](#)

• Approach

The Instrument Approach (IAP or APPR) has similar objectives as a SID or STAR - safely bring an aircraft into a position to land while ensuring separation between multiple aircraft, avoiding terrain, support with noise abatement, etc.

IAP are often designed for handling maximum traffic in even bad weather conditions. With only little traffic and good weather it is quite common that ATC instructs the pilot to leave the approach route by giving the pilot heading vectors for a more direct route to the Final Approach Fix (FAF, also called final approach point).

When flying with Online ATC (VATSIM, IVAO, PilotEdge, ...) expect being vectored to the FAF quite often.

Understand important ILS approach chart features here: [Approach Chart](#)

• ILS

The Instrument Landing System (ILS) is one of several modern forms of helping an aircraft during its final approach to land even in non-optimal weather situations. ILS uses a localizer for lateral guidance and a glideslope for vertical guidance from the Final Approach Fix down to a minimum at which the pilot needs to perform the final landing sequence visually.

Modern airlines like the A320 are even able to use the ILS to land fully automatically as long as the runway's ILS supports it.

Understand important ILS approach chart features here: [Approach Chart](#)

Microsoft Flight Simulator and navigation charts

Although Microsoft Flight Simulator allows some flight planning through the user interface it is highly recommended to use navigational charts when flying airliners. MSFS' flight planning does not provide sufficient information to correctly fly a STAR or an approach.

There are several good sources for charts - free or subscription based. A good free solution is [Chartfox](#) which only requires a free VATSIM account. One of the most known subscription based sources for charts is [Navigraph](#). It is planned to integrate both solutions into the FlyByWire A32NX flyPad in the future.

Also, often a simple internet search will do the trick: Search for "<airport icao code> charts": E.g., "EDDM charts"

1. DESCENT AND APPROACH PLANNING

Pilot's responsibility

It is the sole responsibility of the pilot to conduct proper flight planning and especially proper descent planning. It is not at all ATC's task to do descent planning for pilots by giving descent instructions. On the other hand ATC often actually gives descent instructions, especially on common routes, as they want the aircraft in their responsibility to be at certain altitudes when approaching the destination airport. Nevertheless pilots must know when approaching their top of decent and if necessary need to proactively request clearance to descend from ATC.

Good descent and approach planning is the foundation for a successful landing. It has to be done early during the flight or even before the flight.

Situation:

- Aircraft is in [CRUISE](#) state and phase as per previous chapters.
- Distance to destination is ~200NM (on a short flight start as early as possible and maybe even before the flight).

Important Data Points for Descent Planning:

- **Cruise Flight Level:** The higher we fly the earlier we need to start descending. Also for short flights a too high cruising altitude can make it impossible to actually descend to the destination airport in time. Therefore verify your flight plan if overall distance and flight level make sense.
- **Flight Plan Constraints:** STARs often have flight level (FL) or altitude constraints which we must adhere to. We must plan our descent so we can meet these altitude constraints even when they themselves are still far away from the destination airport.
- **Speed:** STARs also regularly have speed constraints which we need to take into consideration as slowing down will cost time and is hard to do while descending. If we start our descent too late we might not be able to slow down in time as required by a constraint.
- **Aircraft capability and passenger comfort:** Although not a big concern in the A320neo, general aircraft capabilities and passenger comfort also come into play. Descending with -4000ft/min is no fun for a passenger.

Step-by-step Guide for Descent Planning:

1. Read the STAR chart and determine if there are altitude and/or speed constraints which we need to consider.

2. Consider the STAR and APPR route as optional and do not count on them to be flown and available for descending. ATC might want to vector us to a different runway or at least shortcut our approach. But they won't be able to if we are still too high for the final approach.
3. Determine the first constraint you need to meet. This could be a STAR waypoint with an altitude constraint, the Final Approach Fix altitude or even the airport (or runway) elevation itself.
4. Calculate the required distance needed to descend to that waypoint with a standard descent angle of 3° . We can use the FlyByWire flyPad in the cockpit or a simple rule of thumb calculation (details below).
5. Use the MCDU PROG page's DIST function to read out the current distance to this waypoint. It is also possible to use the MCDU flight plan page, maps or the NDs distance rings to help determining the current distance.

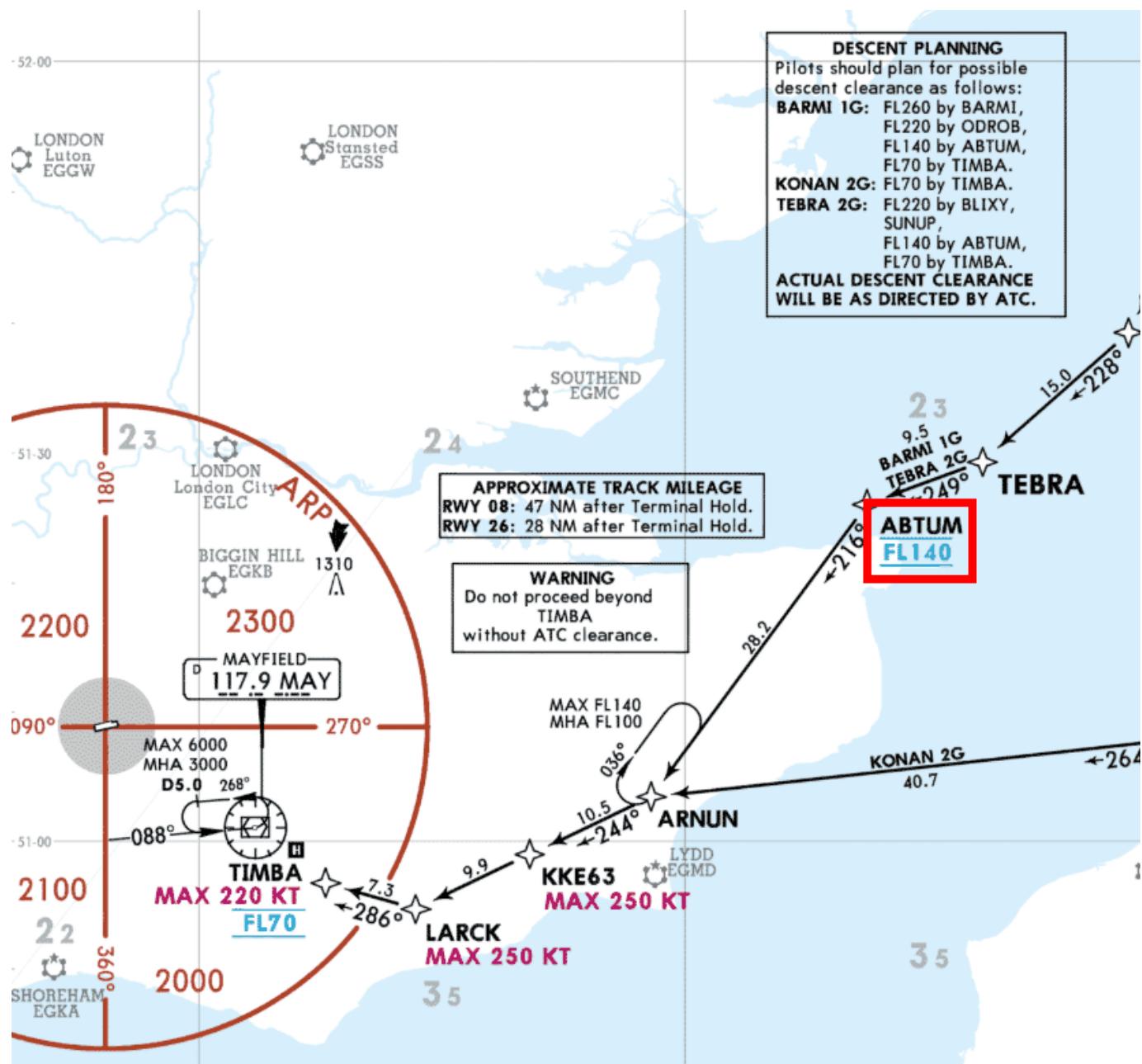


How to Calculate the Required Distance for Descent

Example data:

- Flight to EGKK via STAR TEBRA 2G.
- Flight level FL320.
- STAR constraint at waypoint ABTUM "at FL140".

Example chart:



Copyright © 2021 Navigraph / Jeppesen

"Navigraph Charts are intended for flight simulation use only, not for navigational use."

Using the flyPad:

Standard calculation with 3° descent path:

The screenshot shows the TOD Calculator interface. In the 'Ground Speed' section, it says 'Fetching from sim' and displays '454 kt'. There is a 'Manual input' button. In the 'Data' section, 'Current altitude' is set to 32000 ft and 'Target altitude' is set to 14000 ft. The 'Angle' is set to '- 3 degrees'. In the 'Result' section, it says 'Start your descent about 57 NM before target'.

Calculation with a specific distance to calculate the required descent velocity (V/S):

The screenshot shows the TOD Calculator interface. In the 'Ground Speed' section, it says 'Fetching from sim' and displays '454 kt'. There is a 'Manual input' button. In the 'Data' section, 'Current altitude' is set to 32000 ft and 'Target altitude' is set to 14000 ft. The 'Distance' is set to 80 NM. In the 'Result' section, it displays 'Desired vertical speed -1702 ft/min' and 'Desired descend angle -2.1 degrees'.

Using "Rule of Thumb":

```
Distance = "Altitude difference" * 3 / 1000 + margin**
Altitude difference: 32000 - 14000 = 18000
Times 3: 18000 * 3 = 54000
Divided by 1000: 54000 / 1000 = 54
Plus margin (~10%): 59 NM
```

Margin can be lower for headwind and larger for tailwind. Some pilots also change the margin to compensate for slowing down while descending.

As can be seen on the chart there will be a further descent to TIMBA at FL70 and after that (not visible on the chart above) there will be a descent to the final approach which will be at 2000ft at the Final Approach Fix FF26L.

The same methodology/calculation as our initial descent can be applied to these descents as well but they require less planning as they are usually designed in a way that an aircraft with a 3° descent angle can make these descents with ease.

ATC will quite often instruct certain altitudes within the STAR and APPR which deviate from the STAR and APPR charts. Please expect such instructions at any time.

Advanced Arrival Planning

⚠ Important Notice

The following is a more advanced process for planning our arrival. It is obviously important when we want to have a more realistic experience but in Microsoft Flight Simulator you can skip this part for now.

Also this process is best done with an Online ATC service as the built-in MSFS ATC does not provide the necessary information at the right time.

Before we descend we should also reconfirm our destination runway and input or update our destination data into the MCDU PERF APPR page. This is typically done about 50NM before the starting the descent.



We can obtain this data from the destination airport's ATIS information and the airport charts.

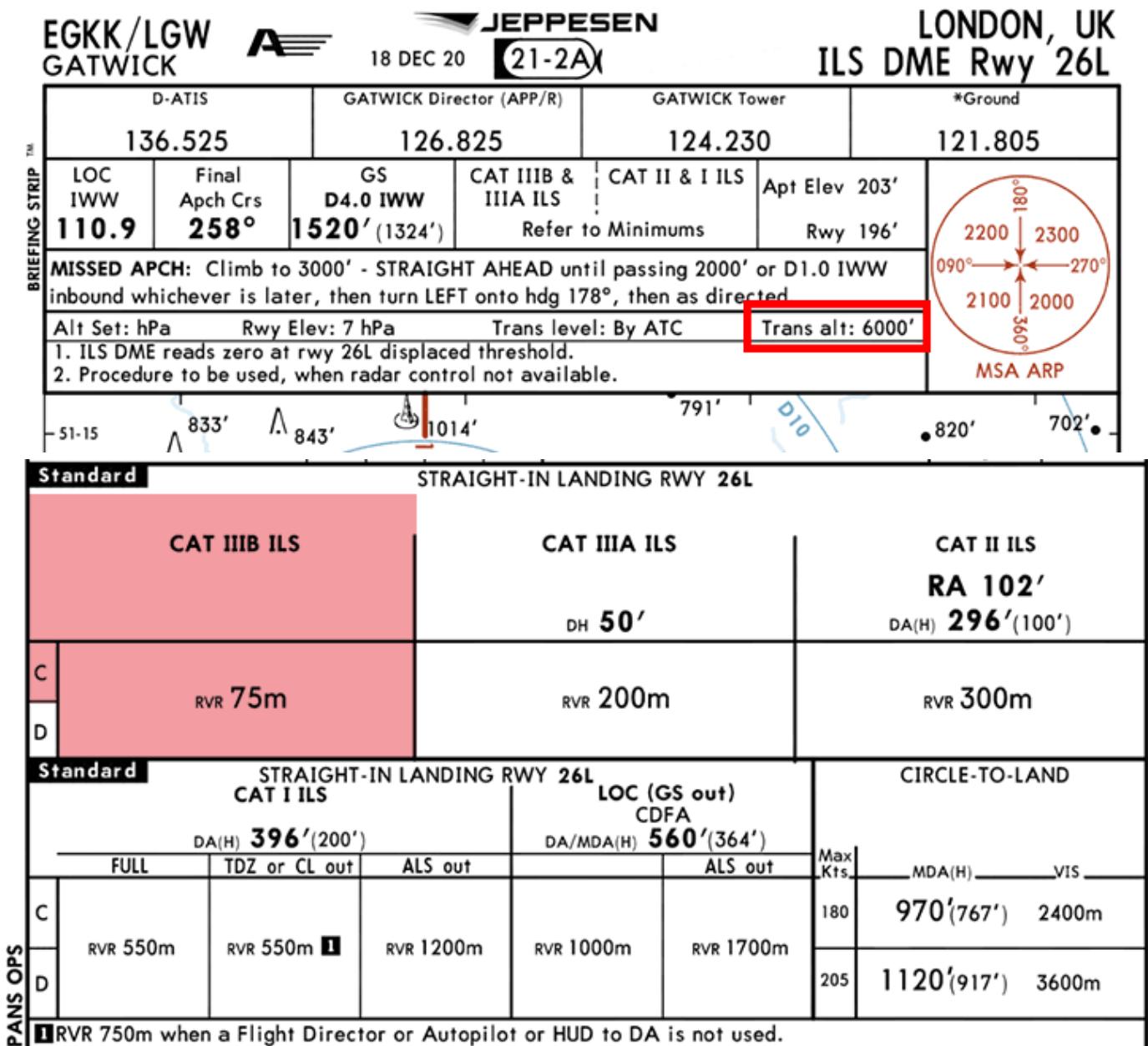
From ATIS we get: **QNH**, **TEMP** and **MAG WIND**. Sometimes **TRANS ALT** or 'TRANS LVL' - if not refer to the approach chart.

ATIS Example:

```
GATWICK INFORMATION K TIME 2020, RUNWAY IN USE 26L
TRANSITION LEVEL FL70, SURFACE WIND 260,7 KNOTS
CAVOK TEMPERATURE +16, DEW POINT +12, QNH 1018,
ACKNOWLEDGE RECEIPT OF INFORMATION K AND ADVISE AIRCRAFT
TYPE ON FIRST CONTACT
```

From the chart we get **TRANS ALT** and **BARO** (=MDA) or **RADIO** (=DH).

- CAT 1 ILS uses MDA and is entered into the **BARO** field.
- CAT 2/3 ILS use DH which is put in the **RADIO** field.
- **BARO** is based on barometric altitude whereas **RADIO** is based on radio altitude (distance to ground).



CHANGES: None.

© JEPPESEN, 1999, 2019. ALL RIGHTS RESERVED.

NAVIGRAPH CHARTS INTENDED FOR FLIGHT SIMULATION ONLY - NOT FOR NAVIGATIONAL USE

Copyright © 2021 Navigraph / Jeppesen

The A320neo is capable of a CAT IIIB ILS approach and has an approach category of "C" - see the red area on the chart. (see [Wikipedia Aircraft approach category](#))In this chart for EGKK 26L ILS there is no DH for CAT IIIB defined - so we can enter "NO" or "NO DH" into the **RADIO** field.

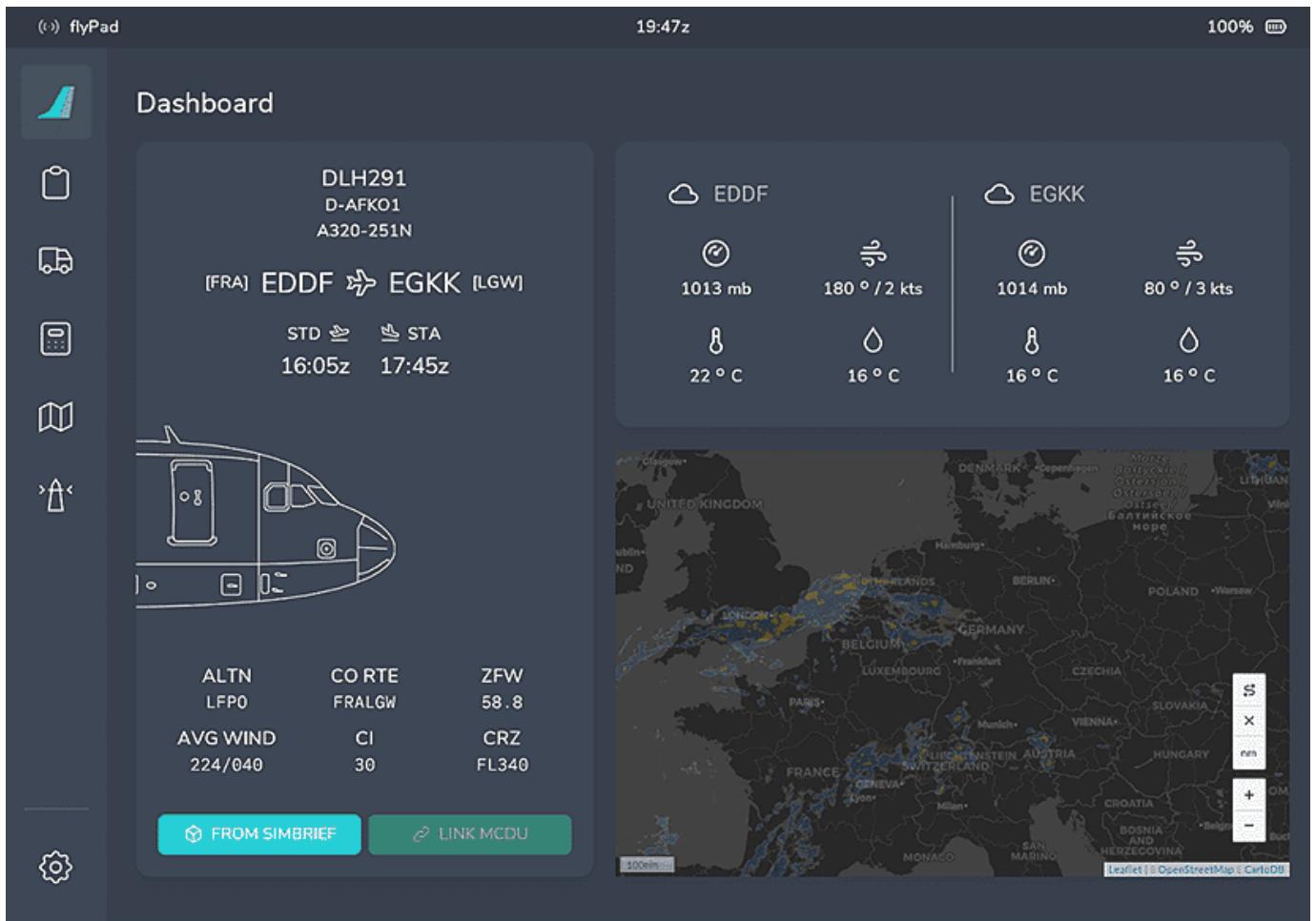
If we are using Microsoft Flight Simulator without any Online ATC services (VATSIM, IVAO, PilotEdge, ...), and using the MSFS built-in ATC, you usually can't request ATIS information for the destination airport at this point. MSFS ATC makes ATIS only available once close to the destination airport.

If we are flying with Online ATC you can request ATIS via the **MCDU-ATSU-ACO** page or your Online ATC network's client at this time.

We can in any case request the METAR weather information for the destination airport via the same page.



If we used Simbrief for flight planning we can also see METAR information on the flyPad after importing the Simbrief plan to the flyPad.



Once we have confirmed the destination runway and the destination data we are set for the approach and we can continue focus on the descent.

This concludes *Descent and Approach Planning*.

2. STARTING THE DESCENT

Situation:

- Aircraft is in `CRUISE` state and phase as per previous chapters.
- Descent and approach planning is done.
- First descent point (altitude at certain waypoint) is identified.
- Distance to descent point is calculated, which is called TOD (top of descent).

A few minutes before we reach our calculated descent point (TOD) we request clearance for descent from ATC if not already given a descent instruction before.

Do NOT start the decent without clearance from ATC.

i TOD marker A320

The FlyByWire A32NX has not implemented the TOD (top of descent) marker on the `ND` yet. Usually the A320 has a downward pointing arrow at the TOD to support the pilot with the decision when to descend. Ultimately it is still the pilot's responsibility to calculate and validate the TOD.

When clearance is given we can start our descent to the flight level or altitude ATC has given us.

For descending we set the new flight level or altitude in the `FCU` with the `altitude selector`. We can then either push the selector for Managed Altitude Mode (constraints are respected, also known as VNAV) or pull the selector for `Selected Altitude Mode` (constraints are ignored). You can also use the `V/S selector` to set a specific descent vertical velocity. Pull the `V/S selector` to start the descent.



ATC typically will not clear us to our final target altitude directly but will give us several step descents down to our required altitude.

Also ATC will often still expect us to respect the STAR's constraints although they might have given us a lower clearance. We should then only descent to the constraint's altitude.

i VNAV in the FlyByWire A32NX

The scenario that we are cleared to a lower altitude or flight level with altitude constraints above the clearance is an ideal scenario for the called so "VNAV" autopilot mode which would be activated by using "`Managed Altitude Mode`" (pushing the `ALT selector`). The autopilot will automatically level off at the constraint and continue descending when the constraint is no longer valid.

Unfortunately the current version of the FlyByWire A32NX does not yet support VNAV. This is planned to be implemented in one of the next versions.

We repeat the process until we have reached our desired final approach altitude.

i Airline SOPs

Some airline's SOPs (standard operating procedures) might have a different order for the following steps.

At 10,000ft Procedure

- **LAND** lights selector: SET
 - **LAND** lights may be switched ON, according to the airline policy/regulatory recommendations
 - Landing lights on the A320neo cause drag as they are extended from under the wings
- **SEAT BELTS** switch: ON
- **EFIS** Option push button: **CSTR** on both sides
- **LS** push button: As required
 - Select **LS**, if an ILS, GLS or LOC approach is intended
 - The PFD displays the LOC and glide scales and deviation symbol, if there is a valid /LS or GLS signal.
 - Check that the /LS/GLS identification is displayed on the PFD.
- **RAD NAVAIDS** (**RNAV** page on MCDU): Selected/Identified
 - Ensure that appropriate radio NAVA/OS are tuned and identified.
 - Currently the FlyByWire A32NX does not auto tune NAVAIDS
 - For NDB approaches, manually select the reference NAVAID.

Approach Checklist

APPROACH	
BRIEFING.....	CONFIRMED
ECAM STATUS.....	CHECKED
SEAT BELTS.....	ON
BARO REF.....	SET (BOTH)
MINIMUM.....	SET (BOTH)
ENG MODE SEL.....	AS RQRD

Cabin Crew

In real life the cabin crew will be asked to prepare the cabin for landing at some point during the descent. The exact moment and process might differ between airlines but most seem to do this when the Seatbelt Signs are turned on (typically at the latest at 10,000ft).

The Cabin Crew will notify the pilots either by a "Cabin Ready" button (A320neo) or by a call to the cockpit (A320ceo) once they are ready and strapped in themselves. Typically we will be in final approach by that time.

This concludes *Starting the Descent*.

3. FLYING THE STAR AND APPROACH**Situation:**

- Aircraft is in **DES** phase.
- Descent has started (we are after TOD).
- We have not yet reached the first waypoint of the STAR.
- **MCDU PERF APPR** page is filled (beginner can skip this - see chapter [Advanced arrival planning](#)).

Flying the STAR and Approach is very similar to any other part of the route within the flight plan. Apart from descending and adhering to constraints the lateral flight path just follows the programmed route.

