



# PSS A319 / A320 / A321



## AOM

- Airbus Aircraft Operating Manual -

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**Phoenix Simulations Software**

**A319 / 320 / 321**  
**AOM**

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### LIMITS

#### Weight Limits

	<b>A319</b>	<b>A320</b>	<b>A321</b>
Max Ramp:	167,400 lbs.	170,600 lbs.	205,900
Max Takeoff:	<b>166,400 lbs.</b>	<b>169,700 lbs.</b>	<b>205,000</b>
Max Landing:	<b>137,800 lbs.</b>	<b>142,200 lbs.</b>	<b>171,500</b>
Max Zero Fuel:	129,000 lbs.	134,400 lbs.	162,700
Seats:	120 – 12/108	142 – 16/126 Shuttle - 150	169 – 26/143

#### Operation Limits

Max 90° crosswind component (including gusts) for Takeoff and Landing:	<b>29 knots</b>
Max 90° crosswind component (including gusts) For CAT II/III:	<b>15 knots</b>
Limiting tailwind component for takeoff and landing:	<b>10 knots</b>
Max operating altitude:	<b>39,000 ft.</b>

#### Speed Limits

Max operating speed ( $V_{MO}$ ):	<b>350 KIAS</b>
Max operating speed ( $M_{MO}$ ):	<b>.82M</b>
Max gear extension ( $V_{LO}$ ):	<b>250 KIAS</b>
Max gear retraction ( $V_{LO}$ ):	<b>220 KIAS</b>
Max gear extended ( $V_{LE}$ ):	<b>280 KIAS / .67M</b>

Turbulence Penetration –	at or above 20,000 ft.:	below 20,000 ft.:
A319/320	<b>275 KIAS / .76M</b>	<b>250 KIAS</b>
A321	<b>300 KIAS / .76M</b>	<b>270 KIAS</b>

Max Flap / Slats ( $V_{FE}$ ):

Model	Position	1	1+F	2	3	FULL
A319/320	$V_{FE}$	<b>230 KIAS</b>	<b>215 KIAS</b>	<b>200 KIAS</b>	<b>185 KIAS</b>	<b>177 KIAS</b>
A321	$V_{FE}$	<b>235 KIAS</b>	<b>225 KIAS</b>	<b>215 KIAS</b>	<b>195 KIAS</b>	<b>190 KIAS</b>

## Ice & Rain Protection

Engine anti-ice must be on during all ground and flight operations when icing conditions exist except during climb and cruise when the temperature is below: -40° C SAT.

Icing conditions exist on ground: **OAT 10° C (50° F) or below**  
Icing conditions exist in flight: **TAT 10° C (50° F) or below**

### Engine Anti-Ice

- Engine anti-ice must be ON during all ground and flight operations when icing conditions exist or are anticipated, except during climb and cruise when temperature is below -40°C SAT.
- Engine anti-ice must be ON prior to and during descent in icing conditions, including temperatures below -40°C SAT.

### Wing Anti-Ice

- Wing anti-ice is not permitted on the ground (AFM), or in flight when TAT exceeds 10°C.

Use of APU bleed air for wing anti-ice is not permitted.

## Fuel

(6.676 lbs. per gal.)	A319/A320	A321
Wing tanks:	27,500 lbs	27,500 lbs.
Center tank:	14,500 lbs.	14,500 lbs.
Additional Center tanks:	N/A	10,500 lbs.
<b>Total useable fuel:</b>	<b>42,000 lbs.</b>	<b>52,500 lbs.</b>

### Fuel Capacity (pounds)

Outer Wing Tanks	3,100
Inner Wing Tanks	25,000
Center Tank	14,900
<b>Total</b>	<b>43,000</b>

### Fuel Imbalance - Maximum

Maximum difference between wing tanks for takeoff and landing - 4410 lbs.

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### Fuel Temperature

Maximum: 54°C

Minimum: -36°C

If fuel temperature is below minimum temp limit, change to a warmer altitude.

### Fuel Usage

Takeoff with center tank supplying the engines is prohibited.

### Landing Fuel - Minimum (Pounds)

Fuel At Touchdown: Ensures adequate fuel boost pump coverage during reverse thrust and landing roll.