Let the **Autopilot** do this for you and just adjust altitude and speed according to the charts or the ATC instructions.

i Passing 10,000ft

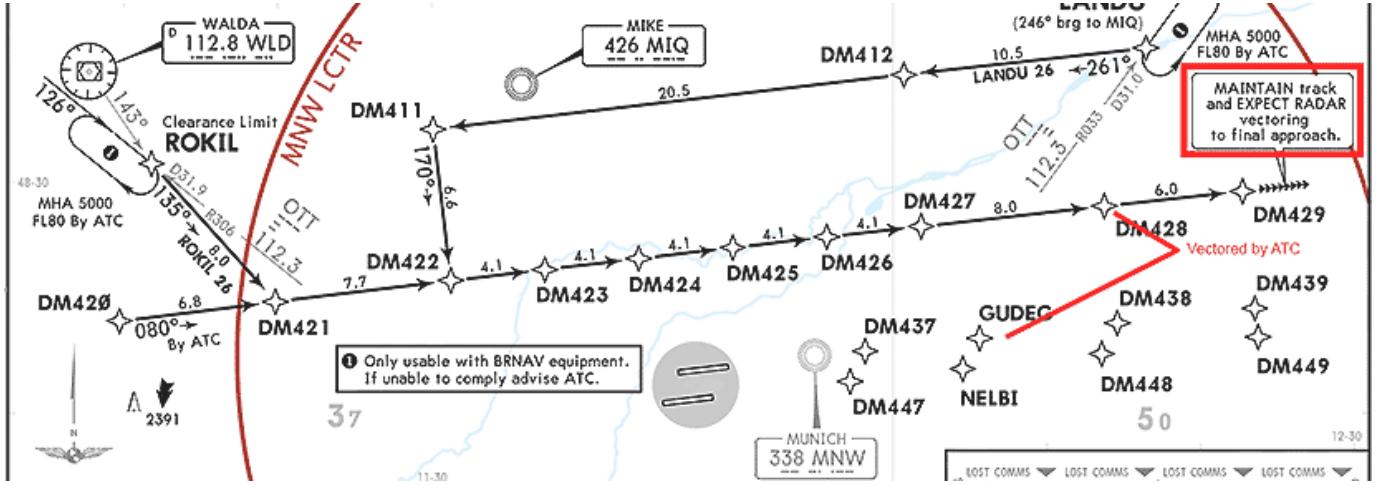
If we are passing 10,000ft within the STAR remember the [At 10,000ft Procedure](#) and the [Approach Checklist](#) from the previous chapter.

At some point during the descent and when close enough to the airport we will be instructed by ATC to contact ATC Approach for the airport we are flying into.

Be prepared for ATC instructions to deviate laterally from the STAR or Approach route to separate from other aircraft or to shortcut the approach when there is little traffic. ATC will then typically give you new heading instructions (heading vectors) and will guide you the rest of the STAR and Approach with additional heading instructions up until intercepting the ILS localizer.

Example for shortcuts:

ROKIL STAR/Transition EDDM (Munich) 26R - it is only in times with a lot of traffic that we would have to fly the whole downwind part of this transition.



Copyright © 2021 Navgraph / Jeppesen

"Navgraph Charts are intended for flight simulation use only, not for navigational use."

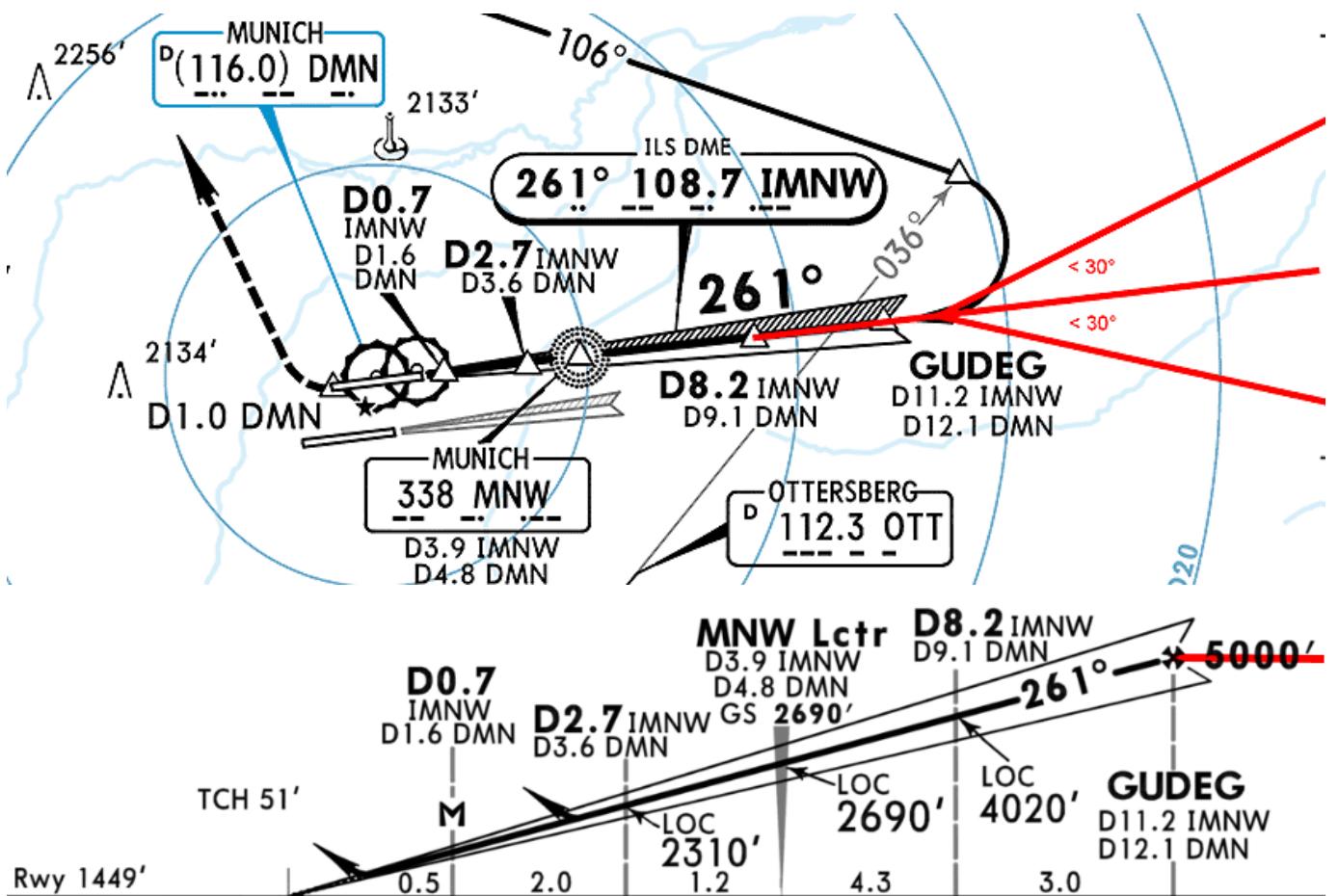
4. INTERCEPTING ILS

Situation:

- Aircraft is in DES phase.
- Aircraft is setup for flight <10,000ft (seat belt signs on, landing lights on, etc.).
- We are either within the IAP (Instrument Approach) and at the correct altitude and speed or at a heading vector, altitude and speed instructed by ATC.

At the end of the Instrument Approach (or by ATC vectoring) we will be on a path to the Final Approach Fix and/or intercepting the ILS localizer and eventually the ILS glideslope.

To intercept the ILS we need to be on the correct altitude and should not have an approach angle larger than 30°.



Copyright © 2021 Navgraph / Jeppesen

"Navgraph Charts are intended for flight simulation use only, not for navigational use."

More details regarding the ILS approach and landing in the next chapter.

This concludes *Intercepting ILS*.

Continue with [Final Approach and Landing](#)

Last update: August 23, 2021

1.2.7 Approach and ILS Landing

This guide will explain the correct procedures to fly a final approach and conduct an ILS landing.

Disclaimer

The level of detail in this guide is meant to get a FlyByWire A320neo beginner currently on approach to intercept the ILS and land the aircraft safely on the runway.

A *beginner* is defined as someone familiar with flying a GA aircraft or different types of airliners. Aviation terminology and know-how is a requirement to fly any airliner even in Microsoft Flight Simulator.

You will also find many great videos on YouTube on how to land the FlyByWire A32NX.

Check out the FlyByWire YouTube Channel as well: [FlyByWire on YouTube](#)

Prerequisites

Aircraft is on approach shortly before intercepting the ILS and is still in phase and state `DES` as per previous chapters.

[Download FlyByWire Checklist](#)

Chapters / Phases

This guide will cover these phases:

1. [Intercepting the ILS Localizer](#)
2. [Intercepting the ILS Glideslope](#)
3. [Preparation and Checklist for Landing](#)
4. [Landing](#)
5. [Vacate Runway](#)

1. Intercepting the ILS Localizer

Situation:

- Aircraft is in `DES` phase.
- Aircraft is setup for flight <10,000ft (`seat belt signs on`, `landing lights on`, etc.).
- We are within the IAP (Instrument Approach) and either:
 - at the altitude and speed from the chart (Final Approach Fix altitude and 250 knots if there are no other speed restrictions on the chart).
 - or we are at a heading vector, altitude and speed instructed by ATC.

At the end of the Instrument Approach (or by ATC vectoring) we will be on a path to the Final Approach Fix and/or a path to intercept the ILS localizer and eventually the ILS glideslope.

As a last instruction from ATC Approach we usually are instructed to contact Tower ATC when fully established on the ILS localizer.

To intercept the ILS Localizer we follow these steps:

- Verify that the correct ILS frequency is tuned in the **MCDU-RNAV** page. We find the correct frequency on the approach chart.

Check ILS frequency

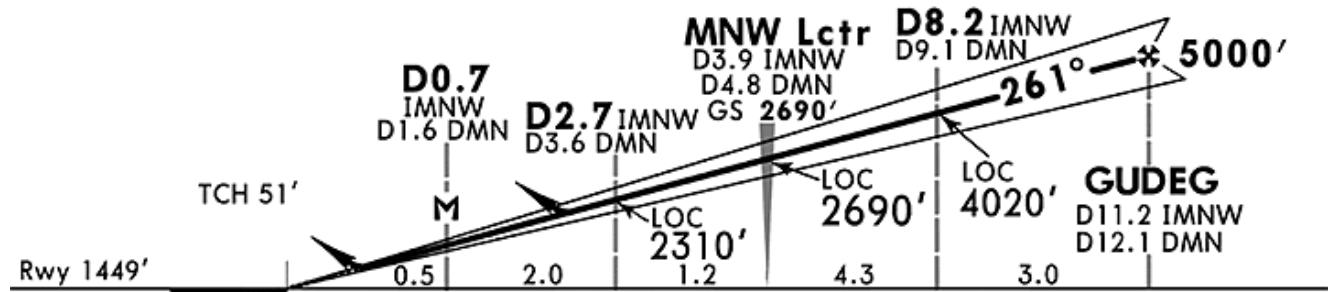
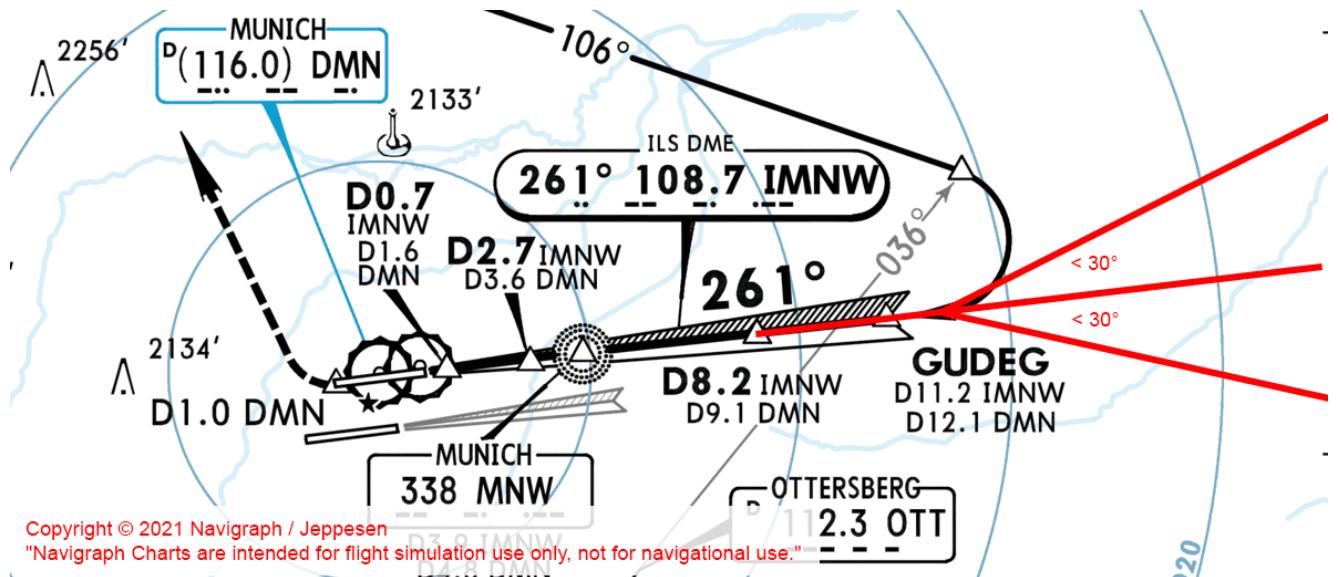
The approach chart shows the MUNICH area with various DME and VOR stations. A red box highlights the ILS DME information: **261° 108.7 IMNW**. The Radio NAV MCDU screen shows the selected frequency: **LS / FREQ 108.70**.

- Turn on the **ILS localizer and glideslope scales** with the **LS** button on the glareshield if not already done before.

Turn on ILS scales

The glareshield controls show the **STD** mode selected and the **LS** button highlighted with a red box. Two Primary Flight Displays (PFD) show the ILS scales. The left PFD displays the ILS frequencies: **IMNW 108.70 19.0 NM**. The right PFD displays the approach information: **GS 217 TAS 220 ILS/GS CAT III RW26R**.

- Make sure we are on the correct altitude (5,000ft in this example) and we should not have an approach angle larger than 30°.



- Optional: Turn on ROSE LS Mode for the ND (can also be on F.O.'s side). The ROSE LS Mode shows the deviation from the localizer approach heading path.



- Activate the APPR phase in the MCDU-PERF page. This is usually automatically done by the aircraft at a certain point during the approach, but we make sure that at this point at the latest it is activated. In APPR phase the Autopilot together with "Managed Speed Mode" reliefs the pilot of a lot of stress by managing the speed according to flaps setting automatically (S-Speed after FLAPS 1, F-Speed after FLAPS 2, V_{app} after landing flap selection).



- Set SPEED to Managed Speed Mode (push the Speed Selector). The aircraft should now decelerate to green dot speed.
- Set FLAPS to 1 at about V_{FE} -15 knots (but never before speed is below V_{FE}) for the first slat/flap configuration (CONF1). The aircraft will then decelerate further to prepare for the next flaps configuration. Our target is to be CONF 1 at S speed by the time you get to the glideslope intercept.



- Turn on APPR in the FCU to command the aircraft to intercept the ILS localizer. The aircraft will keep the current heading until the localizer is captured and guides the aircraft towards the runway. The lateral ILS localizer scale shows the deviation marker moving towards the middle of the lateral deviation scale. Also the lateral FMA shows LOC in blue (armed).



⚠ Arming APPR

Using **APPR** also arms the glideslope descent (G/S) and the aircraft will descend as soon as it captures the ILS glideslope signal. Do not descend without ATC clearance and only when directly on the ILS localizer path as only then obstacle clearance is guaranteed. To help with this you can use the **LOC** button first (only localizer capture) and when cleared for approach press **APPR**.

- When we are established on the ILS localizer (the lateral FMA shows **LOC** in green) we will contact Tower ATC and report that we are established on the ILS localizer (including call sign and runway).



Tower ATC will then give us clearance for ILS approach for the target runway. This clears us to descend on the ILS glideslope.

Do not descent without explicit clearance from ATC.

This concludes *Intercepting the ILS Localizer*

2. Intercepting the ILS Glideslope

Situation:

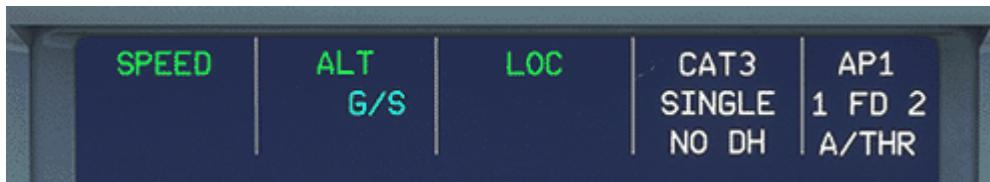
- Aircraft is in **APPR** phase
- Aircraft is established on ILS localizer
- Configuration is **CONF1** at S-Speed (**FLAPS 1**)

After ATC has given us clearance for ILS approach we can also start descending using the ILS glideslope.



Check that the APPR button is activated on the FCU to arm the ILS glideslope descent mode.

The vertical FMA now shows G/S (glideslope) in blue.



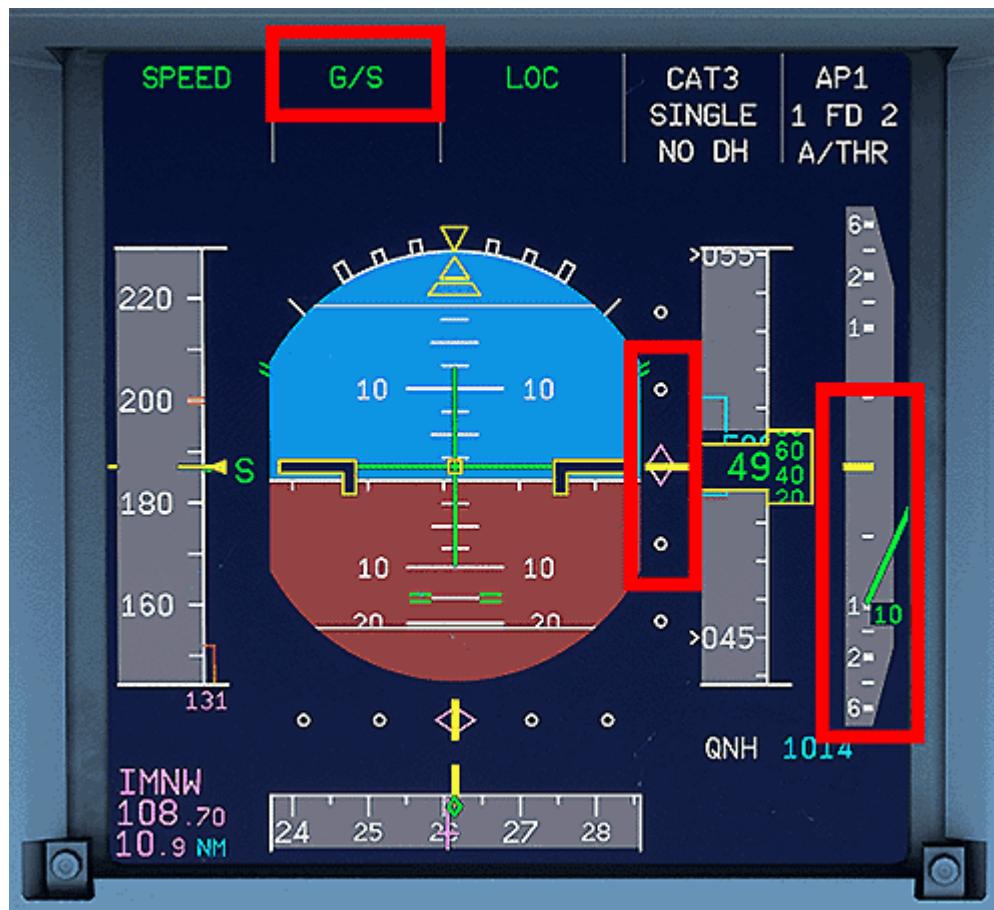
This is a good time to set Flaps 2 (check that the speed is below the V_{FE} for the next flap setting) as slowing down once we are descending along the glideslope can be difficult. We need the drag from the flaps if we do not want to let the gear down too early (which also would help us slowing down).

There is different guidance when to set FLAPS 2 but for beginners we recommend to go to FLAPS 2 before starting the glideslope descent. Airbus guidance for example is FLAPS 2 during glideslope descent at about 2,000ft.

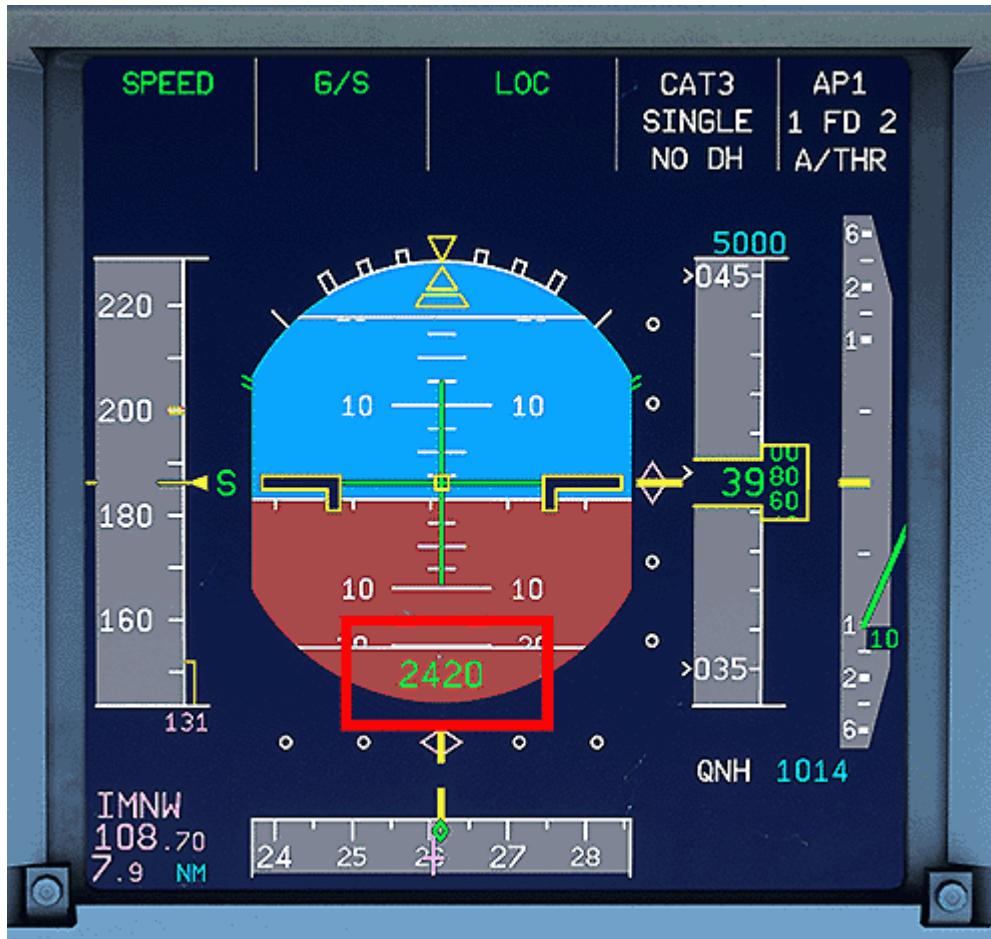
i ATC instructed approach speed

The A320 Autothrust will manage speed during approach automatically and will reduce speed further with each flap setting. In real live and also when flying with Online ATC like VATSIM we need to expect that ATC instructs us to stay at a certain speed (e.g. 160 knots until 5 NM to the runway). In this case we would use Selected Speed Mode (select a speed in the FCU and pull the knob) until the instructed distance to the runway where we would then go back to Managed Speed Mode and drop the gear then as well as setting flaps to 3 and flaps to full - see below.

The aircraft will start descending when the deviation marker is in the middle (we have captured the ILS glideslope). The vertical FMA will now display G/S in green.



We are now descending along the glideslope. The radio altimeter comes alive at 2,500ft above the ground to display the actual precise height above ground.



This concludes *Intercepting the ILS Glideslope*

3. Preparation and Checklist for Landing

Situation:

- Aircraft is established on ILS localizer and glideslope
- Flaps are set to 2

At this point we would prepare the aircraft for a possible missed approach and go-around by setting the go-around altitude in the FCU (see *MISSED APCH* procedure in the charts). We skip this for this beginner guide.

To set us up for the final approach we do the following steps:

- Gear down : Sometime between 2,500ft and 1,500ft , typically around 5-6NM from runway.
- Turn on **RWY TURN OFF** lights and set **NOSE** light to **T.O.**.
- Set **FLAPS 3** and shortly after **FLAPS FULL** (always check speed before setting flaps otherwise you might end up in an overspeed situation).
- Going **FLAPS FULL** will reduce our speed to V_{app} .
- Arm **Autobrakes** (**Low** when dry, **Med** in rain or snow or a short runway).
- Arm **Speedbrake** by pulling up the **Speedbrake** lever (Speedbrake must be retracted to arm).

We need to be fully setup and stable at 1,000ft above the ground.



Cabin Crew

In real life the cabin crew will have been asked to prepare the cabin for landing during the descent. The exact moment and process might differ between airlines but most seem to do this when the [Seatbelt Signs](#) are turned on during descent (typically at the latest at 10,000ft).

The Cabin Crew will notify the pilots either by a "Cabin Ready" button (A320neo) or by a call to the cockpit (A320ceo) once they are ready and strapped-in themselves.

In the Microsoft Flight Simulator we simulate this by pressing the [CALLS ALL](#) button on the left of the overhead panel. This will set the "Cabin Ready" status as shown in the ECAM and there will be a short announcement playing "Cabin Crew take your seats for landing".



Complete the [Landing Checklist](#)

LANDING	
CABIN CREW.....	ADVISED
A/THR.....	SPEED/OFF
AUTOBRAKE.....	AS RQRD
ECAM MEMO.....	LDG NO BLUE
- LDG GEAR DN	
- SIGNS ON	
- CABIN READY	
- SPLRS ARM	
- FLAPS SET	

For the landing we have our hand on the thrust levers for a potential go-around so we can quickly push the levers forward into **TO GA**.

We do not move the levers until the last seconds before landing.

This concludes *Preparation and Checklist for Landing*

4. Landing

Situation:

- Aircraft is fully setup for landing as per previous chapters.
- Configuration is **FLAPS FULL**.
- Aircraft is at about 1,000ft above the ground.
- Wind is calm (no crosswind for this beginner guide).

Although the A320 can do an automatic landing (**Autoland**) we will do a manual landing as this is more common and also more fun.

We MUST get landing clearance from ATC before we actually are allowed to land. Without landing clearance we must do a go-around (not part of this beginner guide) before touching the runway. Usually ATC will have given us clearance at this point. Late clearance is rare and communicated to us beforehand.

Next we turn the **Autopilot OFF** at about 500ft above the ground by pressing the **AP1** button on the **FCU**. We leave the **Autothrust** on so we don't have to worry about thrust and speed at all (Leaving **Autothrust** on for landing is common for the Airbus).



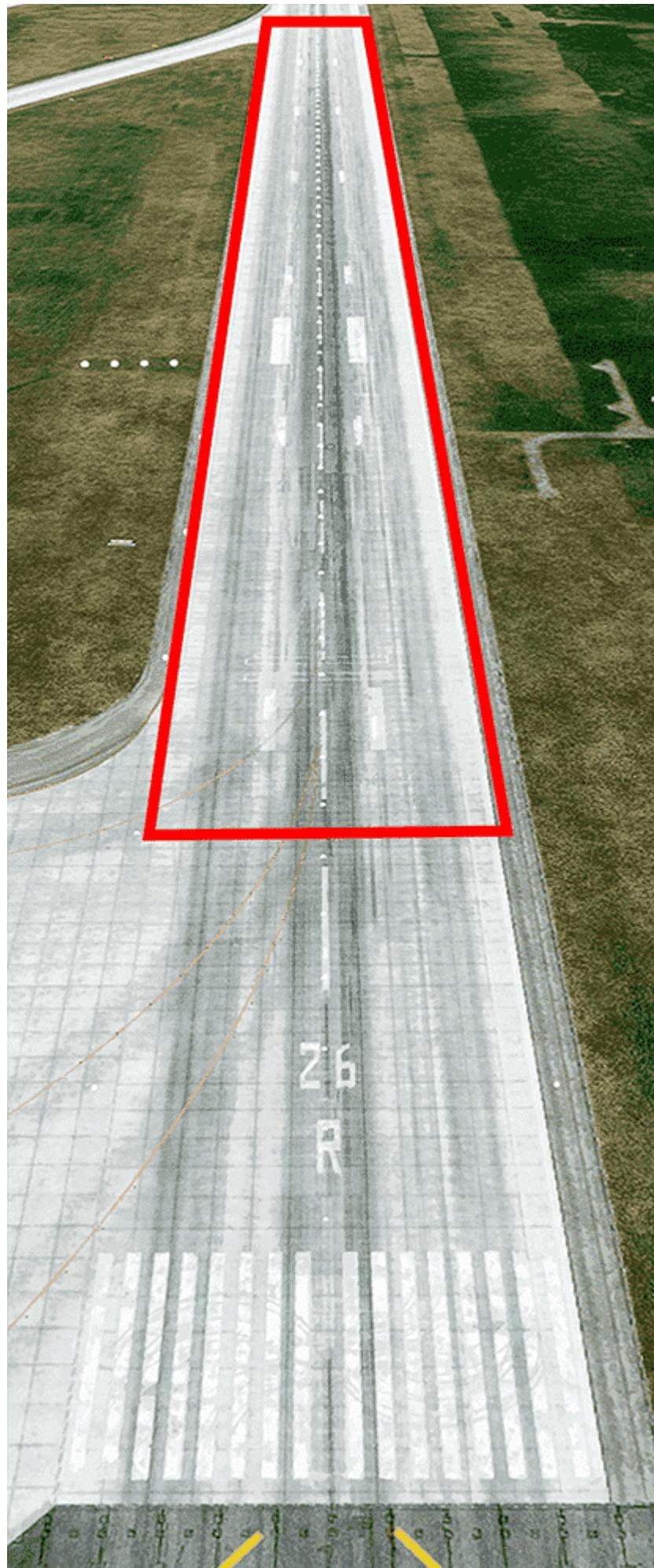
Now look out at the PAPIs which guide us vertically down to the correct touchdown point. We want two white lights and 2 red lights.



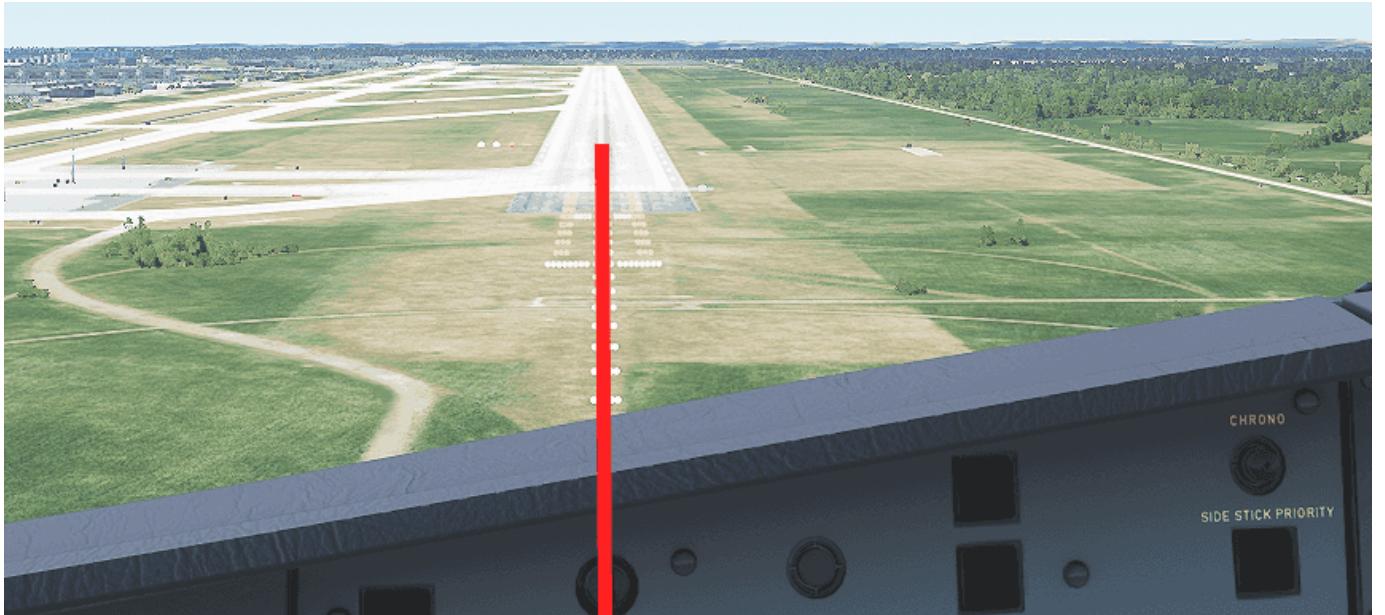
See also [Wikipedia:PAPI](#)

We correct our pitch only very carefully when too high (3-4 white) or too low (3-4 red). We don't need a lot of input to the sidestick to correct.

We aim for the middle of the touchdown zone which is marked by the touchdown zone markers.



Also we try to aim for the center line of the runway in a way that it points directly under us.



Correct your final heading and bank very carefully. We should not need to correct much at this point.

i Crosswind landings

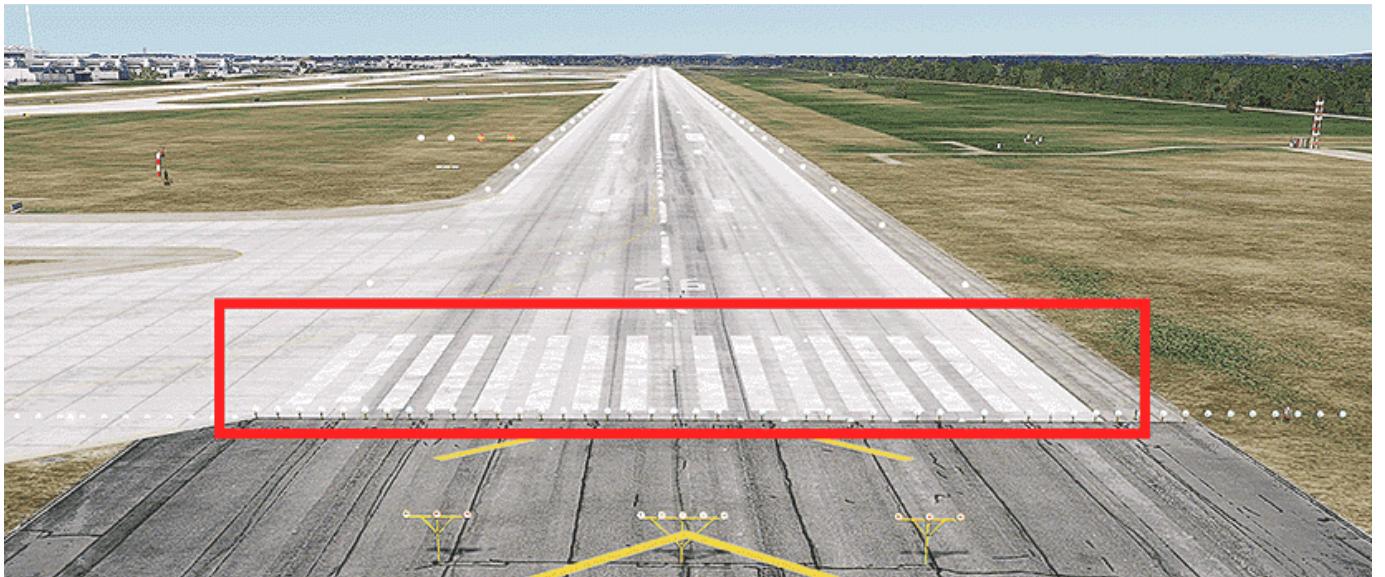
Crosswind landings are beyond the scope of this beginner guide. There are many good tutorials for crosswind landings in the A320 on Youtube.

Once over the runway threshold we look towards the end of the runway to better judge our pitch especially for the so called **Flare**.

i Flare

The flare follows the final approach phase and precedes the touchdown and roll-out phases of landing. In the flare, the nose of the plane is raised, slowing the descent rate and therefore, creating a softer touchdown, and the proper attitude is set for touchdown. [...] In the case of tricycle gear-equipped aircraft, the attitude is set to touchdown on the main (rear) landing gear. (source: [Wikipedia: Landing flare](#))

At the runway threshold we should be about 50ft above ground and prepare to set the thrust levers to idle and flare.



At about 30ft we start our flare by pulling back on the sidestick carefully. We only need a few degrees in positive pitch and hold the aircraft there. Too much flare will cause the aircraft to float down the runway, too little will cause a harder landing.

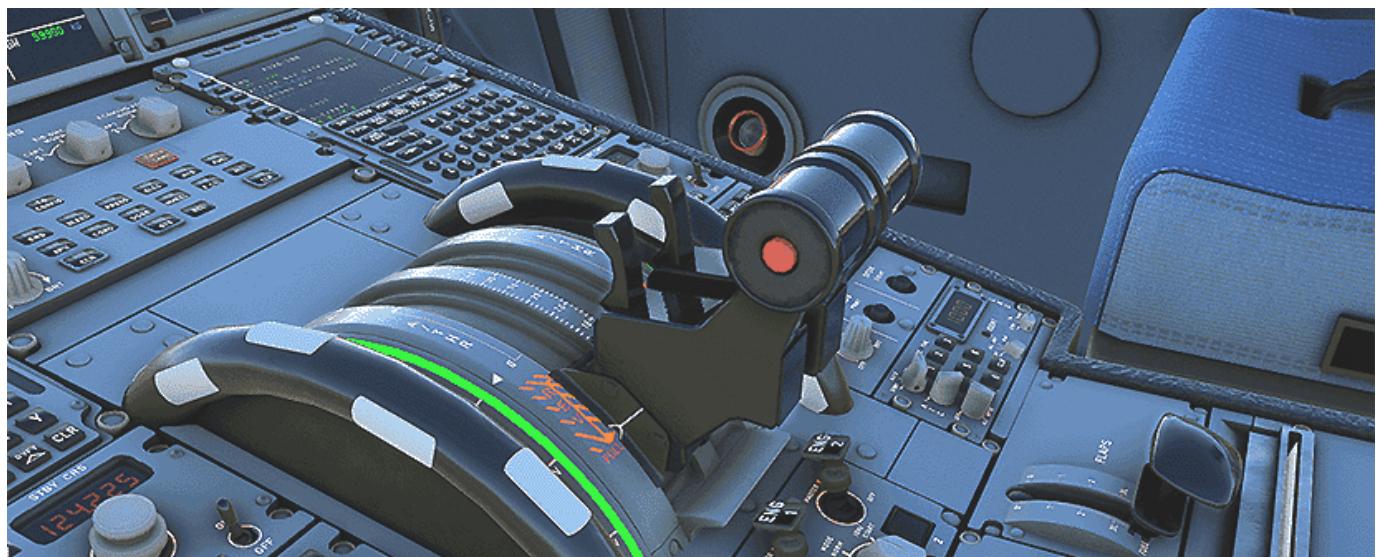
At about 10-20ft we pull back the thrust levers to idle (the aircraft also sounds the callout "retard retard ...") so the we are at idle thrust **before** we touch the ground.



We hold the attitude of the aircraft until it settles on the ground. **Do not push the sidestick forward (nose down) once flared.** We let the aircraft settle to the runway while holding the pitch.

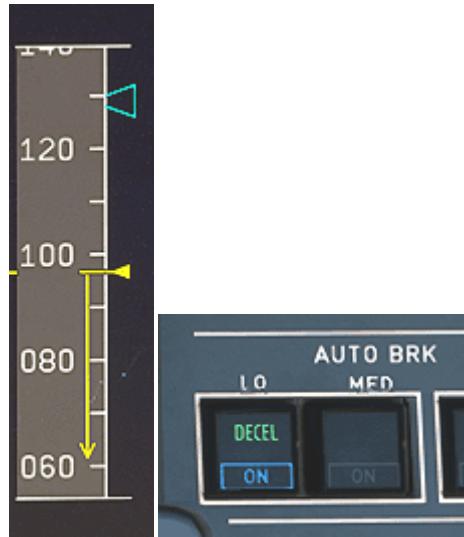
Practice this!!

On touchdown of the main gear the **Speed Brakes** will deploy automatically (we have armed them earlier) and we pull the thrust levers into the reverse position.



We let the front gear settle gently on the runway (don't slam it down) and hold the center line of the runway while we are reducing speed. The speed reduction should be monitored on the PFD speed band and the speed trend arrow.

The Autobrakes should now have activated and started to further decelerate the aircraft. This can be checked by the Autobrake annunciators.



The upper ECAM should now show the engines in reverse mode (REV) and the lower ECAM shows the Speed Brakes (spoiler) deployed. Also you should notice that the brakes actually get hotter.



At about 60knots we put the thrust levers back to idle and at about 40 knots we release the [Autobrakes](#) by braking manually which deactivates the [Autobrake](#).

This concludes *Landing*

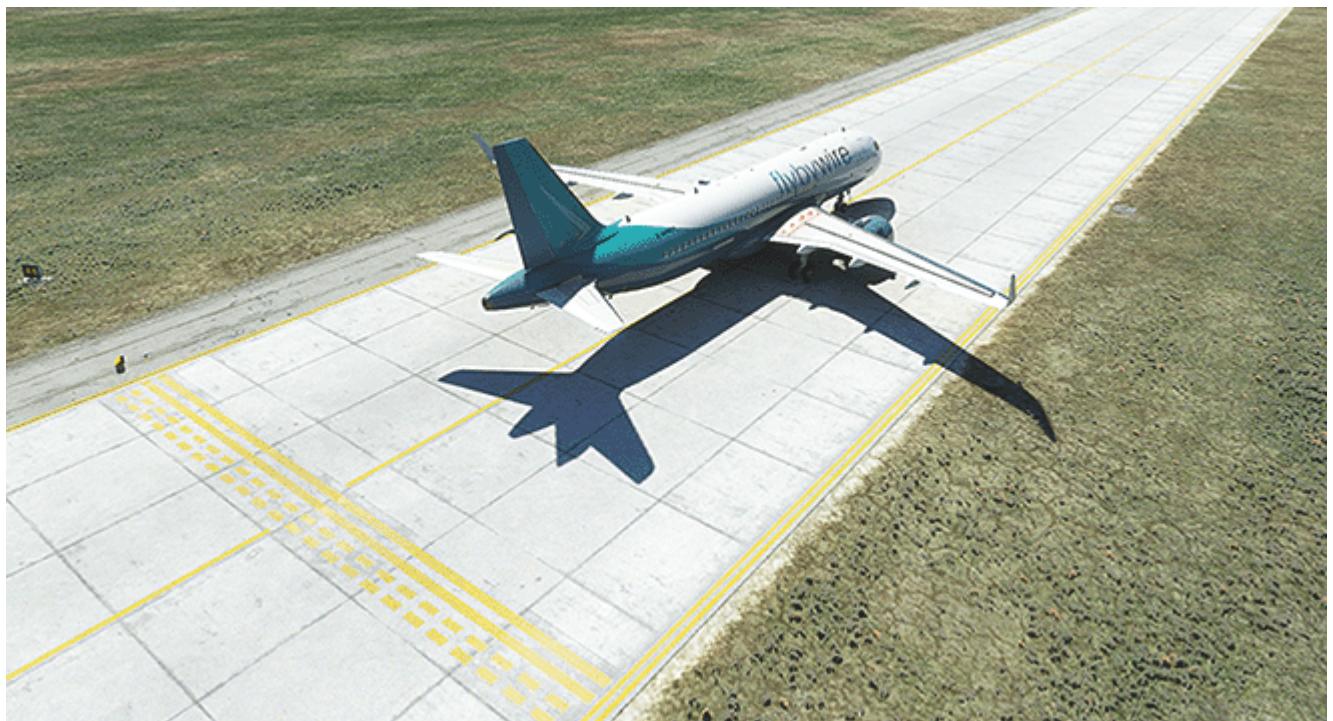
5. Vacate Runway

Situation:

- Aircraft has landed and is still on the center line of the runway.
- Speed is < 40 knots.

We look for the next runway exit and slow down to about 15 knots before we start turning off the runway.

We continue rolling forward until we passed the runway entry marker with the **full length** of our aircraft.



We can now safely stop the aircraft and do our "After Landing" checklist.

If ATC did not already contact us on the ground we would contact them now to let them know we have vacated the runway. They will give us taxi instructions so we can continue taxiing to our gate once we have completed the after landing tasks.

After landing tasks in simulation

In real life the A320 will have two pilots which can actually do things in parallel. Talking to ATC, taxing the aircraft and do the after landing tasks. In the simulation we are typically alone so it is absolutely ok to stop once we have fully vacated the runway and do these things one after the other. Talking to ATC and getting taxi instruction, do the after landing tasks and checklist, taxiing to gate.

This concludes *Vacate Runway*

Continue with [After Landing Steps](#)

1.2.8 After Landing and Taxi to Gate

This guide will explain the correct procedures after we have landed and vacated the runway and then taxiing to the designated gate.

Disclaimer

The level of detail in this guide is meant to get a FlyByWire A320neo beginner from the runway to the designated destination gate.

A *beginner* is defined as someone familiar with flying a GA aircraft or different types of airliners. Aviation terminology and know-how is a requirement to fly any airliner even in Microsoft Flight Simulator.

Further reading: [A320 Autoflight](#)

Also you will find many great videos on YouTube on how to fly the FlyByWire A32NX.

Check out the FlyByWire YouTube Channel as well: [FlyByWire on YouTube](#)

Prerequisites

Aircraft has vacated the runway completely and has been brought to a stop on the taxiway as per previous chapters.



[Download FlyByWire Checklist](#)

Chapters / Phases

This guide will cover these phases:

1. [After Landing](#)
2. [Taxi to Gate](#)

1. AFTER LANDING

Situation:

- Aircraft has vacated the runways completely and has come to a stop on the taxi way as per previous chapters.
- Flaps and Ground Spoilers are still deployed.
- ATC has been informed that we vacated the runway.

1 Simulation vs. Real Life

In real life the A320 will have two pilots who can actually do things in parallel. Talking to ATC, taxing the aircraft and do the after landing tasks.

In the simulation we are typically alone so it is absolutely ok to stop once we have fully vacated the runway and do these things one after the other.

ATC Tower will usually hand us off to ATC Ground and they will give us taxi instructions for our destination gate. Write them down and read them back as usual but you don't have to move immediately unless ATC explicitly tells you to. Online ATC understand that the after-landing- tasks do take some time.

Immediate steps after vacating the runway:

- Set your radio frequency to the one assigned by ATC or the airport charts.

EDDM/MUC Apt Elev **1487'** **MUNICH, GERMANY**
N48 21.2 E011 47.2 **MUNICH**

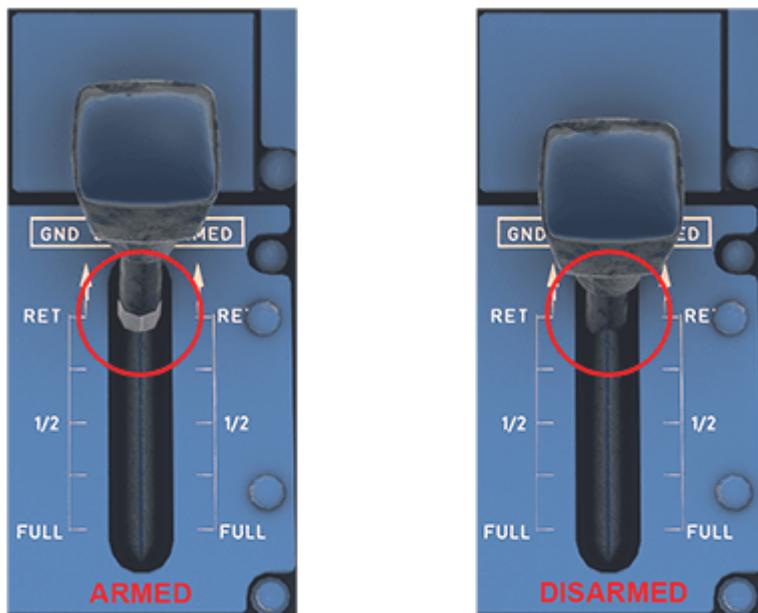
A **JEPPESSEN** 12 MAR 21 **10-9** **Eff 25 Mar**

D-ATIS	ACARS:	MUNICH Delivery (Start-up clearance)	MUNICH Ground Rwy 08L/26R	Rwy 08R/26L	Apron 1	Apron 2	Apron 3
123.130	DCL 1	121.730	121.980	121.830	121.780 3	121.710 4	121.930 5
Tower Rwy 08L/26R 118.705	Rwy 08R/26L 120.505		MUNICH Radar (DEP) North 123.905	South 127.955	MUNICH Arrival (DEP) North 128.030	South 120.780	

Copyright © 2021 Navigraph / Jeppesen
Navigraph Charts are intended for flight simulation use only, not for navigational use.



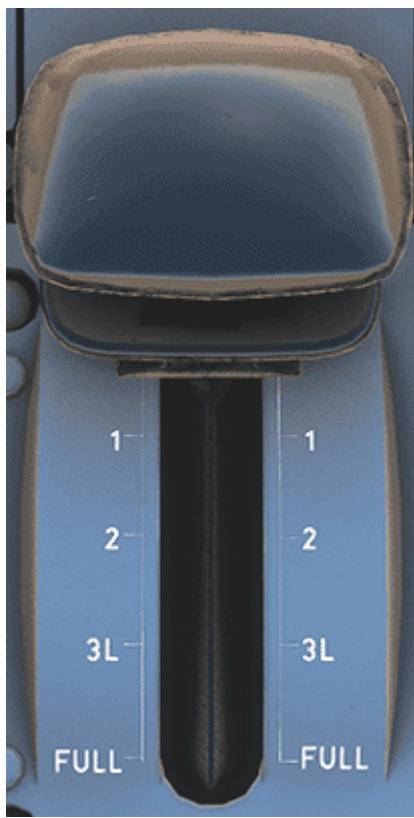
- Disarm the **Speed Brake** lever (Ground Spoilers) by pushing down on the lever.