To Execute Go-Around: The required amount of fuel to execute go-around at runway threshold to 1000' AGL, fly a VFR pattern, intercept a 3° glideslope at approx 2 1/2 miles from the runway and continue to landing.

Fuel Quantity Indicator Error: The maximum design quantity error for all tanks.

Minimum Desired Landing Fuel: Ensures sufficient fuel on board at the threshold in a worst case scenario with max fuel quantity indicator error.

Fuel At Touchdown	400
To Execute Go-Around	800
Fuel Quantity Indicator Error	400
Minimum Desired Landing Fuel (Indicated)	1600

### Operating Fuel Values (Pounds)

Taxi Fuel Per Minute (not included in takeoff weight)	25
Minimum for Dispatch (not including taxi fuel)	6800
Minimum Hold for Contingencies (AFM Limit)	1000
Minimum Alternate Fuel	1200
Holding Fuel Per Hour	5000
APU Fuel Per Hour	290

### Landing Gear

Max landing gear extension altitude: **25,000 ft.**

### Flaps/Slats

Max operating altitude w/ slats and/or flaps extended: **20,000 ft.**

### Autopilot / Autoland

After Takeoff (if SRS is indicated) **100 ft. AGL**

Autoland max winds:

Tailwind: **10 knots**  
Crosswind other than CAT II/III: **20 knots**  
Headwind: **30 knots**

Non-memory limits:

Max tire speed **195 kts.**  
Max taxi speed in turn when greater than 167,550 lbs. **20 kts.**  
Max window open speed (who is going to open it?) **200 kts.**  
Max windshield wiper operations speed ( $V_{WW}$ ) **230 kts.**  
Max continuous load on generator **90 KVA**  
Max continuous load on TRU **200 A**  
Max brake temp for takeoff **300° C**

## **SELECTED LIMITATIONS**

All references to airspeed or Mach Number relate to Indicated Airspeed or Indicated Mach Number, unless otherwise noted. All references to altitude relate to Pressure Altitude, unless otherwise noted.

### Avionics

#### **Autoland**

Autoland is permitted using full flaps only.

#### **Autoland - Maximum Winds**

Headwind - 25 kts  
Tailwind - 10 kts

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Crosswind other than CAT II/III - 15 kts

Crosswind CAT II/III (AFM) - 10 kts

**Autopilot Engaged - Minimum Altitude**

After Takeoff/Go-Around - 30' AGL

Enroute - 500' AGL

Non-Precision Approaches - 50' Below MDA

Coupled Approaches - 50' AGL

Autoland (One or Two Autopilots) - Touchdown

**ILS Approaches (AFM)**

Do not arm the ILS APPR mode above 8200' AGL.

**Inertial Reference System**

In the NAV mode the IRU will not provide valid magnetic heading above 73° North and below 60° South. Flights above/below these latitudes are not permitted.

**Engines (IAE V2527-A5)**

**EGT and Thrust - Maximum**

	Time Limit (minutes)	Instrument Marking	EGT (°C)
Start	None	Red	635
Takeoff/Go-Around	5	Red	635
Maximum Continuous	Unlimited	Amber	610

**Oil Quantity and Consumption (Quarts)**

Minimum Before Engine Start (warm)	17.0 + est. consumption
Minimum Before Engine Start (cold/30°C)	10.5 + est. consumption
Minimum When Engine is at Idle rpm	12.0
Estimated Consumption per Hour	.6

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**Reverse Thrust**

Reverse levers must remain in forward thrust range while in flight.  
Prohibited for power back on the ground.

**RPM - Maximum**

N1 - 100%  
N2 - 100%

**Hydraulics**

**Brake Temperature**

Maximum Brake Temperature for Takeoff - 300°C

**Flaps/Slats Extended Altitude**

Maximum - 20,000 MSL

**Speed Brakes (AFM)**

IMC	Do not use from FAF inbound.
VMC	Do not use below 1000' AGL.
Inflight With Flaps Retracted	Do not use below 200 KIAS.