- Set your **ENG MODE** selector to NORM in case you set it to IGN/START before.



- Retract your FLAPS to 0.



- Set your TCAS to STANDBY.



- Set your **RADAR** and Predictive Windshear System (**PWS**) to OFF.



- Start your **APU** by clicking the **APU MASTER SW** button then the **APU START** button.



- Turn **ANTI ICE** OFF if not required.
- Set your exterior lights:
 - Set your **NOSE** light to **TAXI**.
 - Set **RWY TURN OFF** light to **ON**.
 - Set your **STROBE** lights to **AUTO/OFF** (If you are crossing runway keep them ON until you vacate the runway).
 - For **LAND** lights, you can choose to retract them or turn them off.



- Turn the brake fan (BRK FAN) on if you get a hot brakes ECAM warning.



- Complete the **After Landing** checklist.

AFTER LANDING	
FLAPS.....	RETRACTED
SPOILERS.....	DISARMED
APU.....	START
RADAR.....	OFF
PREDICTIVE WINDSHEAR SYSTEM.....	OFF

This concludes *After Landing*

2. TAXI TO GATE

Situation:

- Aircraft on taxiway directly after runway.
- After Landing** checklist is completed.
- ATC Ground has given taxi instructions.

Taxiing

Make sure to also read the Taxi section of the [Engine Start and Taxi](#) chapter.

Use your charts to follow the ATC taxi instructions to the designated gate.

Crossing a Runway

When approved to cross a runway (active or not) perform the following actions:

- Look out the windows and visually ensure that there are no visible aircraft to your left and right.
- Turn on extra lights to ensure your aircraft is visible when crossing:
 - Strobe lights - Set to ON
- Inform ATC you have vacated the runway if required.

⚠ Warning

Never cross a runway without express permission from ATC and providing a read back of said instructions. Always ensure maximum safety when crossing.

Turning into the Gate

When turning into the gate turn off your **NOSE** light and your **RWY TURN OFF** lights to not blind the ground personnel. This of course is only done at this point if enough lighting is available to safely park into the gate.



This concludes *Taxi to Gate*

Continue with [Powering Down](#)

Last update: August 23, 2021

1.2.9 Powering Down

This guide will explain the correct procedures to power down the aircraft when at the gate after arriving at the destination and taxi to the designated gate.

Obviously this is not strictly required in a simulator but for interested sim pilots this might be an interesting process for a more realistic experience.

Disclaimer

The level of detail in this guide is meant to help a FlyByWire A320neo beginner to correctly shut down the aircraft.

A *beginner* is defined as someone familiar with flying a GA aircraft or different types of airliners. Aviation terminology and know-how is a requirement to fly any airliner even in Microsoft Flight Simulator.

Check out the FlyByWire YouTube Channel as well: [FlyByWire on YouTube](#)

You will find many great videos on YouTube on how to fly the FlyByWire A32NX.

Prerequisites

- Aircraft is at the gate after landing and taxi as per previous chapters.

[Download FlyByWire Checklist](#)

Chapters / Phases

This guide will cover these phases:

1. [Parking at the Gate](#)
2. [Disembarking Passengers and Baggage](#)
3. [Securing the Aircraft](#)

Preface

Shutting down and securing an aircraft is an important part of the overall procedure. Obviously less important in a simulator as the next flight will have the aircraft start in a cold and dark state again.

If we want to actually do a turn around and start a new flight directly the procedure will be a little different as we would not turn off certain systems and at some point simply start with the preparation of the aircraft procedure again.

1. Parking at the Gate

Situation

- We arrived at the designated gate after taxiing from the runway where we landed.
- Aircraft is in taxi state as per previous chapters.
- Engines are still running.
- Lights are still in taxi configuration (`RWY TURN OFF` set to on and `NOSE` is to taxi, `LAND`-ing lights are off).
- `APU` has been turned on during taxi and is `AVAIL`, `APU BLEED` is off.
- **After Landing** checklist is completed.

At the gate:



Steps after arriving at the gate:

- Set parking brake (PARK BRK).



- NOSE TAXI and RWY TURN OFF lights are usually turned off even before we turn into the gate to not blind the ground personnel. This of course is only done if enough lighting is available to safely park into the gate. Turn them off if they were used to assist in parking.



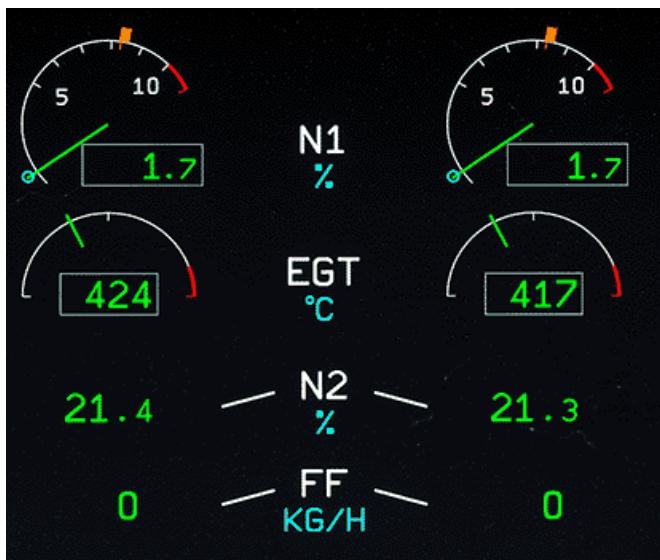
- Turn on APU BLEED before we turn off the engines.



- Shut down the engines by setting the ENG 1 and ENG 2 master switches to off.



- Wait until N1 is below 5%.



- Turn off Seat Belt sign.



- Turn off BEACON (leave NAV & LOGO on as long as the aircraft has power from external or APU, STROBES can remain on AUTO).



- Complete Parking checklist.

PARKING	
APU BLEED.....	ON
ENGINES.....	OFF
SEAT BELTS.....	OFF
EXT LT.....	AS RQRD
FUEL PUMPS.....	OFF
PARK BRK and CHOCKS.....	AS RQRD
Consider HEAVY RAIN	

If external power is available the ground crew would have connected it by now and we can turn on `EXT PWR`. Turning off the APU depends on the turn around time. For a shutdown we do this after the passengers have disembarked to still have airflow in the cabin. See last chapter.

This concludes *Parking at the Gate*.

2. Disembarking Passengers and Baggage

Situation:

- **Parking** checklist is completed.

In real life there are many things starting automatically after parking at the gate. The jetway is connected to the aircraft, doors are opened, passengers disembark, cargo is unloaded, etc. The pilots don't have to do much to trigger these steps.

In the simulator though we would have to trigger them by ourselves. For this we use the FlyByWire flyPad's ground functionality or the Microsoft Flight Simulator's built-in ATC to start these procedures. There are also some nice add-on tools out there which help with this.

Taking care of passengers and luggage with the FlyByWire flyPad:

- Go to the flyPad (view can be activated by `Ctrl+0`).
- Connect the jetway (PAX).
- Call cargo/baggage (Baggage).



Obviously this would take a while in real life and we would not be able to shut down the aircraft before everybody is disembarked.

For a turn around we would start preparing the aircraft for the next flight and the cabin crew would coordinate everything from disembarking the passengers, cleaning and resetting the cabin.

After refuelling the pilot would signal the cabin crew that they could let the new passengers board the aircraft once the cabin is ready.

This concludes *Disembarking Passengers and Baggage*.

3. Securing the Aircraft

Situation:

- **Parking** checklist is completed.
- Aircraft is empty (no passengers or cargo).
- Cabin is cleaned and ready for shutdown.

To secure the aircraft we follow these steps:

- Turn off all fuel pumps.



- Turn off the ADIRS .



- Turn off OXYGEN .



- Turn off APU BLEED .



- Turn off emergency exit lights EMER EXIT LT and no smoking lights NO SMOKING .



- Optional or depending on airline SOPs: Reset air conditioning, lighting and screen brightness.

- Turn off **APU MASTER** (expect the APU to still be AVAIL for a few minutes if you also had APU Bleed on shortly before as it needs a cool down period).



- Wait 2 minutes for the APU FLAP door to close before you turn off power as this needs either APU or external power.
- Turn off **EXT PWR** if it has been turned on before



- Turn off **NAV & LOGO** lights (as aircraft no longer has power).



- Turn off **BAT 1** and **BAT 2**.



Now the aircraft is back in a cold and dark state.

This concludes *Securing the Aircraft*

1.2.10 Airbus Terms and Abbreviations (Selection)

V-Speeds

V-Speed	Term
V1	The highest speed during take-off that you can reject the take-off and still stop on the runway.
V2	Take-off safety speed, where if an engine fails, climb out and control is still guaranteed.
VA	Maximum design maneuvering speed, the maximum speed to do full control deflection in normal or alternate law.
VAPP	Speed for flying down the approach.
VF	Design Flap Speed
VFE	Maximum Flap Extended Speed.
VFEN	Predictive VFE at next flap/slat position
VFTO	Final Takeoff Speed
VLE	Maximum gear extension speed, often lower than the operating speed to prevent gear door damage.
VLO	Maximum gear operating speed, which means the max speed for the gear being down.
VLOF	Lift-off Speed
VLS	Lower Selectable Speed
VMAX	Airbus for the maximum speed for the current configuration, represented by black and red strip at the top of the airspeed indication.
VMCA	Minimum speed in the air that if one engine fails and the other is at TO thrust, you can still control the aircraft with the primary flight controls up to a bank of 5 degrees.
VMCG	Minimum speed on the ground that if one engine fails and the other is at TO thrust, you can still control the aircraft with the primary flight controls.
VMO	Maximum operating speed, also has MMO for maximum Mach number.
VR	Rotate speed, the point where you lift the nose off the runway.
VREF	Reference speed for a normal approach, what you aim to touchdown roughly at.
VS	Stalling Speed at which Airplane is Controllable
VS1	Stalling Speed or Minimum Steady Flight Speed obtained in a specified Configuration
VSO	Stalling Speed or Minimum Steady Flight Speed in the Landing configuration
VSW	Airbus for when the stall warning will activate, represented by a black and red strip at the bottom of the airspeed indicator, when there has been a failure to affect the flight control laws.
VX	Speed of Best Angle of Climb
YY	Speed for Best Rate of Climb
V α MAX	Airbus for the speed that the maximum angle of attack (AoA) can be without the aircraft stalling, shown by the top of a red strip at the bottom of the airspeed indicator.
V α PROT	Airbus for the speed that the angle of attack (AoA) protection will become active to stop the aircraft from stalling, shown as being the top of the black and amber strip at the bottom of the airspeed indicator.

Additional Speeds

V-Speed	Term
MMO	Maximum operating Mach number.
F	Minimum speed at which the flaps may be retracted at takeoff (i.e., CONF 2/3). Also the minimum speed in approach when in CONF 2 or 3
S	Minimum speed at which the slats may be retracted at takeoff. Also the minimum speed in approach when in CONF 1.
O	Green dot speed, engine-out operating speed with flaps up, best lift-to-drag ratio speed, also corresponds to final takeoff speed.

Abbreviations

Abbreviation	Term
A.ICE	Anti-ice, Anti-icing
A/BRK	Autobrake Aircraft
A/THR	Autothrust
ABV	Above
ACARS	Aircraft Communication Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
ACCEL	Acceleration/Accelerate
ACCU	Accumulator
ACFT	Aircraft
ACK	Acknowledge
ACP	Audio Control Panel
ACQ	Acquire
ACQN	Acquisition
ACT	Active
ADD	Addition, Additional
ADF	Automatic Direction Finder
ADIRS	Air Data/Inertial Reference System
ADIRU	Air Data/Inertial Reference Unit
ADR	Air Data Reference
ADS	Air Data System
ADV	Advisory
AESS	Aircraft Environment Surveillance System
AESU	Aircraft Environment Surveillance Unit
AEVC	Avionics Equipment Ventilation Computer
AFFIRM	Affirmative
AFIS	Airline In Flight Information System
AFM	Aircraft Flight Manual
AFS	Automatic Flight System
AFTR	After
AGL	Above Ground Level
AGS	Air Generation System
AGU	Air Generation Unit
AGW	Actual Gross Weight
AI	Anti-Icing
AIDS	Aircraft Integrated Data System

Abbreviation	Term
AIL	Aileron
AIRCOND	Air Conditioning
AIS	Audio Integrated System
AIS	Aeronautical Information Service
ALIGN	Alignment
ALLWD	Allowed
ALPHA	Angle-of-Attack
ALPHANUM	Alphanumerical
ALS	Approach Light System
ALT	Altitude
ALT ACQ	Altitude Acquire
ALT TO	Alternate To
ALTM	Altimeter
ALTN	Alternate, Alternative
AMB	Ambient
AMP	Ampere
ANN	Annunciator
ANN LT	Annunciator Light
AOA	Angle Of Attack
AOC	Airline Operational Control
AOG	Aircraft On Ground
AP	Autopilot
AP/FD	Autopilot/Flight Director
APPR	Approach
APPROX	Approximately
APU	Auxiliary Power Unit
APU AFE	APU Automatic Fire Extinguishing Control Unit
ARMD	Armed
ARMG	Arming
ARND	Around
ARPT	Airport
ARR	Arrival, Arriving
AS	Airspeed
ASD	Accelerate Stop Distance
ASI	Airspeed Indicator

Abbreviation	Term
ASP	Audio Selector Panel
ASSY	Assembly
ASYM	Asymmetric(al)
AT	Autothrottle / Autothrust
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATCI	Air Traffic Control and Information
ATCK	Attack
ATIS	Automatic Terminal Information Service
ATS	Autothrottle / Autothrust System
ATSU	Air Traffic Service Unit
ATT	Attitude
AUTOLAND	Automatic Landing
AVAIL	Available
AVAIL	Availability
AVG	Average
AVIONICS	Aviation Electronics
AVNCS	Avionics
AWY	Airway
B	Blue
B/C	Business Class
BARO	Barometric
BAT	Battery (Electrical)
BCF	Brake Cooling Fan
BCN	Beacon
BCS	Brake Control System
BCU	Brake Control Unit
BETW	Between
BEW	Basic Empty Weight
BKUP	Backup
BL	Bleed
BLK	Block
BLK	Black
BLW	Below
BM	Beam

Abbreviation	Term
BRDG	Bridge
BRG	Bearing
BRK	Brake
BRKNG	Braking
BRKR	Breaker
BRKS	Brakes
BRKT	Bracket
BRT	Bright, Brightness
BT	Bus Tie
BTL	Bottle
BTN	Button
BU	Battery Unit
BUS	Busbar
BYP	Bypass
C	Celsius, Centigrade
C/B	Circuit Breaker
C/L	Check List
C/M	Crew Member
CAB	Cabin
CAB PRESS	Cabin Pressurization
CAPT	Captain
CAS	Collision Avoidance System
CAT	Category
CAUT	Caution
CAUT LT	Caution Light
CFDS	Centralized Fault Display System
CHAS	Chassis
CHG	Change
CHK	Check
CHM	Chime
CIDS	Cabin Intercommunication Data System
CK	Check
CKD	Checked
CKPT	Cockpit
CL	Climb

Abbreviation	Term
CLB	Climb
CLG	Ceiling
CLK	Clock
CLR	Clear
CLR ALT	Clearance Altitude
CLRD	Cleared
CLRNC	Clearance
CLSD	Closed
CLSG	Closing
CM	Centimeters
CMD	Command
CNCT	Connect
CNCTD	Connected
CNTOR	Contactor
CNTR	Counter
CO	Company
CO RTE	Company Route
COM	Communication
COMP	Compass
COND	Condition
CONT	Continue, Continuous
COOL	Cooling
CORR	Correct
COUNT	Counter
CPT	Capture
CRG	Cargo
CRK	Crank
CRZ	Cruise
CSL	Console
CSTR	Constraint
CTK	Center Tank
CTL	Control
CTL	Central
CTLR	Controller
CU	Control Unit

Abbreviation	Term
CUR	Current
CW	Clockwise
CY	Cycle
DAC	Digital to Analog Converter
DADC	Digital Air Data Computer
DADS	Digital Air Data System
DAMP	Damping
DAU	Data Acquisition Unit
DB	Decibel
DB	Data Base
dB	Decibel
DB	Database
dB(A)	A-Weighted Decibel
DC	Direct Current
DCDU	Datalink Control and Display Unit
DCP	Display Control Panel
DECEL	Decelerate
DEG	Degree
DEGRADD	Degraded
DEL	Delete
DES	Descent
DEST	Destination
DET	Detection, Detector
DEV	Deviation
DFDAMU	Digital Flight Data Acquisition and Management Unit
DFDAU	Digital Flight Data Acquisition Unit
DFDR	Digital Flight Data Recorder
DFDRS	Digital Flight Data Recording System
DH	Decision Height
DI	Deicing
DIBU	Door Illumination Ballast Unit
DIFF	Differential
DIR	Direct, Direction, Director
DIR TO	Direct to
DISC	Disconnect, Disconnected

Abbreviation	Term
DISCH	Discharge, Discharged
DISCNTY	Discontinuity
DISRMD	Disarmed
DIST	Distance
DISTR	Distribute, Distribution, Distributor
DITCH	Ditching
DLK	Data Link
DLY	Delay
DMD	Demand
DME	Distance Measuring Equipment
DN	Down
DOW	Dry Operating Weight
DPI	Differential Pressure Indicator
DR	Door
DSPL	Display
E	East
EC	Engine Control
ECAM	Electronic Centralized Aircraft Monitoring
ECM	Engine Condition Monitoring
ECS	Environmental Control System
ECU	Electronic Control Unit
EE	Electrical and Electronic
EEC	Electronic Engine Control
EFCC	Electronic Flight Control Computer
EFCS	Electrical Flight Control System
EFCU	Electrical Flight Control Unit
EFIS	Electronic Flight Information System
ELAC	Elevator Aileron Computer
ELAPS	Elapsed Time
ELEC	Electric, Electrical, Electricity
ELEV	Elevator
ELS	Emergency Lighting System
ELT	Emergency Locator Transmitter
ELV	Elevation
EMER	Emergency

Abbreviation	Term
EMLS	Emergency Lighting System
ENG	Engine
ENG OUT	Engine Out
ENT	Entry
ENV	Envelope
EO	Engine Out
EO ACCEL ALT	Engine Out Acceleration Altitude
EPU	Emergency Power Unit
ERR	Error
ERS	Erase
ESC	Escape
ESD	Electronic System Display
EST	Estimated
ET	Elapsed Time
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
ETE	Estimated Time En Route
ETO	Estimated Time Over
ETOPS	Extended Range Twin Engined Aircraft Operations
ETT	Estimated Time for Takeoff
EVAC	Evacuation
EWD	Engine/Warning Display
EWS	Electronic Warning System
EXT	Extend, Extension
F	Fuel
F	Fahrenheit
F	Minimum Flap Retract Speed (EFIS)
F/CTL	Flight Controls
F/O	First Officer
F/S	Fast/Slow
F/W	Failure Warning
FAA	Federal Aviation Administration
FAC	Flight Augmentation Computer
FACS	Flight Augmentation Computer System
FADEC	Full Authority Digital Engine Control

Abbreviation	Term
FAF	Final Approach Fix
FAIL	Failed, Failure
FAWP	Final Approach Waypoint
FBW	Fly-by-wire
FCC	Flight Control Computer
FCCS	Flight Control Computer System
FCCU	Flight Control Computer Unit
FCGU	Flight Control and Guidance Unit
FCMC	Fuel Control and Monitoring Computer
FCMS	Fuel Control Monitoring System
FCOM	Flight Crew Operating Manual
FCPC	Flight Control Primary Computer
FCPI	Flight Control Position Indicator
FCST	Forecast
FCTN	Function
FCU	Flight Control Unit
FD	Flight Director
FDR	Flight Data Recorder
FDU	Fire Detection Unit
FE	Flight Envelope
FEC	Flight Envelope Computer
FES	Fire Extinguishing System
FF	Fuel Flow
FG	Flight Guidance
FGES	Flight Guidance and Envelope System
FGS	Flight Guidance System
FL	Flight Level
FLDK	Flight Deck
FLEX	Flexible
FLP	Flap
FLT	Flight
FLT CTL	Flight Control
FM	Flight Management
FMA	Flight Mode Annunciator
FMC	Flight Management Computer

Abbreviation	Term
FMCS	Flight Management Computer System (FMC and CDU)
FMCU	Flight Management Computer Unit
FMGC	Flight Management and Guidance Computer
FMGEC	Flight Management Guidance and Envelope Computer
FMGES	Flight Management Guidance and Envelope System
FMGS	Flight Management and Guidance System
FMS	Flight Management System (FMCS and AFS sensors)
FNA	Final Approach
FNCP	Flight Navigation Control Panel
FNSG	Flight Navigation Symbol Generator
FOB	Fuel On Board
FPA	Flight Path Angle
FPL	Flight Plan
F-PLN	Flight Plan
FPM	Feet per Minute
FREQ	Frequency
ft	Feet, Foot
ft/mn	Feet per Minute
FTK	Fuel Tank
FU	Fuel Used
FUSLG	Fuselage
FWC	Flight Warning Computer
FWD	Forward
FWS	Flight Warning System
FWSD	Flight Warning and System Display
G	Green
g	Gram
G/S	Glide Slope
GA	Go-Around
GDNC	Guidance
GEN	Generator
GLS	GNSS Landing System
GMT	Greenwich Mean Time
GND	Ground
GNSS	Global Navigation Satellite System

Abbreviation	Term
GP	Glide Path
GPCU	Ground Power Control Unit
GPS	Global Positioning System
GPU	Ground Power Unit
GPWC	Ground Proximity Warning Computer
GPWS	Ground Proximity Warning System
GR	Gear
GS	Ground Speed
GSHLD	Glareshield
GW	Gross Weight
GYRO	Gyroscope
H	Hot (Electrical Point)
h	Hour
h	Height
H NAV	Horizontal Navigation
HCU	Hydraulic Control Unit
HDG	Heading
HDG/S	Heading Selected
HI	High
HLD	Hold
HOLD	Holding
HP	High Pressure
Hpa	Hecto Pascal
HPA	High Power Amplifier
HR	Hour
HRS	Hours
HSI	Horizontal Situation Indicator
HUD	Head Up Display
HYD	Hydraulic
HZ	Hertz
I/P	Intercept Point
IAF	Initial Approach Fix
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IDENT	Identification, Identifier, Identify

Abbreviation	Term
IF	Initial Fix
IFR	Instrument Flight Rules
IGN	Ignition
ILS	Instrument Landing System (LOC and G/S)
IM	Inner Marker
IMU	Inertial Measurement Unit
in	Inch
IN	Inch
IN HG	Inches of Mercury
INA	Initial Approach
INB	Inbound
INBD	Inboard
INCR	Increase
INCR	Increment
IND	Indicator
INFO	Information
INHI	Inhibit
INHIB	Inhibit, Inhibited, Inhibition
INIT	Initial(ization)
INOP	Inoperative
INS	Inertial Navigation System
INST	Instrument
INTCP	Intercept
INTERCOM	Intercommunication
INV	Inverter
IPDU	Ice Protection Data Unit
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	Inertial Sensor Assembly
ISO	International Standardization Organisation
JEP	Jeppesen
kg	Kilogram
kg/m ³	Kilograms/Cubic Meter
KHZ	Kilohertz
KIAS	Knots Indicated Airspeed

Abbreviation	Term
kPa	Kilo Pascal
KT	Knot(s)
KV	Kilo Volt
KVA	Kilovolt Ampere
kW	Kilowatt
L	Length
L	Litre or Liter
L	Left
L ECAM DU	Left ECAM Display Unit
L/D	Lift/Drag
L/G	Landing Gear
LAND	Landing
LAT	Lateral
LAT	Latitude
LAV	Lavatory
lb	Pound
LB	Pounds
lbf/in ²	Pounds force per square inch
LB-FT	Pound - Force - Foot (Torque)
LB-IN	Pound - Inch
LCD	Liquid Crystal Display
LCH	Latch
LD	Load
LDG	Landing
LDG GR	Landing Gear
LED	Light Emitting Diode
LGERS	Landing Gear Extension and Retraction System
LGMS	Landing Gear Management System
LH	Left Hand
LIM	Limit, Limitation, Limiting, Limiter
LKD	Locked
LO	Low
LO PR	Low Pressure
LOC	Localizer
LP	Low Pressure

Abbreviation	Term
LP VALVE	Low Pressure Valve
LS	Landing System
LT	Light
LTD	Limited
LTG	Lighting
LTS	Lights
LVL	Level
LVL/CH	Level Change
LVR	Lever
LW	Landing Weight
LWR	Lower
M	Maneuvering Speed (EFIS)
M	Magenta
m	Meter
M	Mode
M	Mach Number
M	Mach
MA	Milli-Ampere
MAG	Magnetic
MAINT	Maintenance
MAN	Manual
MAX	Maximum
MAX CLB	Maximum Climb
MAX DES	Maximum Descent
MB	Millibars
mbar	Millibar
MCDU	Multipurpose Control & Display Unit
MCT	Maximum Continuous Thrust
MCU	Master Control Unit
MDA	Minimum Decision Altitude
MDA	Minimum Descent Altitude
MDH	Minimum Descent Height
MEA	Minimum En Route IFR Altitude
MED	Medium
MEM	Memory

Abbreviation	Term
MFD	Multifunction Display
MGT	Management
mile/h	Miles per Hour
MIN	Minimum
min	Minute
MIN FUEL	Minimum Fuel
MIN TIME	Minimum Time
MISC	Miscellaneous
ml	Milliliter
MLG	Main Landing Gear
MM	Middle Marker
mm	Millimeter
MMO	Mach Max Operating Speed
MMO	Maximum Operating Mach
Mn	Mach Number
MON	Monitor, Monitoring, Monitored
MRW	Maximum Ramp Weight
MSG	Message
MSTR	Master
MTO	Maximum Take-Off
MTOW	Maximum Design Takeoff Weight
MTR	Meter
MWARN	Master Warning
MWC	Master Warning Computer
MWP	Master Warning Panel
MWS	Master Warning System
MZFCG	Maximum Zero Fuel Center of Gravity
MZFW	Maximum Design Zero Fuel Weight
n	Load Factor
N	Newton
N	Normal
N	North
N/A	Not Applicable
N/P	Next Page
N/W	Nose Wheel

Abbreviation	Term
N/WS	Nose Wheel Steering
N1	Low Pressure Rotor Speed
N1	Engine Fan Speed
N1.D	N1 Descent
N2	High Pressure Rotor Speed
NAV	Navigation
NAVAID	Navigation Aid
ND	Navigation Display
NDB	Navigation Data Base
NDB	Non-Directional Radio Beacon
NDB	Non-Directional Beacon
NEG	Negative
NLG	Nose Landing Gear
NM	Nautical Mile
Nm	Moment (Newtonmeter)
NO	Normal Operation
No	Number
NORM	Normal
NOTAM	Notice to Airmen
NW	Nose Wheel
O	Open
O2	Oxygen (Symbol)
OAT	Outside Air Temperature
OEW	Operational Empty Weight
OFFR	Off/Reset
OFST	Offset
OK	Correct
OLW	Operational Landing Weight
OM	Outer Marker
OMS	Onboard Maintenance System
OMT	Onboard Maintenance Terminal
OP	Operational
OPP	Opposite
OPS	Operations
OPT	Optional

Abbreviation	Term
OPT	Optimum
OPTL	Optional
OPU	Overspeed Protection Unit
OTOW	Operational Take-Off Weight
OUT	Outlet
OUT	Output
OUTR	Outer
OVFL	Overflow
OVHD	Overhead
OVHT	Overheat
OVLD	Overload
OVPRESS	Overpressure
OVRD	Override
OVSP	Overspeed
OVSTEER	Oversteer
OVV	Overvoltage
OWE	Operating Weight Empty
OXY	Oxygen
OZ	Ounce
P	Pressure
P/B	Pushbutton
P/BSW	Pushbutton Switch
P/L	Payload
Pa	Pascal
PARK	Parking
PAS	Pitch Attitude Sensor
PAX	PAX Announcement Entertainment &
PAX	Passenger
Pb	Pressure Ambient
PCT	Percent
PCU	Power Control Unit
PED	Pedestal
PERF	Performance
PF	Pilot Flying
PFD	Primary Flight Display

Abbreviation	Term
PG	Page
phi	Bank Angle
phi N	Nominal Bank Angle
PHR	Pounds per Hour
PLT	Pilot
PMP	Pump
PMU	Power Management Unit
PNEU	Pneumatic
PNL	Panel
POS	Position
PPM	Parts per Million
PR	Pressure
PRB	Probe
PREV	Previous
PRGM	Program
PRI	Priority
PROC	Procedure
PROG	Progress
PSU	Power Supply Unit
PTR	Push to Reset
PTT	Push to Test
PTT	Push-to-Talk
PTU	Power Transfer Unit
PW	Pratt and Whitney
PWR	Power
QFE	Baro Pressure Setting for Airfield Altitude
QFE	Field Elevation Atmospheric Pressure
QFE	Pressure Setting for Airfield Altitude
QNE	Sea Level Standard Atmosphere Pressure
QNH	Baro Pressure Setting for en Route Altitude
QNH	Sea Level Atmospheric Pressure
QNH	Pressure Setting for En Route Altitude
QNH	Sea Level Pressure
R	Red
R	Radius

Abbreviation	Term
R	Release
R	Reset
R	Right
R/C	Rate of Climb
R/D	Rate of Descent
R/H	Radar Height
R/L	Reading Light
r/min	Revolutions per Minute
R/T	Receiver Transmitter Unit
R/T	Radio Transmit
RA	Resolution Advisory
RA	Radio Altimeter, Radio Altitude
RAD	Radio
RAT	Ram Air Turbine
RCDR	Recorder
RCLM	Runway Center Line Marking
RCLS	Runway Center Line Light System
RCVR	Receiver
RCVY	Recovery
RDY	Ready
RECOG	Recognition
REFLNG	Refueling
REFUEL	Refueling
RET	Retract
RET	Return
RETR	Retract
REV	Reverse
REV	Revise, Revision
RF	Radio Frequency
RMP	Radio Management Panel
RMU	Radio Management Unit
RNAV	Area Navigation
RNG	Range
RNI	Radio Navigation Indicator
RPLNT	Repellent

Abbreviation	Term
RPTG	Reporting
RQRD	Required
RR	Rolls Royce
RST	Reset
RSV	Reserve
RSVR	Reservoir
RTE	Route
RTG	Rating
RTN	Return
RTO	Rejected TakeOff
RTOLW	Runway Takeoff and Landing Weight
RTOW	Runway Takeoff Weight
RTR	Router
RTRSW	Rotary Switch
RTU	Radar Transceiver Unit
RUD	Rudder
RVR	Runway Visual Range
RVS	Reverse
RVSN	Reversion
RWY	Runway
S	South
S	Minimum Slat Retract Speed (EFIS)
s	Second
S/C S/D	Step Climb Step Descent
SAT	Static Air Temperature
SATCOM	Satellite Communication
SBL	Symbol
SC	Single Chime
SD	System Display
SEAL	Sealing
SEC	Spoiler Elevator Computer
SEC	Secondary
SEC	Secondary Computer
SEG	Segment
SEL	Select, Selected, Selector, Selection

Abbreviation	Term
SELCAL	Selective Calling System
SEQ	Sequence, Sequential
SER	Serial Number
SER	Serial
SGU	Symbol Generator Unit
SHT	Short
SI	Slip Indicator
SID	Standard Instrument Departure
SIG	Signal
SIM	Simulation
SL	Sea Level
SLT	Slat
SMK	Smoke
SNSR	Sensor
SPAD	Scratchpad
SPD	Speed
SPD/M	Speed-Mach
SPEC	Specification
SPLR	Spoiler
SPLY	Supply
SRS	Speed Reference System
STAB	Stabilizer
STAR	Standard Terminal Arrival Route
STARTG	Starting
STAT	Static
STBY	Standby
STDY	Steady
STRG	Steering
STRUCT	Structure
STS	Status
SURF	Surface
SVCE	Service
SW	Switch
SYS	System
T	True

Abbreviation	Term
T	Turn
T	Trim
T	Time
t	Tonne
T/C	Top of Climb
T/D	Top of Descent
T/R	Thrust Reverser
TA	Traffic Advisory
TACAN	Ultra-high Frequency Tactical Air Navigation Aid
TACH	Tachometer
TAS	True Airspeed
TAT	Total Air Temperature
TBC	To Be Confirmed
TBU	Time Base Unit
TBV	Transient Bleed Valve
TC	Takeoff Charts
TCAS	Traffic Alert and Collision Avoidance System
TEMP	Temperature
TGT	Target
THR	Thrust
THROT	Throttle
THS	Trimmable Horizontal Stabilizer
TK	Ground Track Angle
TK	Tank
TKE	Track Angle Error
TLA	Throttle Lever Angle
TMA	Terminal Control Area
TMR	Timer
TO	Takeoff
TO/APPR	Takeoff/Approach
TOD	Takeoff Distance
TOGA	Takeoff/Go Around
TOGW	Takeoff Gross Weight
TOR	Takeoff Run
TOT	Total

Abbreviation	Term
TOW	Takeoff Weight
TOW	Towing
TR	Thrust Reverser
TRANS	Transition
TRANSF	Transfer
TRGT	Target
TRIG	Trigger
TRK	Track
TRK	Track (angle)
TROPO	Tropopause
TRT	Turn Round Time
TRU	True
TST	Test
TT	Total Time
TURB	Turbine
TWR	Tower
TWY	Taxiway
TX	Transmission (TCAS to Transponder)
TYP	Typical
UHF	Ultra High Frequency
V	Volt, Voltage
V	Valve
V/L	VOR/LOC
V/L	VOR/Localizer
V/S V1 V1 V2	Vertical Speed
V2min	Critical Engine Failure Speed Decision Speed
VACU	Vacuum
VCTREND	Airspeed Tendency
VDF	Very High Frequency Direction Finding Station
VDR	VHF Data Radio
VEL	Velocity
VERT	Vertical
VFR	Visual Flight Rules
VHF	Very High Frequency
VHV	Very High Voltage

Abbreviation	Term
VIB	Vibration
VLF	Very Low Frequency
VOL	Volume
VOR	Very High Frequency Omnidirectional Station
VOR.D	VOR-DME
VORTAC	Visual Omni-Range Tactical Air Navigation
VSI	Vertical Speed Indicator
W	Weight
W	Watt
W	West
W/V	Wind Direction and Speed
WAI	Wing Anti-Ice
WARN	Warning
WB	Wide Body
WD	Warning Display
WDO	Window
WG	Wing
WHL	Wheel
WR	Weather Radar
WS	Wind Speed
WT	Weight
WX	Weather Mode (ND)
WXR	Weather Radar
X	Cross
X	Trans Crossbleed
X BLEED X FEED	Crossfeed
X LINE	Crossline
X VALVE	Cross Valve
XFR	Transfer
XING	Crossing
XPDR	Transponder
XPNDR	Transponder
X-TALK	Cross-talk
XWIND	Crosswind
Y	Yellow

Abbreviation	Term
Y/C	Economy Class
YCR	Economy Class-Rear
YE	Year
Z	Greenwich Mean Time
ZC	Zone Controller
ZFCG	Zero Fuel Center of Gravity
ZFW	Zero Fuel Weight
Zp	Pressure Altitude
Zpi	Indicated Pressure Altitude

Last update: August 22, 2021

1.3 Airliner Flying Guide

1.3.1 Overview

This is a rough basic guide to general airliner terminology and flying techniques that can be generally applied to most aircraft in the simulator, with a focus towards the Airbus A320 Family and the FBW A32NX add-on.

For Simulation Use Only

Author Credit: *Shomas on Discord (A320 Pilot)*

Topics:

[Types of Approaches](#)

[Navigation](#)

[Understanding Altitude References](#)

[METARs/TAFs/ATIS](#)

Last update: August 22, 2021

1.3.2 Types of Approaches

Different Approaches Available

To land any aircraft, the first step is to start an approach that will bring you to a position where you can see the runway. There are a multitude of different approaches, divided into three terms, precision, non-precision and approach with vertical guidance.

Depending on what equipment the airfield has, what the aircraft is capable of, what the pilot is certified to do and the weather that is on the airfield will determine which of these approaches you will do. Here are some of the more common ones you may see in an airliner.

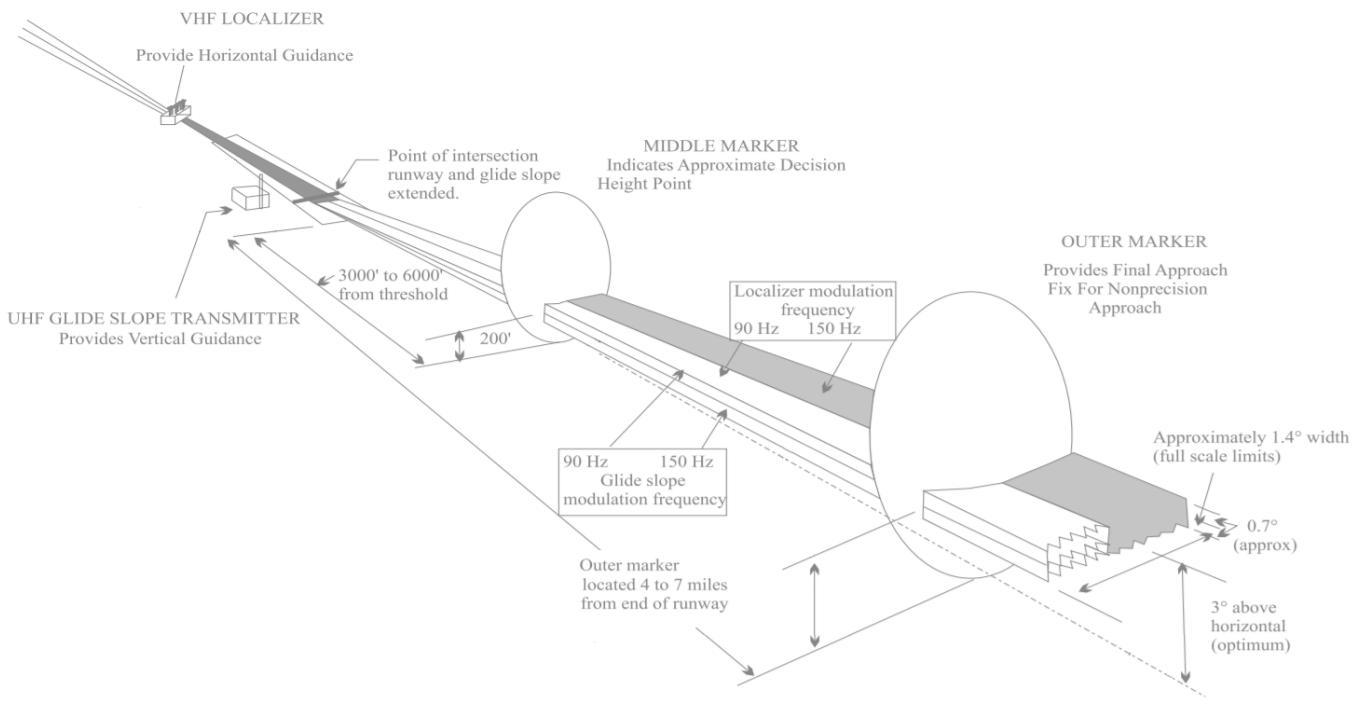
Precision Approaches (PA)

A precision approach will give you full guidance, both vertically and laterally, to guide you down to a point where you can see the runway. This information can come from a set of radio beacons on the ground, satellite information or from a controller.

Approach Type	Equipment Used	Used For
Instrument Landing System (ILS)	A localiser and glideslope radio beacon	Most precise available, the most common for airliner operations.
GBAS Landing System (GLS)	GPS Satellite systems and ground transmitters	A new alternative to ILS, for difficult approaches
Precision Approach Radar (PAR)	A radar dish and a controller	Commonly as a backup, or at military airfields



Lucash, CC BY-SA 3.0, via Wikimedia Commons

ILS

ILS Diagram Simplified, U.S. Dept. of Transportation, Federal Aviation Administration, Public domain, via Wikimedia Commons

Using a localiser beacon at the end of the runway, and a glideslope beacon at the side, the aircraft is guided along two radio signals to the touchdown point. These can be accurate enough to position the aircraft all the way down to touchdown and steer it along the runway. The pilots need to tune the ILS frequency into their aircraft's radio navigation system to receive the correct signals.

GLS

Like an ILS, but instead of using a set of radio beacons, the aircraft is guided by being fed information from a set of ground stations, which are in turn fed details about the position of the aircraft through GPS satellites.

Not common, but as they do not need radio signals that go out in straight lines, the station can guide the aircraft around curves and turns to avoid terrain and built up/sensitive areas. Only some aircraft are equipped to do GLS and is only an option on the A320 family.

PAR

This is an approach where a controller, with an advanced radar, steers you towards the runway while telling you corrections to your heading or altitude. To the pilot, the controller will give you corrections such as, "Left 2 degrees", "Right 3 degrees", "Slightly high, correcting", to bring you towards the runway.

When all other systems fail, this system can be used as a backup to provide these kinds of approaches, and several large international airports will practice these to keep the controllers skills current. Military airfields commonly use them as they can be setup much quicker than an ILS for use in temporary airfields and only rely on a radar, which can be portable.

NON-PRECISION APPROACHES (NPA)

A non-precision approach officially can only give you lateral guidance to the point where you can see the runway. This is fed either to the pilots either using a single radio beacon or by satellite navigation, but these cannot tell you if you are too high or low. The only way is to use a table off an aviation chart that shows you at what altitude you need to be at certain distances.

Approach Type	Equipment Used	Used For
Localiser Only (LOC)	A localiser that would be part of an ILS system normally	Some airports only have localiser but also when ILS glideslopes have failed.
VOR-DME or VOR Only	A VOR beacon with/without a distance from a DME	Old style approaches, where ILS cannot be used.
NDB-DME or NDB Only	A NDB beacon with/without a distance from a DME	Old style approaches, where an ILS cannot be used
LNAV Only	GPS or the Aircraft's position inside the flight management computers	Approaches where there are no radio beacons in the area
Approach Surveillance Radar (ASR)	A radar dish and a controller (No altitude compared to PAR)	Commonly as a backup, or at military airfields.
Visual	Pilots eyeball!	Where there is no issue with the weather and the runway is already in sight

These approaches are all flown traditionally with just a beacon pointer, a localiser giving left/right corrections, or a controller giving rough headings. With a helpful co-pilot who will be using the altitude table to check if you are high or low, you keep correcting down towards the runway. As the term non-precision hints, these approaches are nowhere near as accurate as a precision approach and as such can require quite good weather to be able to attempt them. VOR and NDB beacons are slowly disappearing due to maintenance costs and the more useful APV approaches being made available.

APPROACHES WITH VERTICAL GUIDANCE (APV)

A newer kind of approach, that uses both lateral and vertical guidance from sources such as GPS satellites, and does not require the use of radio beacons at all. At the time of writing, these approaches were not yet classed as precision, as they do not quite have the accuracy required but are constantly getting better with each new design. They are now flown very similarly to an ILS and do not require much input from the pilots.

Approach Type	Equipment Used	Used For
RNP/RNAV	Satellite GPS systems and the aircraft's on board positioning system	Approaches where there are no radio beacons in the area
RNP-AR	Satellite GPS systems and the aircraft's onboard positioning system	As per RNP/RNAV but allow curved approaches with margins as little as 0.1 NM.

The Different Categories of ILS

With the ILS system, there are several categories that have different requirements from the pilots, the aircraft, the weather and the airport equipment. They are known as CAT, short for category, and are listed as both roman numerals and Latin numbers:

ILS Category	Autoland Required (in the Airbus)	Weather (Normally)	MDA or DH
CAT 1 / CAT I	No (May also be unsafe due to interference)	Cloud base above 200ft Visibility 550m	MDA
CAT 1 LTS / CAT I LTS (Lower Than Standard)	Yes	Cloud base above 200ft Visibility 400m or 450m	MDA
CAT 2 / CAT II	Yes	Cloud base above 100ft Visibility 300m	DH
CAT 3A / CAT IIIA	Yes	Cloud base above 100ft Visibility 200m	DH
CAT 3B / CAT IIIB	Yes (2 Autopilots)	Cloud base above 50ft Visibility 75m	DH (can be 0)
CAT 3C / CAT IIIC	Yes (2 Autopilots)	Cloud base above 0ft Visibility 0m	DH (can be 0)

As the weather gets progressively worse, the higher the category you need to use, which in turn requires more advanced equipment both on the airfield and in the cockpit. To be able to do this, pilots are required to retrain on low visibility operations every year.

The CAT 3C can be performed without ever seeing anything at all but this is not in practice yet as there has not been designed a system for the aircraft to be able to leave the runway and go to the parking stands completely blind. The A320 family are capable of everything including CAT 3C.



MichaelDiederich CC BY-SA 3.0

Minimums and MDA/DH

So, you have picked your approach and are flying towards the runway, but how close can you get before you decide it is a bad idea and to try again somewhere else? This is where the minimums come into effect. These are fixed values that decide how low you can go on the approach, and when you get to this altitude, you cannot go any lower until you can see the runway.

Minimum Type	Defined As	Approaches Used In
MDA (Minimum Descent Altitude)	Altitude Above Mean Sea Level	CAT 1 / CAT 1 LTS ILS VOR, NDB, RNAV, RNP, Visual, SRA
DH (Decision Height)	Height Above the Ground	CAT 2 ILS CAT 3 A/B/C ILS

These are defined in feet, (or meters if that airspace uses meter altitudes) and can be found at the bottom of the aeronautical chart that is published for that approach. Each approach to each airport will have a separate value, changing due to obstacles, terrain, and other things that may get in the way while descending towards the runway.

AIRCRAFT APPROACH CATEGORIES

Now depending on the aircraft you are flying, depends on the minimums you are allowed to use. These are grouped together by the approach speed of your aircraft, while in normal landing configuration at the maximum landing weight that it is certified to do.

- The higher the maximum weight approach speed means:
- The higher category is required, which means:
- The higher minimums are used.

Aircraft Category	Approach Speeds	Typical Aircraft
A	< 91 knots	C172 PA28 SR22 DC3
B	91 - 120 knots	ATR72 C17 S340 TBM850
C	121 - 140 knots	A320 A380 737 MD80
D	141 - 165 knots	A340 A350 747 777 787 MD11
E	166 - 210 knots	Concorde and specialist military

MDA/DH ON A CHART

CATEGORY	A	B	C	D
S-ILS 23		928/18 200 (200-½)		
S-LOC 23		1060/24 332 (400-½)		1060/40 332 (400-¾)
CIRCLING	1200-1 472 (500-1)		1200-1½ 472 (500-1½)	1280-2 552 (600-2)

ILS_RWY_23_KBUF.jpg: The original uploader was Centpacrr at English Wikipedia. Derivative work: Atmoz, Public domain, via Wikimedia Commons

In the above example, which is for the ILS or LOC/DME for Runway 23 at Buffalo Airport, NY in the USA, this chart uses a format designed by the Federal Aviation Administration (FAA) of the USA. Each chart designer unfortunately has slight differences compared to each other, but the basics are usually the same. So, for the above approach:

	MDA (ft)	Visibility (in 100s of ft (USA))	Visibility (m)	Height above the ground (ft)
ILS CAT 1 RW23	928	1800	550	200
LOC RW23 (Category ABC)	1060	2400	730	332
LOC RW23 (Category D)	1060	4000	1220	332

N.b. The brackets in the above image are used by the FAA for military operations, nothing to worry about in an airliner!

In this example, for Paris Charles De Gaulle Airport, ILS or LOC/DME for runway 26L:

CAT	ILS				LOC		
	DA (H)	RVR	OCH CAT 1	OCH CAT 2 (1)	MDA (H)	RVR	OCH
A			141	54			
B			152	67			
C	520 (200)	550	178	78	710 (390)	1100	385
D			188	94			
DL			194	94	-	-	-

SIA, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

	MDA (ft)	Visibility (m)	Height above the ground (ft)
ILS CAT 1 R26L	520	550	200
LOC 23	710	1100	390

As this chart is now designed differently, it has described the MDA as a DA for the ILS. Now this is just a difference between charts and countries, some use one terminology over the other. Also to note is the inclusion of OCH values. These are the obstacle clearance heights of all possible objects on the approach path, so if you descend below this, then there is a possibility of a collision. These OCH values are not used by the pilots in an approach but are used by the professional bodies who design the approaches as to what the minimum values should be.

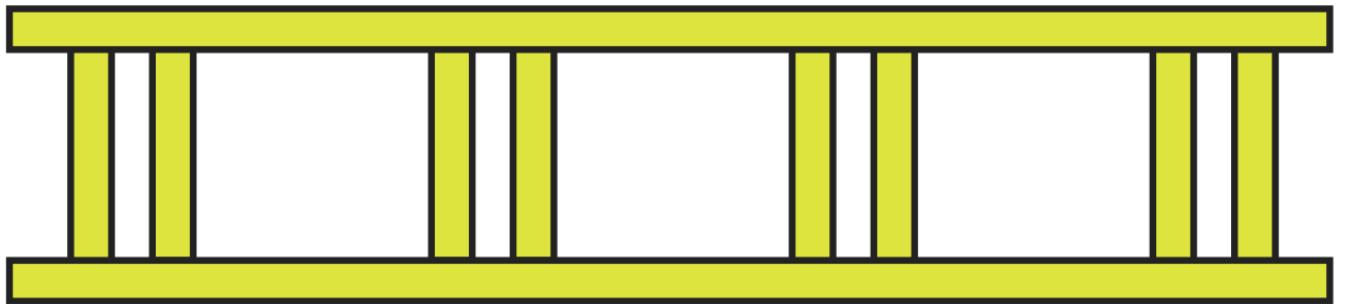
Autoland

Autolands are, unlike what the media might want everyone to think, not used all that frequently! The only time it is fully used is in conditions of bad weather, where the clouds are too low or the visibility not far enough to continue to do a normal manual approach. Special rules must be in place to prevent any interference with the aircraft, as this is a precise manoeuvre with not much room for error.