**Speeds**

**Cockpit Window Open Speed**

Maximum - 200 KIAS

**Design Maneuvering Speeds - Va (KIAS/Mach)**

* Only when in alternate or direct flight control laws.								
Speed	Pressure Altitude (1000 Feet)							
	SL	10.0	16.0	20.0	24.0	28.0	30.0	39.0
* Va	248	250	260	270	280	290	295	.78

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### Flaps/Slat Extended Speeds - Vfe (KIAS)

Config	1	1 + F	2	3	FULL
Vfe	230	215	200	185	177
Slats	18	18	22	22	27
Flaps	0	10	15	20	40
Remarks	Initial Approach	Takeoff	Takeoff/Approach	Takeoff/Approach Landing	Landing

#### Takeoff with Flaps 1

When Flaps 1 is selected for takeoff (1 + F), the flaps automatically retract to 0 at 210 KIAS.

#### Takeoff or Go-Around with Flaps 2 or 3

When Flaps 1 is selected, the 1+F configuration is obtained if airspeed is less than 210 KIAS. The flaps automatically retract to configuration 0 at 210 KIAS.

#### Flaps Selection in Flight

When the flaps lever is moved from 0 to 1 in flight, only the slats are extended.

#### Landing Gear Limit Speeds - Vlo/Vle (KIAS/MACH)

Retraction - Vlo	220
Extension - Vlo	250
Extended - Vle	280 / .67
Maximum Tire Speed	195 Knots Groundspeed

#### Maximum Operating Limit Speeds - Vmo/Mmo

Speed	Pressure Altitude	
	SL - 25,000	25,000 - 39000
Vmo/Mmo	350	.82

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**Minimum Control Speed Air - Vmca**

Vmca - 119 KIAS

**Minimum Control Speed Ground - VmCG**

VmCG - 114 KIAS

**Operating Speeds (KIAS/Mach)**

Optimum Climb (FMGC Operative)	ECON CLIMB
Standard Climb (FMGC Inoperative) FL 290 and above 10,000' to FL 290	.78 290
Best Climb Rate	280
Best Climb Angle	220
Optimum Cruise (ECON)	Cost Index = 35
Standard Cruise FL 310 and above 10,000' to FL 310	.80 300
Optimum Descent (FMGC Operative)	ECON DES
Standard Descent (FMGC Inoperative) 10,000' and above	.78 280

**Stall Speeds**

Stall speeds apply to takeoff and landing altitudes only.

Gross Weight (1000 lbs)	Flap Position					
	0	1	1 + F	2	3	FULL
170	179	140	134	125	124	121
160	170	136	130	120	119	117
150	161	132	125	116	115	113
140	154	127	119	112	111	109
130	144	121	115	108	107	105
120	138	116	110	104	103	101
110	132	111	105	99	98	96
100	126	106	100	95	94	92
90	119	100	95	90	89	87
80	114	95	90	85	84	82

**Taxi Speed - Maximum**

When takeoff weight is higher than 167,550 lbs, do not exceed 20 kts in a turn.

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### Structural Weights (Pounds)

Maximum Taxi	170,600
Maximum Takeoff	169,750
Maximum Landing	142,200
Maximum Zero Fuel	134,400

## GENERAL LIMITATIONS AND SPECIFICATIONS

### Center of Gravity Limits

The A320 has two certified CG envelopes. One is a curtailed (normal) envelope with a forward limit of 25%. The other is a full envelope with a forward limit of 15%. Most airplane combinations of fuel and passenger loading will operate in the curtailed envelope. When load planning identifies an aircraft as having a forward CG use the Forward Center of Gravity procedure in the takeoff section.

### Flight Load Acceleration Limits (G Load)

Clean Configuration	-1.0 to +2.5
Flaps Retracted and Slats Extended	-1.0 to +2.5
Flaps and Slats Extended	0.0 to +2.0

### Pressure Altitude - Maximum

Takeoff and Landing - 8000'

Operating Altitude - 39,100'

### Runway Slope

Maximum - +/- 2%

### Winds - Maximum (Knots)

The following are the maximum demonstrated crosswinds with flight controls in normal and direct law (with or without the yaw damper).

Crosswind -Takeoff	29
Crosswind -Landing	33
Crosswind with Gusts	38
Tailwind - Takeoff and Landing	10

## **SYSTEMS**

### **ICE & RAIN PROTECTION**

**Wing Anti-ice** - Wing anti-ice heats the three outer wing slat panels on each wing.

Available for single-engine by using pack off and crossbleed open after ENG 1(2) SHUT DOWN.