RULES AT AIRFIELD

To fly an Autoland, the approach you are flying must be a CAT 2 ILS or higher. This means that only certain airfields can perform these, where the localiser and glideslopes have been certified as accurate enough to guide the aircraft to a successful landing. An airfield with anything such as an offset ILS, where the ILS is not aligned with the runway, will not be able to offer an Autoland approach.

The airfield must also be in Low Visibility Procedures (LVPs). This aims to reduce the chance of anything interfering with the ILS signals by reducing the amount of vehicles and aircraft near the runway at any time. Special holding points that are further back from the runway are used, and an ILS critical area is established. The image below is a form of LVP ILS holding point.



Claudius Henrichs, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

No vehicles or aircraft are allowed into this area while an Autoland is being made. This has the knock-on effect of slowing down operations at an airfield, as the normal rate of landings is now not allowed to reduce interference. From personal experience, an A380 vacating the runway at 90 degrees was enough to force an A320's autopilot to disconnect as the ILS signal was lost, which is something you do not want to happen when you cannot see anything!

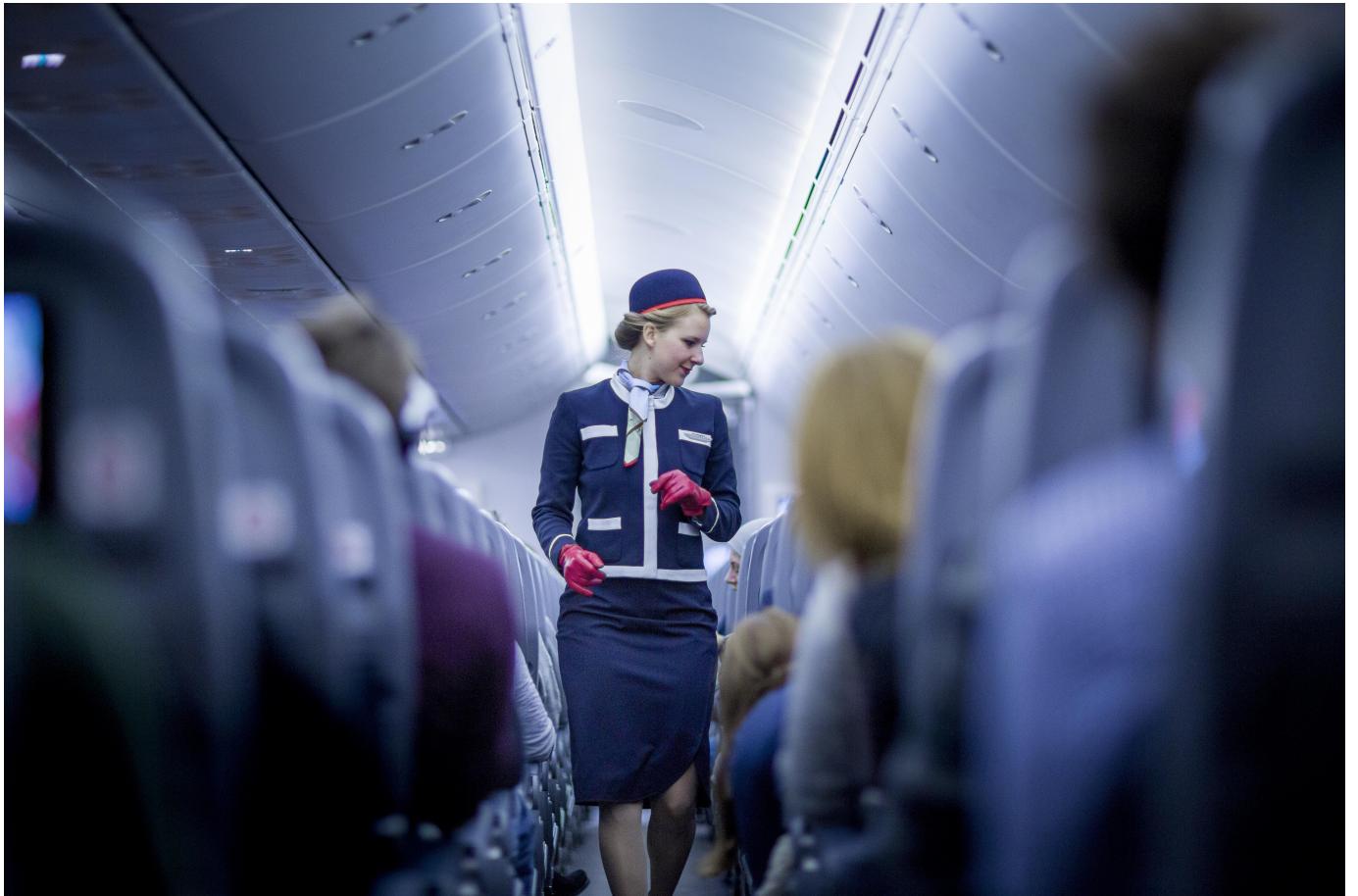
RULES ON THE AIRCRAFT

The aircraft must first be certified as capable of doing an Autoland and have all the equipment functioning that it was certified with. Many systems used must have a backup, especially for the very low visibility approaches such as CAT 3B/C, including dual autopilots. If any of these systems fail, the aircraft is normally reduced in its landing capability to a lower Category of ILS. The Airbus has an extra Red warning light in front of the pilot's eyesight which flashes if any Autoland equipment fails while the aircraft is performing an Autoland. Depending on when this happens, this can force the pilots to do a go-around to prevent an accident.



UR-SDV (GFDL <http://www.gnu.org/copyleft/fdl.html> or GFDL <http://www.gnu.org/copyleft/fdl.html>), via Wikimedia Commons

Another rule onboard is the banning of the use of personal electronic devices (PEDs). This is required to prevent any sort of interference with the onboard equipment on the aircraft as it is that sensitive to radio signals. Normal approaches do not require this level of protection, so many airlines now allow the use of devices during all phases of flight. As testing all possible devices that a passenger could possibly bring on board is a bit impractical, a complete ban is enforced to cover all potential issues. Nowadays, some aircraft have removed the No Smoking sign and replaced it with a No Electronic Devices sign to account for the change in times. A prerecorded public announcement is usually played and the flight attendants will check for devices being used before the approach is made.



Norwegian, CC BY 3.0 <https://creativecommons.org/licenses/by/3.0>, via Wikimedia Commons

RULES FOR THE PILOTS

Pilots must be certified to commence autolands and are regularly tested in simulators to keep them in check. Most airlines require their pilots to do emergency exercises while recertifying their Autoland qualification, including with engine problems and Autoland failures. At the author's airline, the captain is also required to be the pilot flying during an Autoland, with the first officer calling out changes to the aircraft state and monitoring the performance of the aircraft for any deviation.

In the Airbus, a Quick Reference Handbook (QRH) is carried in the cockpit which includes, as well as emergency procedures, a list of equipment and guidebook briefing to complete an Autoland approach. With the possibility of being so low to the ground without being able to see, in the last stages of an Autoland approach the crew are focused and nonimportant radio calls are ignored to prevent distractions.

The Airbus will have several Flight Mode Annunciators (FMAs) display during an Autoland:

FMA	Description
LAND	Appears at 350ft AGL and locks in the final guidance
FLARE	At or below 40ft AGL, and flares the aircraft for landing
ROLLOUT	On touchdown, keeps the aircraft straight on the runway until the autopilot is disconnected

Last update: August 23, 2021

1.3.3 Navigation

Reading a Chart

CHART SAMPLE 1

Reading Chart Sample 1

1

The category of aircraft allowed to do this approach (A, B, C & D).

The altitude of the airfield (392ft) and altitude of the runway touchdown (317ft)

2

A top-down picture of the approach (solid line), go-around (dotted line), dangerous airspace (red area), the airport layout and obstacles nearby.

A box in the top-left corner showing local holding waypoints (MOPAR) with speed limits (230 knots) and altitude limits (between FL070 and FL110).

3

The transition altitude (5000ft).

4

The missed approach described in text form.

5

The minimums box for this approach.

6

A box describing, depending on your groundspeed, how long it will take you to get to the runway from the first point you start to descend and what vertical speed is expected.

7

The ILS frequency (108.35), its identifier (DSU) and that it has a DME linked to it.

The magnetic variation of the area (0 degrees).

8

Special notes for this approach that may be different than normal.

9

A side-on view of the approach, with starting altitude (4000ft), inbound course (265 degrees), slope of the glideslope (3.0) and distances to the runway for several points along the bottom.

10

A distance-altitude check box, where the altitude you should be at for different distances is described. This is useful to check in case there are any issues with any of the radio beacons you are using.

AIP
FRANCE

AD 2 LFPG IAC RWY26L FNA -ILS CAT123 LOC

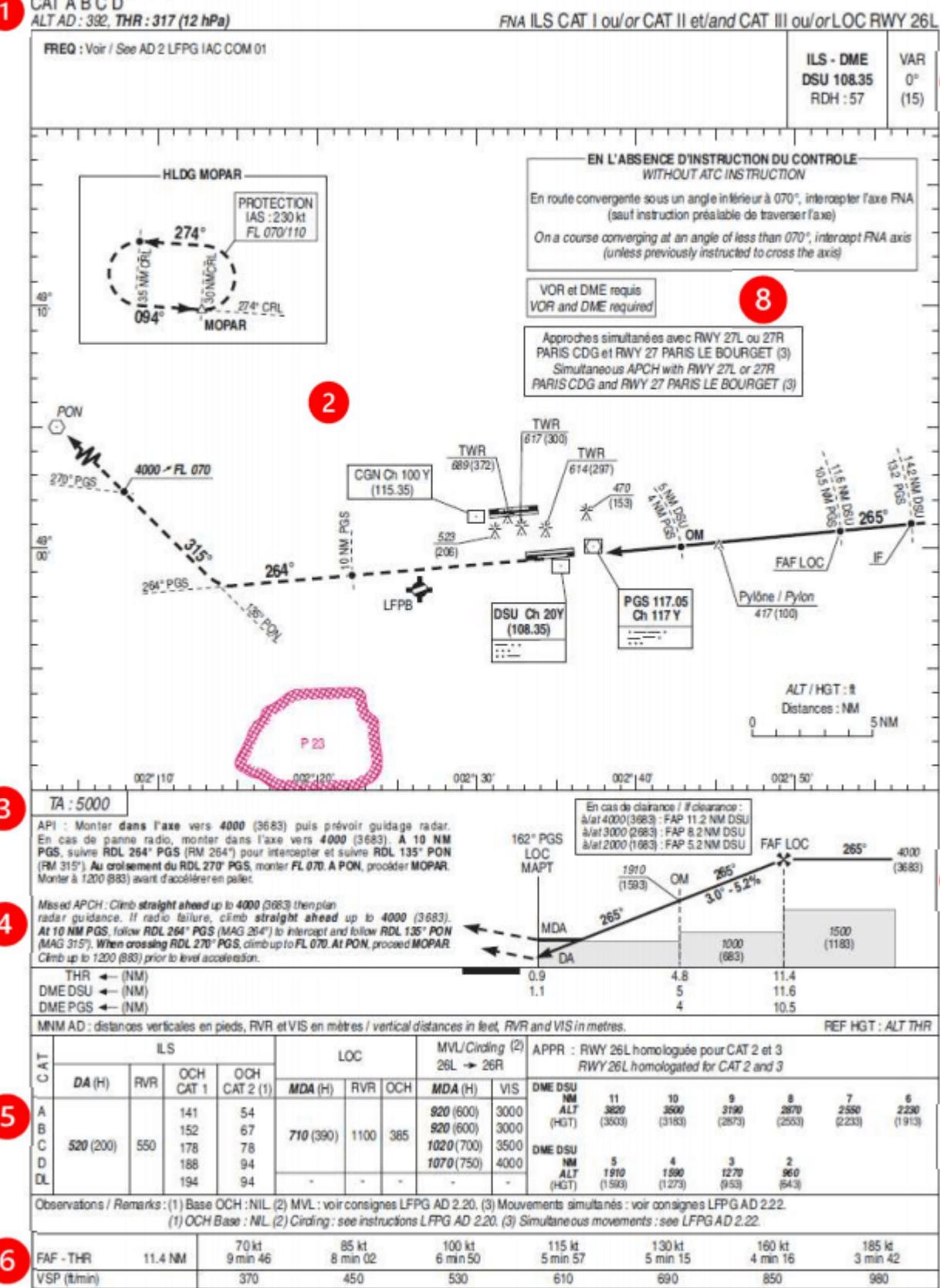
03 JAN 19

APPROCHE AUX INSTRUMENTS*Instrument approach*

CAT A B C D

ALT AD : 392, THR : 317 (12 hPa)

PARIS CHARLES DE GAULLE



SIA, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

NOTE

All approach charts, no matter the designer, will have this information provided to you as a bare minimum.

However, the layout may be significantly different, so a quick 5 minutes to look at the chart can make all the difference before starting an approach.

CHART SAMPLE 2

Reading Chart Sample 2

1

One of the starting waypoints of the arrival (RILAX), including a holding pattern with Minimum Holding Altitude (FL110) and Maximum (FL200).

2

A radio beacon used on this arrival (Trasadingen VOR), with its identifier (TRA), frequency (114.3) and Morse code (-.-.-).

3

The airfield that this approach is designed for (Zurich), with the runway layout and an on-airfield radio beacon (Kloten VOR).

4

The names of the arrivals and where they terminate (AMIKI).

5

The location of the waypoint (NEGRA) defined by radio beacons (TRA & KLO), by the distance and direction from each of them (track 087 at 40.2 nautical miles/track 066 at 39.2 nautical miles).

6

The initial approach fix or IAF (AMIKI), which is normally where the arrival will end and the approach chart will start from.

7

A text description of the route for each arrival.

8

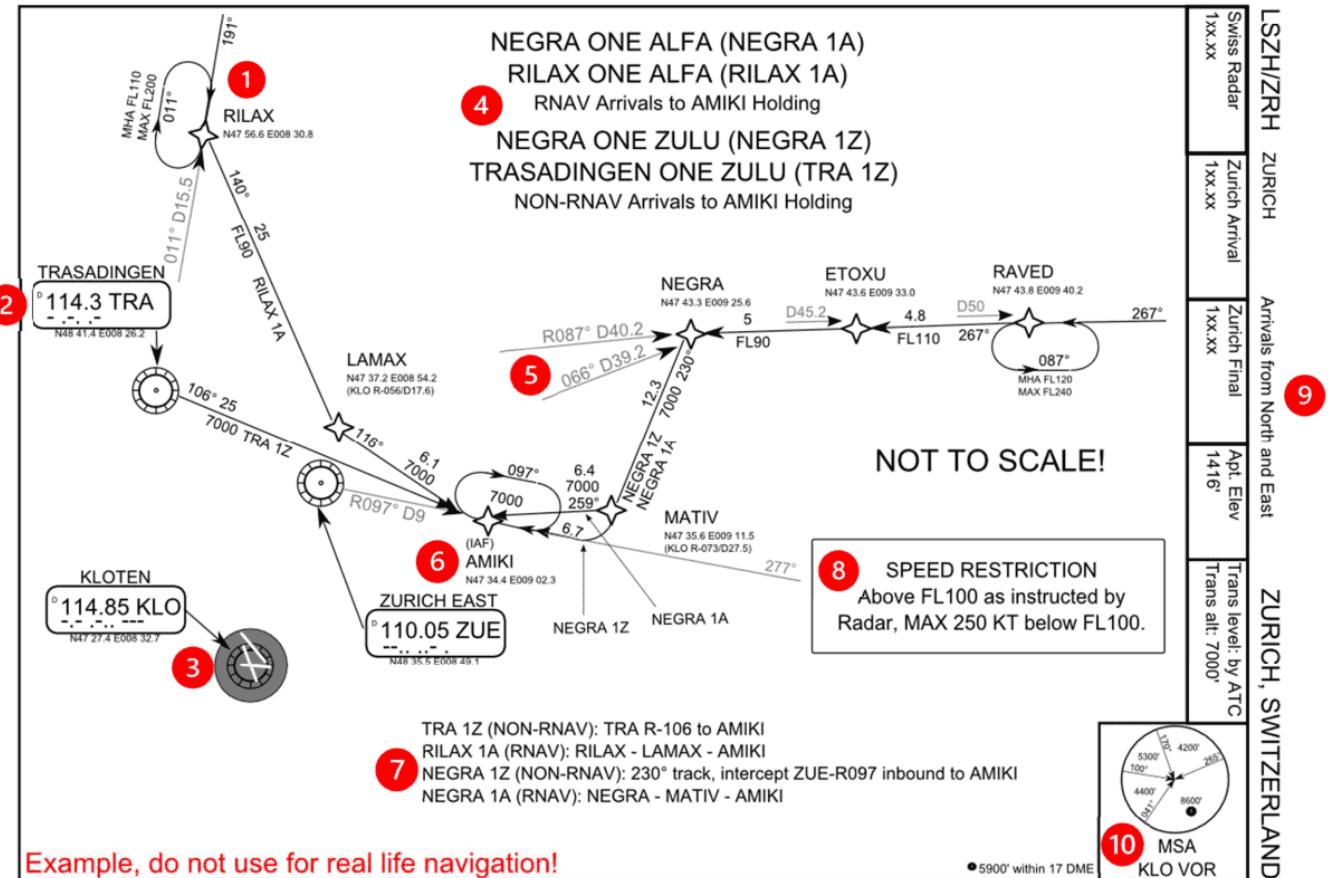
Special notes for this arrival that may be different than normal.

9

A box with ATC frequency information, the airport altitude (1416 feet) and the transition level and altitude (by ATC/7000ft).

10

The minimum safe altitude (MSA), which below this you are in danger of hitting terrain. This is traditionally based on a 25 nautical mile ring around a VOR beacon (KLO), and different segments are split up by tracks into the beacon.



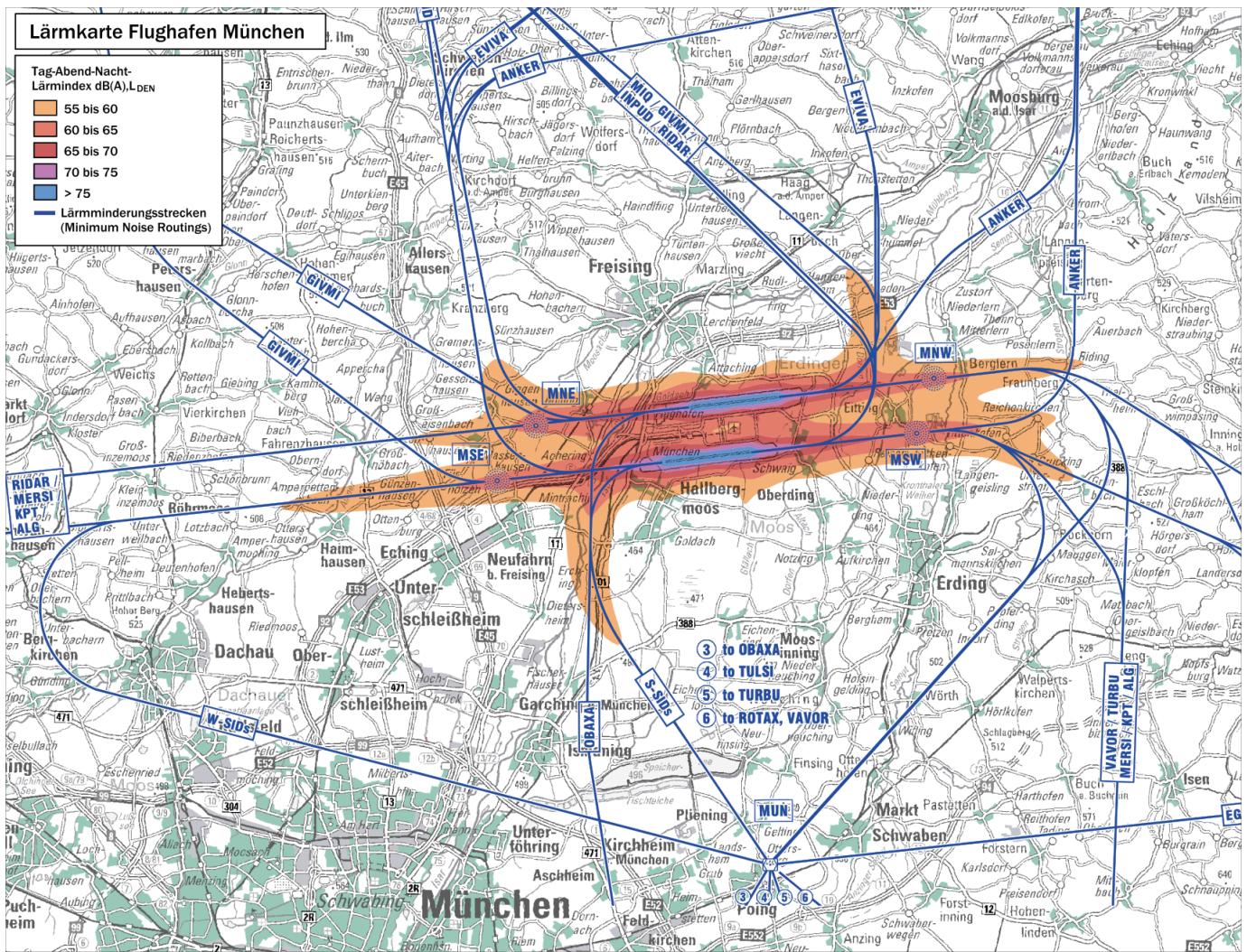
El-mejor, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons

SIDs and STARS

As much as an airway might be the highway/motorway of the sky, SIDs and STARS are the roads that lead you to and from it. An airport will have multiple SID/STARS for each runway, which will take you a different direction usually to a waypoint which connects to an airway. The airport will publish a chart for each SID and STAR, which should be checked by the pilots and followed unless cleared to do otherwise.

SID (STANDARD INSTRUMENT DEPARTURE)

These are the roads away from the airport, navigating around obstacles while keeping the aircraft safe from others with altitudes. Usually, an IFR clearance that you receive on the ground will have a SID or some form of departure instruction, which will depart you from the runway in use and connect onto the rest of your flight plan.



By Alexrk2 - own work, using Digitale Topographische Karte 1:250.000, © GeoBasis-DE / BKG 2016 (GeoNutzV) Strategic noise maps (DF 4 and DF 8), European Environment Agency Minimum Noise Routing (SID), opennav.com, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=51978317>

In the above image, you can see all the possible SID routes out of Munich Airport (EDDM). Although the diagram is a noise map, you can see that all routes have a common part to start with when they leave the runway, until they start turning away to their respective waypoints. This means that the noise of departing aircraft is confined to a particular area as best as possible, hopefully away from built up areas.

STAR (STANDARD TERMINAL ARRIVAL ROUTE)

Where a SID is the route out of an airport, the STAR is the way in. Extremely similar in design to the SID, this will route you down from the end of an airway normally, until ending at the start of the approach for the runway you are landing on. A STAR will have a route that also keeps it clear of obstacles/terrain etc. and give hard altitudes for the pilot to descend to when cleared. Some of these charts will also have holding patterns listed on them for controllers to keep aircraft out of the way to wait until the flow of traffic allows them to land.

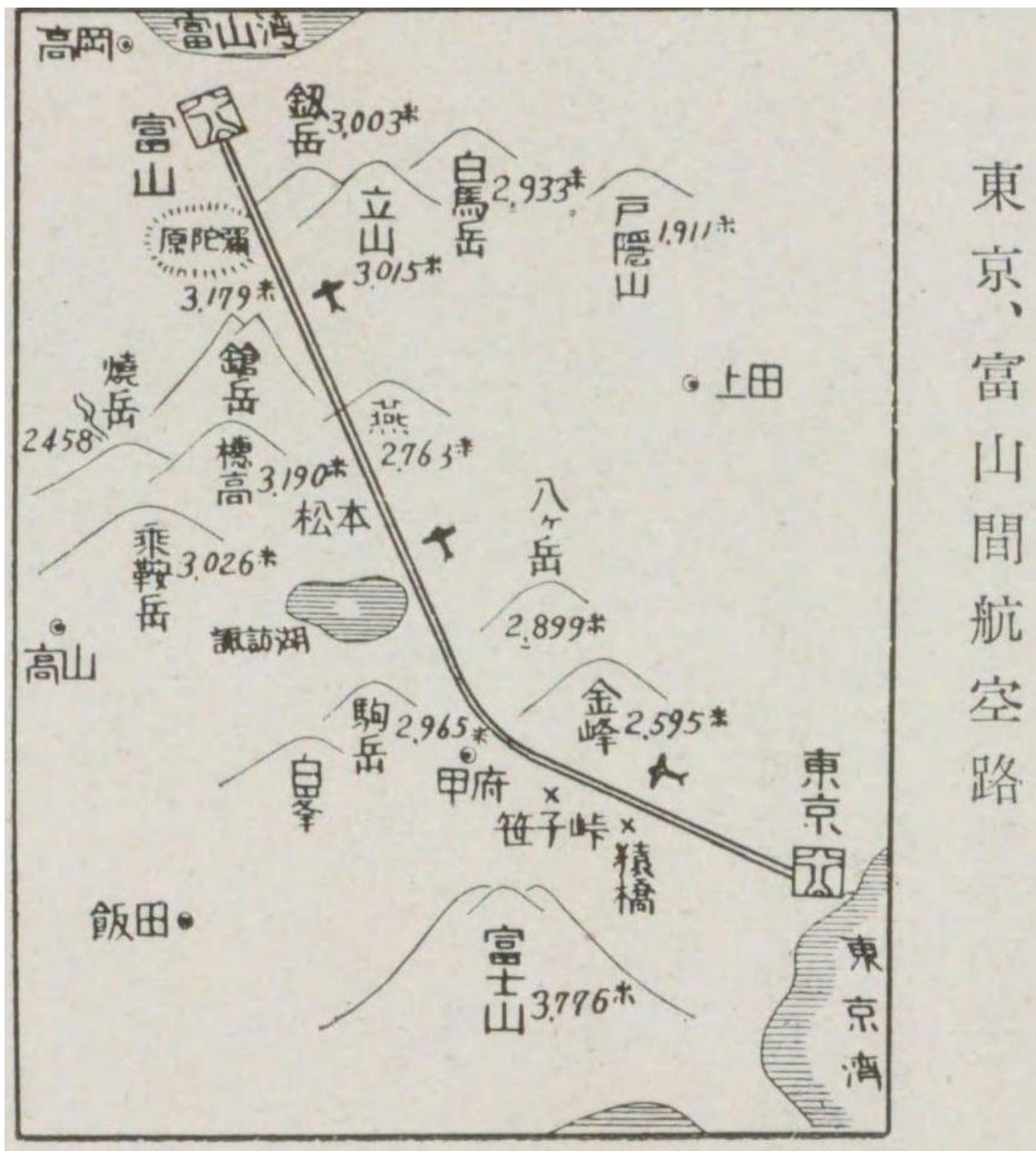
LNAV and VNAV

With the advent of more complex autopilots and reference systems inside aircraft, aircraft systems are now much more capable of knowing their position in three dimensions. From earlier technology such as the CIVA INS, to the complex fully automated RNP approaches without any radio guidance that we have now, the terms LNAV and VNAV have become commonplace within the airliner world.

LNAV (LATERAL NAVIGATION)

The earliest form of navigation would involve a compass and looking out of the cockpit windows for landmarks, or possibly setting a heading and correcting for weather over distance.

東京、富山間航空路



By 港湾協会第九回通常総会富山準備委員会 - 港湾協会第九回通常総会富山準備委員会編、『富山県の産業と港湾』、1936年（昭和11年）5月、港湾協会第九回通常総会 富山準備委員会, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=49569993>

LNAV allows for the aircraft to navigate across the world using fixed points in space, such as waypoints or radio beacons. These are defined using a latitude and longitude which are compared, in basic terms, against the aircraft's known latitude and longitude to allow navigation towards them.

To know of the position of the aircraft, the Inertial Reference Systems (IRS) are aligned while the aircraft is stationary at the gate which sets a baseline position. This is then updated during flight using tracks and distances from radio beacons or has GPS data fed to it to keep accurate. Without these, as IRS systems are not perfect, the position becomes a guess, and the aircraft will slowly drift off route. This was a particular problem crossing the ocean on older aircraft, where there are no radio beacons and GPS was not invented yet, resulting in the aircraft being possibly miles off course when it eventually arrived overhead land.

VERTICAL NAVIGATION

VNAV allows for an aircraft to climb and descend using a calculated path to optimise the flight. It will maintain restrictions on SIDs and STARs, plan the ToD (Top of Descent) and minimise fuel burn while still allowing for the aircraft to get into a position to land. For VNAV to work correctly, the aircraft's computer systems must be correctly set with the correct weights, route, weather and performance information.

With a good database inside the MCDU, the Airbus family can fly an entire SID or STAR with no interaction from the pilots, if the data has been checked beforehand. Speed and altitude restrictions are followed to match the chart information.

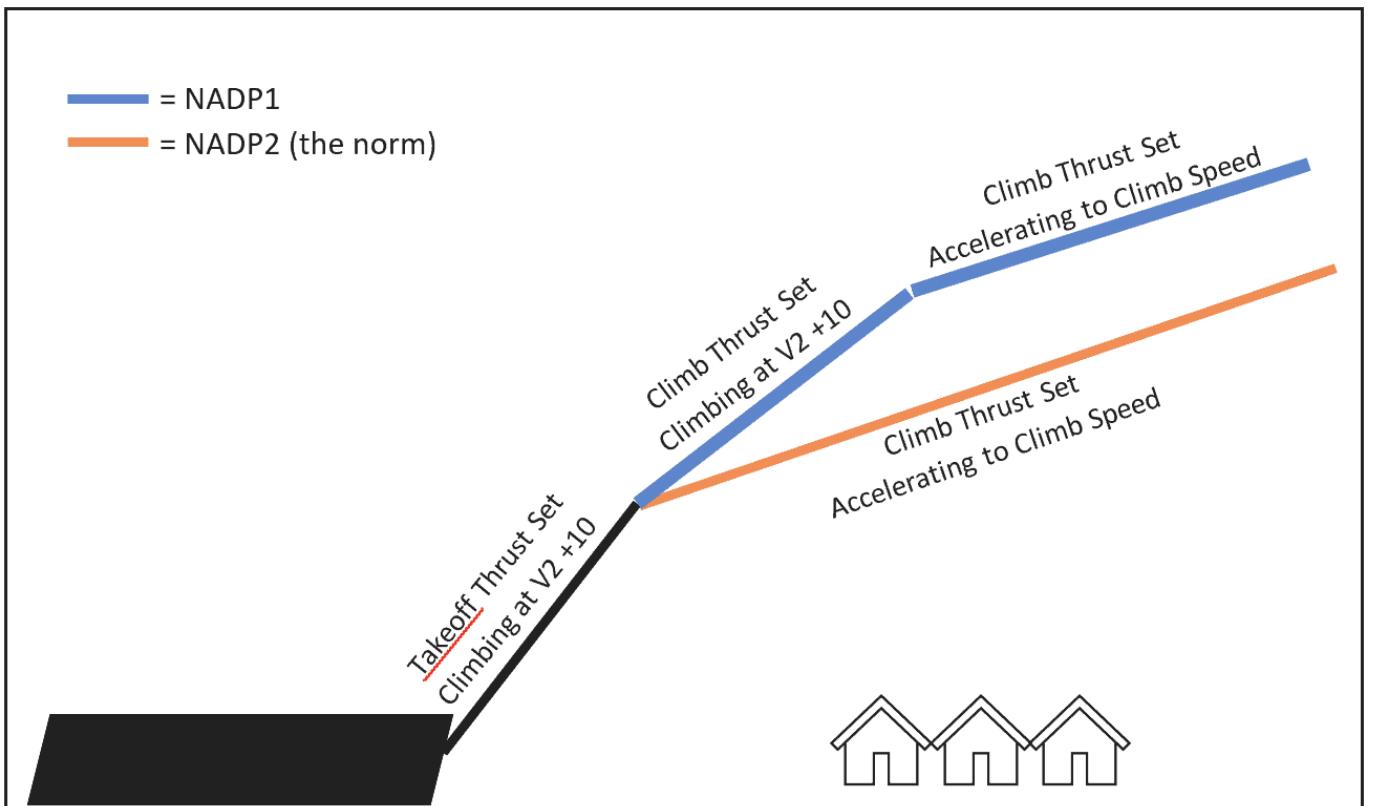
The Airbus Flight Management will try to calculate a 3-degree path from the start of the runway you are landing on, working backwards through your flight plan to achieve all the restrictions until it arrives at your current cruising altitude. This will generate a point on the Navigation Display for the top of descent where if the altitude is set lower than the cruising level, and you push for DES, then the aircraft will follow the 3-degree path. The altitude always needs to be set lower than your current altitude, as the Airbus will stop at whatever is set in the FCU i.e., it will not carry on with the VNAV path. Unlike the Boeing fleet, the Airbus will also not automatically descend at ToD and requires a descent mode to be selected.

Noise Abatement (NADP1 vs 2)

To reduce the noise effects on local residents, some airports require the use of noise abatement procedures to help keep the noise levels down. On the airport, the reduction of the use of the APU and using more external power helps, plus the requirement to ban the use of anything more than idle reverse on landing unless the aircraft performance needs it. The big change that prevents a lot of noise is the use of NADP. These Noise Abatement Departure Procedures change the way aircraft climb out from the airport to help keep noise levels down at buildings that are directly under the flightpath.

NADP1 requires you to climb to your thrust reduction altitude, but instead of accelerating at the same time, you hold the speed until you get to a higher acceleration altitude. This means that over the same distance, you will be higher than the normal procedure, also known as NADP2. And being higher over the buildings means you will generate less noise.

Airports will describe in their airfield documents which departure you should be doing, but the standard method of NADP2 is probably in 80/90% of airports across the world. Common example airports with NADP1 are Paris LFPG, San Francisco KSFO on certain runways and Geneva LSGG.



Credit - Shomas Pilot on Discord

Last update: August 23, 2021

1.3.4 Understanding Altitude references

QNH/QFE/STD and in.Hg/hPa

These codes are all related to settings on your altimeter, which can give you several readings depending on what you use.

QNH AND QFE

Part of the “Q-codes” created by the British Government in roughly 1909, these are used to set altimeters to a specific reference. These, unlike most acronyms in the aviation world, do not have any direct meaning for their letter combinations, though some instructors think of the letters FE in QFE as being for “field elevation”.

QNH is the setting of the altimeter so that it will read the altitude above mean sea level (MSL) based on the location where that altimeter reading was set. This is to say that if you landed on an ocean, this setting would cause the altimeter to read zero. QNH is the most used reference in airline operations and several airlines prohibit flying using a QFE reference.

QFE is the setting of the altimeter so that it will read the height above the airport that you are landing or departing from. The aim is for the altimeter to read approximately zero when the wheels of the aircraft touch down on the runway. Very commonly used during General Aviation flying or during early instruction.

STD

STD (standard) is the setting of the altimeter to reference to ISA conditions. ISA is an internationally developed and recognized model of how air pressure, temperature, and density vary with altitude, and for pilots, this means a QNH of 1013 hPa or 29.92 in.Hg.

To fly a flight level (i.e., FL350 as opposed to 35000ft), all aircraft are required to be set to STD to remove any chances of differences between QNH causing aircraft to be closer to each other than the altimeters are indicating. The change from being on a QNH to STD happens at the transition altitude, and at the transition level vice-versa. A QNH/QFE is required to be set before landing. To set the STD in the Airbus, pull the dial that sets the altimeter, and push to return to QNH.

IN.HG/HPA

These two acronyms are the measure of the pressure around you, just as much as kg/lbs or cm/feet. In.Hg stands for inches of mercury, commonly used in the USA, Canada and Japan. The rest of the world commonly uses hPa, the hectopascal. The weather reports in the country you are flying to/from, will have the altimeter setting reported in the measure that that country uses.

As you may fly from a country that uses one setting, to another country that uses the other setting, aircraft usually have a dial or switch that will allow the pilots to change from one measure to the other. In the Airbus, this is a turning switch behind the dial that sets the altimeter.

Transition Altitudes and Transition Levels

Transition altitudes and levels are the changeover points for the altimeter references to be changed. The transition altitude in the climb, and the transition level in the descent.

TRANSITION ALTITUDE

In the climb, the transition altitude is where you would switch from QNH to STD, and your altitudes will become flight levels. Every clearance ATC will give you above this will be called a Flight Level, and everything below will be called an altitude.

This altitude is found on the departure or arrival charts of the airport you are departing from and will vary from airport to airport except for some countries. Usually, the demands of air traffic control or the terrain around the airfield will define what the altitude will be for that airport. In the USA and Canada, this is fixed at 18000ft to reduce complexity, whereas in other countries such as the UK or the Netherlands, this can be as low as 3000ft.

TRANSITION LEVEL

In the descent, this is where you would change from STD to QNH and is vice-versa to the transition altitude. However, depending on the pressure at the airfield on that day, this is not a fixed value and changes to accommodate high- or low-pressure waves. This means it can only be assigned to you by information from ATC, such as using an ATIS or by being told it through radio communications.

In the Airbus, transition altitudes or levels can be selected in the performance page of the MCDU. As you cross over the altitude or level, the altimeter setting on the PFD in front of the pilot will flash to remind them to change over to the new setting. Some airlines only use transition altitudes in their MCDU, even in the descent.

A common technique is to change the reference as soon as you are cleared to an altitude or FL, to prevent it being forgotten, as this can cause TCAS issues when aircraft are not separated by safe amounts.



Christopher Michel, CC BY 2.0 <https://creativecommons.org/licenses/by/2.0>, via Wikimedia Commons

Last update: August 22, 2021

1.3.5 Reading METARs/TAFs/ATIS

METAR

These are weather reports created by an on-airport weather station and tend to be released every 30 minutes for most airports around the world. These have a standard layout as:

AIRPORT ID - DATE/TIME - WIND - VISIBILITY - WEATHER - CLOUD - TEMP/DEWPOINT - QNH - REMARKS

 **Metar Decoding**

AIRPORT ID

It always starts with the airport ID as the 4 letter ICAO code

- EGLL = Heathrow UK
- KDEN = Denver, USA etc.

DATE/TIME

Then follows the Date and Time in the format of DDDTTTZ. So, the date in two digits, followed by the Zulu (GMT) time in four digits. The time is always referenced in Zulu no matter what time zone you are in. For example: 032050Z = The 3rd day of that month, 20:50Z or 8:50PM GMT time. If this is followed with AUTO, it means that the weather station is publishing the METARs without any intervention or checks by a human controller.

WIND

The wind field is written as direction in degrees true followed by the strength in knots. So 36011KT is a wind of 11 knots coming from 360 degrees (north). Some countries still use meters per second (MPS) which will replace the KT so you know which measure is in use. A G can also be added for gusts, e.g. 36011G28KT.

The letters VRB can replace the direction to say it is blowing in a variable direction. After the wind, there can be two directions with a V in between if a strong variable wind is blowing. 240V350 means the wind is varying between 240 degrees and 350 degrees.

VISIBILITY

The visibility field comes next, with prevailing distance in meters in four digits and goes up to 9999 if it is greater than 10km visibility. Some countries use statute miles which will be labelled SM.

If there is a minimum visibility in a certain direction, this will come next as the same format as the prevailing distance but with a direction afterwards in letters, for example 1500NW will mean that in the northwest direction it is down to 1500m.

RVR is the final option, which shows the distance you can see down a runway in meters. It will be in the format of the runway designator/meters, and can have a D, N or U to show its decreasing, staying the same or going up, such as R28L/1000D.

WEATHER

The weather field can have multiple codes written in it, to describe the current conditions.

These can be mixed, with the max of one from each column at a time. For Example:

-TSRA = Light Thunderstorms and Rain
+SHSN = Heavy Showers of Snow
VCFC = Vicinity Funnel Cloud

First is Intensity	Second is Description	Third is the Weather
Light (-)	Patches (BC)	Mist (BR)
Moderate ()	Blowing (BL)	Dust Storm (DS)
Heavy (+)	Drifting (DR)	Dust (DU)
Vicinity (VC)	Freezing (FZ)	Drizzle (DZ)
	Shallow (MI)	Funnel Cloud (FC)
	Partial (PR)	Fog (FG)
	Showers (SH)	Smoke (FU)
Thunderstorm (TS)	Hail > 5mm (GR)	
		Small Hail (GS)
		Haze (HZ)
		Ice Crystals (IC)
		Ice Pellets (PL)
		Dust Devils (PO)
		Rain (RA)
		Sand (SA)
		Snow Grains (SG)
		- 170/187 -
		Snow (SN)
		Squalls (SQ)

METAR EXAMPLES DECODED

```
EGLL 031150Z AUTO 26004KT 9999 FEW026 OVC035 08/07 Q0994
```

London Heathrow, UK, weather recorded on the 3rd day of the month at 11:50Z time. Automatic observation by the weather station. Wind 260 degrees at 4 knots. Visibility 9999m (greater than 10km). Few clouds at 2600ft above the airfield, overcast clouds at 3500ft above the airfield. Temperature 8C, dewpoint 7C. QNH 994 hPa.

```
LFPG 031130Z 21018KT 9999 FEW020 BKN024 BKN034 12/08 Q0997 TEMPO 25025G40KT 3000 SHRA FEW015CB SCT020TCU
```

Paris Charles de Gaulle, France, weather recorded on the 3rd day of the month at 11:30Z time. Wind 210 degrees at 18 knots. Visibility 9999m (greater than 10km). Few clouds at 2000ft above the airfield, broken clouds at 2400ft above the airfield, broken clouds at 3400ft above the airfield. Temperature 12C, dewpoint 8C. QNH 997 hPa. Temporarily wind 250 degrees at 25 knots gusting 40 knots, 3000m visibility in showers of rain, few cumulonimbus clouds at 1500ft and scattered towering cumulus at 2000ft.

```
VHHH 031130Z 10010KT CAVOK 20/11 Q1021 NOSIG
```

Hong Kong International, weather recorded on the 3rd day of the month at 11:30Z time. Wind 100 degrees at 10 knots. Ceiling and visibility okay. Temperature 20C, dewpoint 11C. QNH 1021 hPa. No significant weather

```
KJFK 031151Z 32012KT 9SM -SN OVC070 M01/M05 A2948 RMK AO2 SNE14B45 SLP981 4/011 P0000 60000 70002 T10111050 11006  
21017 53013
```

New York JFK, USA, weather recorded on the 3rd day of the month at 11:51Z time. Wind 320 degrees at 12 knots. Visibility 9 statute miles. Light snow. Overcast clouds at 7000ft. Temperature -1C, dewpoint -5C. QNH 29.48inHg. (This is then followed by remarks about the snow conditions and temperature variations, too much detail for this guide).

```
EGCC 031120Z VRB2KT 1500 200SW R23R/150D R23L/100N FG VV000 8/8 Q1030
```

Manchester, UK, weather recorded on the 3rd day of the month at 11:20Z time. Wind variable at 2 knots. 1500m prevailing visibility, 200m visibility to the south-west. Runway 23R has a visibility of 150m and decreasing, Runway 23L has a visibility of 100m but unchanging. Fog. Vertical visibility of 0, (cannot see upwards due to the fog). Temperature and dewpoint both 8C. QNH 1030hPa.

TAF (Terminal Area Forecast)

A TAF is a forecast of the weather that is going to be at that airport for a length of time. It follows a similar format as the METAR in using the same weather codes but has the addition of timespans and probabilities.

The timespans are written as date/hour, in the format DDTT/DDTT, so 0312/0409 will mean the timespan is from 12Z on the 3rd until 09Z on the 4th.

The probabilities are either 30% or 40%, 30 meaning unlikely and 40 meaning likely. These are written as PROB30 or PROB40. No idea why its these figures, just always has been!

TAF EXAMPLE DECODED

```
EGLL 031100Z 0312/0418 29010KT 9999 BKN024 PROB30 TEMPO 0312/0313 6000 RA BKN012 BECMG 0318/0321 21008KT PROB30  
TEMPO 0403/0410 3000 BR BKN003 TEMPO 0410/0418 7000 -RA BKN008 PROB30 TEMPO 0415/0418 3000 RADZ BKN003
```

London Heathrow, UK, TAF created at 1100Z on the 3rd day of the month.

Between 12Z on the 3rd until 18Z on the 4th, weather is primarily, wind 290 degrees 10 knots, visibility greater than 10km and broken clouds at 2400ft.

Probability of 30%, temporarily between 12Z and 13Z on the 3rd, 6000m visibility in moderate rain, clouds broken at 1200ft.

Weather changing and becoming, between 18Z and 21Z on the 3rd, wind 210 degrees 8 knots.

Probability of 30%, temporarily between 03Z and 10Z on the 4th, 3000m visibility in mist, clouds broken at 300ft.

Temporarily between 10Z and 18Z on the 4th, 7000m visibility in light rain, clouds broken at 800ft.

Probability of 30%, temporarily between 15Z and 18Z on the 4th, 3000m in rain and drizzle with clouds at 300ft.

What does this all mean to us though? The weather at Heathrow for the next 24 hours or so is going to be a bit wet, with short bursts of rain bringing the visibility and cloud down, that is about it really!



Sheba_Also 43,000 photos, CC BY-SA 2.0 <https://creativecommons.org/licenses/by-sa/2.0>, via Wikimedia Commons

ATIS (Automatic Terminal Information Service)

Now using the METAR or TAF is good for seeing what is happening at an airport throughout the day or generally as a guide, but it does not tell us much about what is happening at the airport at the time when we want to land.

This is where the ATIS comes in, which is a message transmitted over a specific radio frequency that gives a spoken reading of the current weather and useful information on the airfield such as the runways in use or if any taxiways are closed. These are always started and ended with a letter, “Information Charlie”, which is told to the departure or approach controllers when you first speak to them to confirm that you have listened to the latest ATIS information. This message changes after so many minutes depending on the airport's updating frequency, and when it does, the next letter in the alphabet is then used at the start and end of the new message.

Now to make things easier, Digital ATIS is starting to be used throughout the world, which allows for the aircraft to print out a text version of the ATIS from a distance beyond the range of the radio frequency. This means that the workload in the cockpit is much less, as some ATIS radios can only be received in the descent. Here is an example of a DATIS:

09FEB20 1124Z

EGCC ARR ATIS W
 EGCC ARR ATIS W 1121Z
 ARRIVAL RWY 23R
 RWY23R SFC WET WET WET
 TRANSITION-LEVEL FL 70
 SINGLE RWY OPERATIONS.
 PILOTS BE ADVISED MODERATE TURBULENCE
 HAS BEEN REPORTED ON FINALS
 29021G53KT 1200 +RA BKN011CB 12/11
 Q0978 QFE0969
 ACKNOWLEDGE RECEIPT OF INFORMATION W
 AND ADVISE AIRCRAFT TYPE ON FIRST
 CONTACT WITH MANCHESTER APPROACH
 RADAR

Credit - Shomas Pilot on Discord "I guess you can see why I saved this one"

As you can see, this is information W, Whiskey for Manchester, UK EGCC. The weather information is written out in a METAR like format, but with the addition of a QFE as well.

The extra airfield information starting from the top on this particular ATIS is:

- The arrival runway (23R)
- The runway state (Wet at the start, middle and end)
- The transition level (FL70)
- That single runway operations are in effect
- That moderate turbulence has been reported (due to the 53kt wind!)
- And to acknowledge the information and tell them your aircraft type when you first contact the approach controller

Last update: August 22, 2021

1.4 Standard Operating Procedures

We have created our very own standard operating procedures (SOP) valid for the A32NX.

They are available for download or preview online via the links below.

For Simulation Purposes Only

1.4.1 Checklist

An in-flight checklist for flight crew operations. Items critical in regard to flight safety are on this list.

[Download](#)

[Online Preview](#)

1.4.2 Flight Crew Flow

The flight crew flow is best described as a methodology of going through the systems checks of the aircraft and respective setup during various phases of flight. Usually these steps become second nature for pilots.

[Download](#)

[Online Preview](#)

1.4.3 Normal Procedures

This document can be considered as an overview of what to do during each phase of flight with comments about each location and item.

[Download](#)

[Online Preview](#)

Last update: September 19, 2021

2. Release Notes

2.1 Stable Release v0.7.0

FlyByWire Simulations Stable v0.7.0 is our largest release to date featuring entirely custom systems developed and tested meticulously with our pilot staff and QA team.

This release now includes these major features:

- Entirely custom fly-by-wire, autopilot and autothrust systems, written from the ground up to incredible accuracy.
- Reworked flight model using real-world data, adapted to our custom flight systems.
- Custom LEAP 1A-26 engine performance model.
- Entirely custom automatic pressurisation, hydraulic and ADIRS systems.
- Significant overhaul to avionics system, including more accurate symbology and improved frame rates.
- flyPadOS 2: New layout, Navigraph charts, landing performance calculator, aircraft configuration options.
- Entirely reworked cockpit texturing, with realistic amounts of wear for an A320neo.
- Improved soundscape - entirely custom sound pack with 100% custom samples.

...and much more!

For a full release changelog - [see here](#)

Downloads available through our [installer](#) or [website](#).

Please see our [Support Guide](#) and [Reported Issues](#).

2.1.1 Quick Links

1. [Custom Fly-by-Wire Autopilot and Autothrust System](#)
2. [Custom Engine Model](#)
3. [Custom Systems](#)
4. [Overhauled Avionics System](#)
5. [EFB flyPadOS v2](#)
6. [Reworked Cockpit Textures](#)
7. [Improved Soundscape](#)

2.1.2 Custom Fly-by-Wire Autopilot and Autothrust System

These systems have been built from the ground up to provide a robust realistic experience throughout all stages of flight. You can now enjoy expert handling of the A32NX when utilizing the autopilot with better climb performance, flight dynamics, and accurate FMA indications on our redesigned PFD.

Additionally, we have also included several features of note:

- Dual AP autoland
- Alpha Floor protections
- Automatic SPD/MACH switching
- Fly-By-Wire Normal Law
 - C* law with proper limits (+2.5g/-1.0g in clean, +2.0g/0.0g with flaps)
 - Auto-Trim
 - Flare law
 - Rotation law (with optional tailstrike protection)
 - Yaw damper
 - Roll limits
- Reworked managed speed management
- ILS auto-tuning for departure and improved for approach

Take Note

For now only normal law is supported at the moment.

Throttle detent calibration is now required - [Read Here](#)

2.1.3 Custom Engine Model

The engine model now supports a realistic cold engine start-up process based on the primary parameters spooling the engines as a function of pressure and temperature. We have implemented custom EGT and fuel flow logic additionally adapting the engine IDLE N1 to be based on the environment conditions of the aircraft in the simulator.

Our engine model supports the above custom autopilot and fly-by-wire system.

2.1.4 Custom Systems

Our team has been hard at work creating realistic simulations of various systems in the A32NX.

Pressurization

Initial implementation of the automatic mode for the pressurisation system. This brings a first simulation of the CPC and outflow valve, while managing cabin pressure and rate using engine parameters and landing field elevation.



Hydraulics

Major steps have been taken to bring an accurate hydraulics system to the A32NX. This has allowed for more realistic braking action both manually and with the custom autobrake to provide for better dynamic deceleration targets of the real A320neo. These hydraulics have also been connected to our electrical system.

For a great overview of this implementation check out 320 Sim Pilot's video:



ADIRS System

We have created an advanced ADIRS implementation that allows for separated ADIRUs allowing for improved functionality in the A32NX. Previously having only one ADIRU aligned would allow the PFD and ND on both sides to fully work. This system now allows for ADR and IR systems to be pushed OFF to disconnect the output and the resulting information is reflective on both the PFD and ND.

See our Developer Series video for more information:



Electrical System

One of our largest custom systems is the electrical system. Each individual aircraft light, display unit, and windscreen wiper is now accurately powered by the correct electrical bus. If some electrical systems are lost or the flight crew turned them off the A32NX will react accordingly - even keeping the engines running when all electrical systems are lost.

You can see some examples below of how the aircraft lights and systems react when certain electrical systems are not working properly.

Exterior Lights



Interior Lights and Avionics



2.1.5 Overhauled Avionics System

The overhaul encompasses both features and increased performance reliability for improved frame rates. We've added realistic symbology and functionality to the avionics including:

- Baro setting flashing
- VOR/ADF needles on the ILS arc display
- True to spec pixelation on avionics
- Auto-brightness
- BRG/DIST on the MCDU

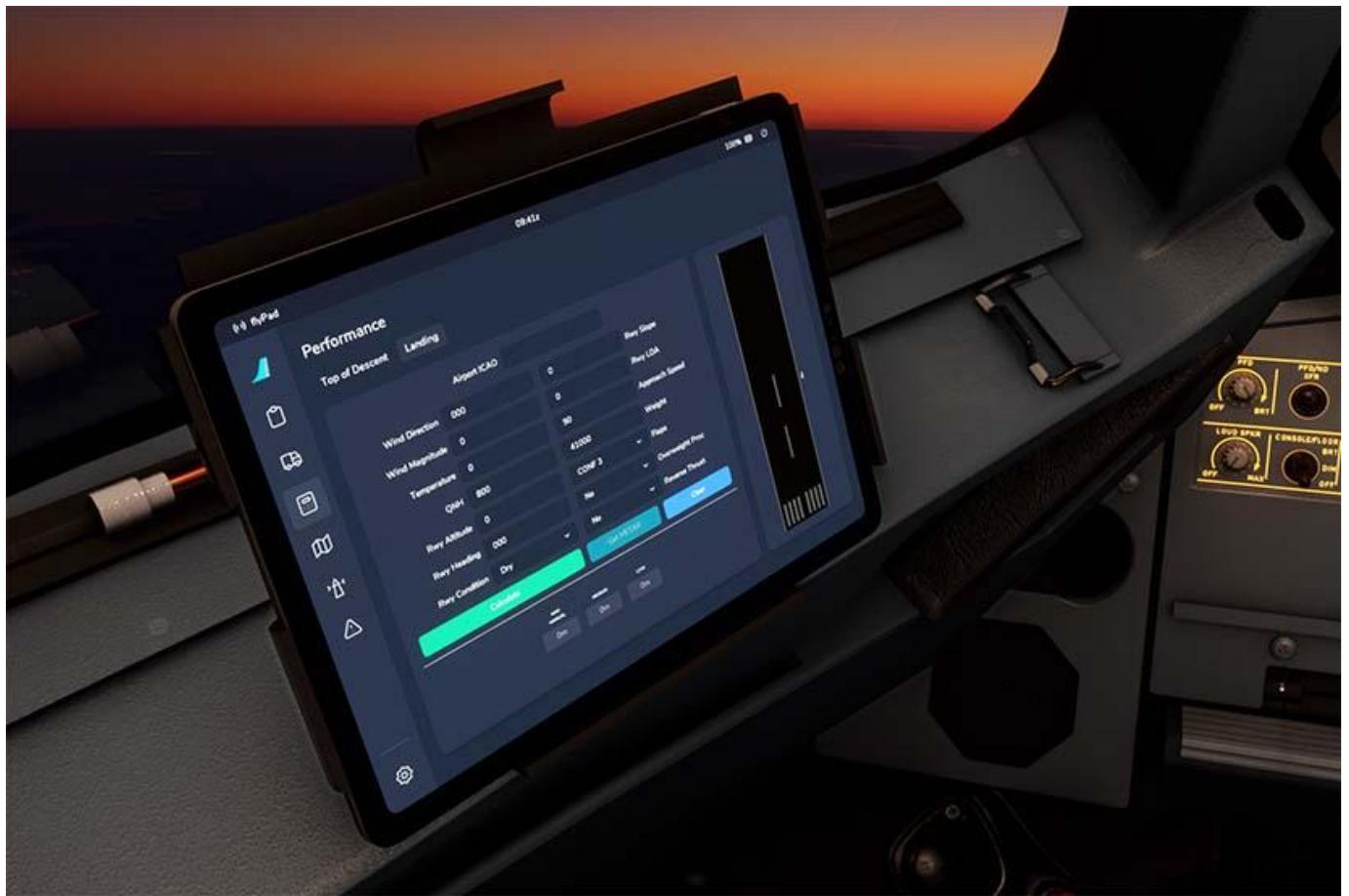
As a convenience feature, keyboard input is now available on the MCDU - [Guide Here](#).

2.1.6 EFB flyPadOS v2

Major improvements have gone into the flyPad onboard the A32NX. This update provides an entirely overhauled UI for all the features you are already accustomed to, creating a more refined experience and improved usability. The settings page has been reworked and many features ported over from the MCDU.

We also introduced two new major features with this version:

- Landing performance calculator.
- Navigraph charts integration built in.





2.1.7 Reworked Cockpit Textures

As we work towards creating our own A320neo model we have completed an overhaul of the cockpit textures in the A32NX. There is now visible wear and tear across the entire flight deck creating the feel of a real world cockpit.



2.1.8 Improved Soundscape

Our sound engineer continuously tweaks and improves the digital soundscape from both within the flight deck and on the outside. Using real world references and verified by our pilot staff the A32NX now provides an immersive experience throughout the power up sequence, engine start, flight, cockpit interaction and aircraft shutdown.

We are happy to note that we have replaced all remaining Asobo sounds.

2.1.9 Changelog

This is a curated list of changes roughly grouped by [ATA chapters](#).

★ represent new features and functions.

Other lines represent improvements, bug fixes or other changes.

ATA 21: Air Conditioning / Pressurization / Ventilation

- ★ First implementation of automatic pressurization system - @MJuhe (Miquel)

ATA 22: Auto Flight - Flight Management

- ★ Added ISA DEV to ECAM - @BlueberryKing (BlueberryKing#6641)
- ★ Added hydraulics page on SD - @RichardPilbery (tricky_dicky[Z+0]#3571)
- ★ Added clear scratchpad on CLR held down - @tracernz (Mike) and @MisterChocker (Leon)
- ★ ILS auto-tuning for departure and improved for approach - @tracernz (Mike)
- ★ Implement BRG/DIST function on PROG page - @tracernz (Mike)
- ★ MCDU accepts direct keyboard input (enabled by new option in A32NX Realism Settings). - @2hwk (2Cas#1022)
- Add REFUELG message to upper ECAM when refuelling via fuel page on EFB - @sidnov (sidnov#8337)
- Autoswitch ECAM pages use proper FWC phase logic - @2hwk (2Cas#1022)
- Change flight control page to use hydraulic simulation vars - @lukecologne (luke)
- Convert Cruise page to React - @RichardPilbery (tricky_dicky[Z+0]#3571)
- ENG oil temperature amber while below takeoff minimum - @tracernz (Mike)
- Fix REFUELG message being shown on ECAM even when refueling is complete - @BlueberryKing (BlueberryKing#6641)
- Implement amber REV message while reverser doors are in transit. - @BlueberryKing (BlueberryKing#6641)
- Improved alternating of igniters - @joseph-tobin (joseph#1001)
- Refactor flight control page to use React - @RichardPilbery (tricky_dicky#3571)
- Rewrite fuel page for React - @Benjozork (Benjamin Dupont) and @RichardPilbery (tricky_dicky[Z+0]#3571)
- Corrected EMER CANC ECAM button emissive behavior - @ImenesFBW (Imenes)
- Add hard sign to temp field on PERF APPR, remove FLS/FINAL APP, adjust alignment - @tracernz (Mike)
- DEST EFOB and ALT DEST EFOB amber coloring fixed - @erso44 (Ersin Karakilic)
- Disallow ATIS request when no airport is specified - @ExampleWasTaken (ExampleWasTaken#0886)
- Do not show duplicate names page with 1 option, fix return key - @tracernz (Mike)
- Fix max page number on duplicate waypoint selection - @tracernz (Mike)
- Fixed entry of in.Hg baro settings ending in zero - @tracernz(Mike)
- Fixed input and display issues on PERF/W&B and INIT pages - @felixharnstrom (Felix Härnström)
- Fixed performance page refresh on flight phase transition - @MisterChocker (Leon)
- Fixed sometimes bad error message on crz fl entry - @MisterChocker (Leon)
- Fixed tropo entry validation - @MisterChocker (Leon)
- Improve robustness of Lat/Lon & P-B/P-B input parsing - @tracernz (Mike)
- Progress page only shows GPS Primary when it should - @Username23-23 (NONAmr2433 #8777)
- Remove some settings from MCDU that are now in the FlyPad - @tracernz (Mike)
- Removed invalid chars from- and updated AOC TELEX warning message - @ExampleWasTaken (ExampleWasTaken#0886)
- Show max distance of 9999 NM on duplicate waypoint selection - @tracernz (Mike)

ATA 22: Auto Flight - Flight Guidance

- ★ New custom fly-by-wire system - @aguther (Andreas Guther)
- ★ New custom autopilot system - @aguther (Andreas Guther)
- ★ New custom autothrust system - @aguther (Andreas Guther)
- ★ Added triple click and FMA mode reversion logic - @aguther (Andreas Guther)
- ★ New high angle of attack and high speed protection - @lukecologne (luke), @aguther (Andreas Guther)

- Improved managed speed and V2 validity - @aguther (Andreas Guther)
- Automatically arm NAV on ground when flight plan becomes available - @aguther (Andreas Guther)
- Fixed and improved mode transitions related to LAND modes - @aguther (Andreas Guther)
- Improved OP CLB/DES, CLB/DES speed hold characteristics - @aguther (Andreas Guther)
- Improved V/S and FPA speed protection mode - @aguther (Andreas Guther)
- Improved disengage conditions for ROLL OUT and when excessive pitch or roll attitude - @aguther (Andreas Guther)
- Fixed potential engagement of reverse thrust in flight - @aguther (Andreas Guther)
- Adapted take-off A/THR engagement and added thrust lever not set warning - @aguther (Andreas Guther)
- Fixed incorrect THR LK activation when A/THR disconnect buttons have been used - @aguther (Andreas Guther)
- Fixed permanent A/THR disconnect (15s press) not being able to activate with 3D button on thrust levers - @aguther (Andreas Guther)
- Support flight director off take-off procedure - @aguther (Andreas Guther)
- Improved ROLL OUT and G/S laws - @aguther (Andreas Guther)
- Adapt pitch attitude protection for configuration - @aguther (Andreas Guther)
- Added visual aileron droop and anti-droop - @aguther (Andreas Guther)
- Elevator trim wheels no longer move when stop is reached - @aguther (Andreas Guther)
- Improved ground spoiler logic - @aguther (Andreas Guther)
- Inhibit alpha floor and protection law for 10 s after flight start / plane reload - @aguther (Andreas Guther)
- Realistic rudder pedals animation only following pilot input or trim - @aguther (Andreas Guther)
- Realistic rudder trim deflection and reset rate - @aguther (Andreas Guther)
- Added LVAR for selected speed and only fill active LVAR for VS or FPA mode
- Added more custom events that can be triggered via SimConnect to control the FCU - @aguther (Andreas Guther)
- Automatically connect flight directors when FCU is powered on - @aguther (Andreas Guther)
- Fix FCU DISPLAY AC1 BUS power. - @bouveng (Johan Bouveng)
- Init FCU with SPD 100 kn, HDG = 0° and ALT 100 ft - @aguther (Andreas Guther)
- Added VS descent phase initiation - @MisterChocker (Leon)
- Added reset of fmfc variables - @MisterChocker (Leon)

ATA 23: Communications

- Enabled LED indicators when testing ANN lights - @ImenesFBW (Imenes)

ATA 24: Electrical

- ★ Add ground service electrical buses - @davidwalschots (David Walschots)
- ★ All external and internal lights are powered by the correct electrical bus. - @davidwalschots (David Walschots)
- ★ Button and indication lights are powered by the correct electrical bus - @davidwalschots (David Walschots)
- ★ EMER ELEC PWR overhead MAN ON push button triggers emergency generator start (RAT not yet simulated) - @davidwalschots (David Walschots)
- ★ Engines keep running when electrical systems are lost - @davidwalschots (David Walschots)
- ★ Equipment such as wipers and display units are powered by the correct electrical bus - @davidwalschots (David Walschots)
- ENG FIRE push button deactivates IDG - @davidwalschots (David Walschots)
- Improve electrical system implementation to allow for implementing advanced scenarios - @davidwalschots (David Walschots)
- Pushing the GEN 1 LINE push button to OFF opens the GEN 1 contactor - @davidwalschots (David Walschots)
- RAT & EMER GEN fault light illuminates when applicable - @davidwalschots (David Walschots)
- The BCL commands the BAT contactor be closed when the BAT push button is moved from OFF to AUTO - @davidwalschots (David Walschots)
- When turning the BAT pb to AUTO, the battery charge limiter has a 1 second startup delay - @davidwalschots (David Walschots)

ATA 29: Hydraulic

- ★ Brakes are now connected to hydraulic system - @crocket63 (crocket)
- ★ Connected hydraulics element to electrical buses. - @crocket6 (crocket)
- ★ New custom auto brakes replace default one - @crocket63 (crocket)
- Added basic LGCIU implementation with per wheel weight on wheels sensors - @Crocket63 (crocket)
- Blue electric pump override button changed to momentary latched - @Crocket63 (crocket)

- First building block, more to come. Hydraulics do not impact the sim YET. - @crocket6 (crocket)
- Fixed autobrake inputs response for rotating knob type controllers - @Crocket63 (crocket)
- Fixed catering door movement wrongly starting the yellow elec pump - @crocket63 (crocket)
- Switched hydraulics to new engine model simvars - @Crocket63 (crocket)
- Updated fix for autobrake rotating knob type controllers - @Crocket63 (crocket)

ATA 31: Indicating/Recording Systems

- ★ Add pixelated screens - @bouveng (Johan Bouveng)
- ★ Chrono auto-brightness - @sidnov (Sid)
- ★ Add VOR/ADF needles to ILS arc display - @tracernz (Mike)
- ★ Add baro setting flash when passing TA/TL - @lukecologne (luke)
- Fix Self-Test no longer triggers when spawning from an in-flight state i.e. cruise/landing/takeoff on runway - @2hwk (2Cas#1022)
- Improved pixelated screens, only appears when camera is close to displays - @2hwk (2Cas#1022)
- RMP backlight, ATC and RTPI font color and backlight - @marcman86 (marcman86#4907)
- Fix pushing of MASTER WARN and MASTER CAUT not disabling aural warnings - @davidwalschots (David Walschots)
- Improved logic for chronometer operations - @sidnov (Sid)
- Fix Behaviour of TAS and Wind Info displayed inflight and on Take-Off - @ChruutvoLuzi (ChruutvoLuzi#8902)
- ND Waypoint Icon Size, Icon Outlines, Airplane Icon Color and Outline - @marcman86 (marcman86#4907)
- TCAS symbols correctly display in 10, 20, 40nm ARC/ROSE views + bug fixes - @2hwk (2Cas#1022)
- CVR ground test auto-resets on first engine start - @tracernz (Mike)
- Reimplemented and improved PFD in react - @lukecologne (lukecologne#1156)
- Fix Cockpit Door Video Toggle - @sidnov (Sid)

ATA 32: Landing Gear

- ★ Autobrake can be armed via keybindings - @Saschl (saschl#9432)

ATA 33: Lights

- ★ Add OVHD ANN LT DIM functionality - @bouveng (Johan Bouveng)
- Added workaround for missing lighting definitions in Asobo templates - @cloudynetwork (Peter Joseph)
- Correct Korry button labels - @tracernz (Mike), @tyler58546 (tyler58546)
- New potentiometer for lights, emissives and screens. - @bouveng (Johan Bouveng)

ATA 34: Navigation

- ★ ADR1, ADR3, or ADR2 can be pushed OFF to disconnect output of ADR information from that particular ADIRU - @davidwalschots (David Walschots)
- ★ IR1, IR3, or IR2 can be pushed OFF to disconnect output of IR information from that particular ADIRU - @davidwalschots (David Walschots)
- ★ Simple ATT mode implementation (does not yet include HDG entry) - @davidwalschots (David Walschots)
- Add on delay for ON BAT light - @tracernz (Mike)
- Fix ADIRUs not aligned starting on runway - @davidwalschots (David Walschots)
- GPS PRIMARY LOST is only indicated when none of the IRs are aligned or ON - @davidwalschots (David Walschots)
- SAT, TAT, and ISA indications depend on the selected ADR (1 or 3) - @davidwalschots (David Walschots)
- Switching panel's ATT HDG and AIR DATA knobs functionality - @davidwalschots (David Walschots)
- The longest instead of the shortest remaining alignment time is displayed on the upper ECAM - @davidwalschots (David Walschots)
- Upper ECAM shows IR x IN ATT ALIGN when any ADIRU is in ATT mode alignment - @davidwalschots (David Walschots)
- Wind, TAS, and GS indications depend on availability of IR and ADR data - @davidwalschots (David Walschots)
- Display units only run their self-test when unpowered over 10 seconds - @davidwalschots (David Walschots)

ATA 34: Surveillance

- ★ Implement automatic brightness adjustment for standby instrument - @BlueberryKing (BlueberryKing#6641)
- ★ Standby instrument brightness buttons can now be held down rather than pressed to +/- brightness - @2hwk (2Cas#1022)
- Fix "retard" callout so it plays at less than 20 ft radio altitude with autopilot off - @donstim (donbikes#4084)

ATA 46: Information Systems

- ★ Add flypad themed simbrief maps to EFB/OFP - @bouveng (Johan Bouveng)
- ★ Added throttle calibration for autothrust system - @Saschl (saschl#9432)
- Reworked airport handling on AOC Weather Request Page - @MisterChocker (Leon)
- Add tabbed settings page to EFB - @ErickSharp (Erick [Z-6]#6484)
- Disabled LINK MCDU button on dashboard page - @ExampleWasTaken (ExampleWasTaken#0886)
- Fix fuel tank capacity values - @donstim (donbikes#4084)
- Persist sound and EFB settings correctly - @tracernz (Mike)

ATA 72: Engines

- ★ Adapt engine IDLE N1 based on environmental conditions - @Taz5150 (TazX [Z+2]#0405), @aguther (Andreas Guther)
- ★ New engine model with custom EGT and fuel flow logic - @Taz5150 (TazX [Z+2]#0405)
- ★ Cold Engine start-up model (primary parameters) - @Taz5150 (TazX [Z+2]#0405)
- Fixed fuel consumption model - @Taz5150 (TazX [Z+2]#0405)
- Fixed fuel flow being 0 at Start-up - @Taz5150 (TazX [Z+2]#0405)
- Fix "fuel used. Fuel used is reset to zero when an engine is restarted on the ground. - John P Maguire#9027

3D Model / Sound / Textures / Animations

- ★ Implement an early version of closed vs open cockpit door sounds - @hotshotp (boris#8008)
- ★ Added CVR test sound - @hotshotp (Boris)
- ★ Added blue and yellow electric hydraulic pump sounds - @hotshotp (Boris)
- ★ Add APU exhaust heat blur effect - @wpine215 (Iceman)
- Added 3D brake gauge - @tyler58546 (tyler58546), @DarkOfNova (DarkOfNova)
- Fixed EVAC button animation - @tyler58546 (tyler58546)
- Change ECAM button lights to white - @tracernz (Mike)
- Fix no-smoking/no-PED switch animation - @tracernz (Mike)
- Reverse thrust animation no longer proportional to thrust lever position - @tracernz (Mike)
- Un-mirror sharklet textures - @tracernz (Mike)
- Correct EVAC button behaviours - @tracernz (Mike)
- Fix invisible fault emissive decal on centre fuel pump 2 - @tracernz (Mike)
- Add separate RTPI font file - @sidnov (Sid)
- Replace all remaining Asobo sounds - @hotshotp (boris#8008)
- Added custom FCU and GPWS, push-button sounds @ImenesFBW - (Imenes)
- Added glareshield chrono button sound - @ImenesFBW (Imenes)
- Further improved ambience and engine sounds - @hotshotp (Boris)
- Improved engine startup sound and added wiper sounds - @hotshotp (Boris)
- Improved engine startup, idle sounds, and cabin wind - @hotshotp (Boris)
- Improved engine, ground roll, and ambience sounds - @hotshotp (Boris)
- Added a white dot to the test button and corrected DISCH alignment on the fire panel - @ImenesFBW (Imenes)
- Improved cockpit textures and screen reflections - @MoreRightRudder (Mike), @tyler58546 (tyler58546)
- Upscaled the existing FBW livery to 8K - @FoxinTale (Aubrey)

Miscellaneous

- ★ Failures are supported - @davidwalschots (David Walschots)
 - ★ Force usage of modern flight model - @aguther (Andreas Guther)
 - ★ Added separated flaps position for 1 and 1+F - @donstim (donbikes#4084), @aguther (Andreas Guther)
 - ★ Added Notification to user via popup + notification when settings change requires aircraft reload. - @2hwk (2Cas#1022)
 - Aircraft can only be fueled when on ground - @erso44 (Ersin Karakilic)
 - Added missing Fuel Pumps checkpoint - @sidnov (sidnov#8337)
 - Adds new parameters introduced by SU4 - @donstim (donbikes#4084)
 - Fix flap transition bounce - @donstim (donbikes#4084)
 - Increased gear drag, reduced flap drag - @donstim (donbikes#4084)
 - Custom spoiler logic and realistic impact on flight model - @donstim (donbikes#4084), @aguther (Andreas Guther)
 - Fixed excessive weather vaning stability - @donstim (donbikes#4084)
 - New flight model adapted to new engine model - @donstim (donbikes#4084)
 - Added JP, FI, SE, NO and NL language support for tooltips. - @kpotschi (MelodyConnor)
 - Added annunciator lights to interactive checklist - @oim1 (oim)
 - Change back to airliner hud in external view for SU5 - @donstim (donbikes#4084)
 - Seatbelt sign state can be toggled via external events - @Saschl (saschl#9432)
 - Sync settings across instruments - @tracernz (Mike)
 - Workaround for altitude issues of MSFS - @aguther (Andreas Guther)
 - Removed unused material to fix potential crash to desktop - @aguther (Andreas Guther)
 - Swap EFIS WPT and VOR D buttons - @tracernz (Mike)
-

Last update: September 18, 2021