Wing A-I valves close automatically:

- On touchdown
- Leak detected
- Electrical power lost

Wing A-I is not permitted on ground or above TAT 10° C  
APU bleed is NOT permitted for Wing anti-ice.

Note: Wing A-I test opens valves for 30 sec. on ground.

In normal use select Wing Anti-Ice :

- On after thrust reduction on take-off
- Off at FAF during approach

**Engine Anti-ice** – Engine A-I ducting is independent of wing A-I. Engine A-I valves will open automatically on loss of electrical power. They close with air pressure available. Engine limits are automatically reset when Engine A-I selected and continuous ignition is turned on for that engine as well.

**Probe and Mast Heat / Window Heat / Rain Removal** - All heat is turned on at low power on ground after the first engine start. In flight all heat automatically goes to High. Can turn on manually on ground before engine start by pressing pb to ON. Deselect to Auto after second engine start.

### **Electrical**

All normal electrical power shifts automatically except the External Power which must have the EXT PWR pushbutton selected to supply power to the AC bus tie.

Normal priority for AC power is: (work across ELEC panel from GEN 2)

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- 1) On side engine generator
- 2) External Power
- 3) APU
- 4) Off side engine generator
- 5) Emergency Generator (RAT)
- 6) Batteries

PH doesn't use the On / Off side terms, below is the official PH version of the

Electrical priorities:

- 1) Engine Generators
- 2) External Power
- 3) APU
- 4) Emergency Generator (RAT)
- 5) Batteries

The only way to power both AC busses from a single power source is through the AC BUS TIE. The APU and EXT PWR both feed the AC BUS TIE. Both AC busses connect to the AC BUS TIE as needed. APU will automatically power AC unless the EXT PWR or ENG GEN is on. If both IDG's are available then the AC busses will not be connected to the AC BUS TIE. If only one ENG GEN (no APU or EXT PWR) is available the opposite AC bus will connect to it through the AC BUS TIE.

The Electrical system is divided into two main branches. Both AC and DC are normally separated into two branches with Engine 1 driving IDG (integrated drive generator) 1 and IDG 1 feeding AC BUS 1. AC BUS 1 then feeds DC BUS 1 through TR 1 (transformer rectifier). The same happens on side 2.

As long as each engine IDG is available then the two sides remain electrically isolated. If there is a loss of power on an AC bus then the remaining powered bus will automatically power the unpowered AC bus through the AC BUS TIE. If the APU is then started it will automatically power the bus tie and the failed AC bus. The AC BUS TIE will then be isolated from the normal powered bus. IDG should not be disconnected when engine not turning (operating or windmilling) and the IDG disconnect should not be pressed more than 3 seconds. IDG can only be reconnected on the ground.

In case of TR failure the DC busses can be automatically connected through the DC BAT BUS.

Two batteries are installed. Battery charging is automatic and is controlled by the BCL (Battery Charge Limiter). The BCL connects the battery to its respective DC BAT BUS during battery charging and during APU start. The batteries have an automatic cut-off logic to prevent complete battery run-down when the aircraft is unpowered and on the ground. This will shut off the batteries at about 25% capacity to ensure APU start after overnight.

Min Battery voltage is 25.5v. Check battery voltage with the BAT switch OFF. To charge batteries turn them on by pressing their respective pb's and connecting external power. A 20 min. charge is required if BAT voltage is not enough.

Part of the normal procedures for the Originating Checklist call for the check of both batteries to make sure that they are charging properly. Turn off both batteries and then

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turn them back on. Watch on the ECAM ELEC page to see that both batteries have initial current charge rates of less than 60 amps and decrease the amperage within 10 secs.

If all AC (no RAT) is lost a static inverter is connected from HOT BAT 1 bus to AC ESS bus (not SHED bus). BAT 2 will supply DC ESS (not SHED) in the event of loss of all AC (no RAT emerg. gen.) regardless. Below 50 kts. AC ESS will no longer be supplied by the inverter and will be unpowered. DC BAT will connect below 100 kts., it is not supplied above 100 kts. in loss of all AC.

If both Main AC busses lose power and the airspeed is 100 kts. or more the RAT will automatically deploy. The emergency generator will then power AC ESS BUS and DC ESS BUS. During the 8 seconds it takes the RAT to deploy and supply power the batteries will supply the ESS busses (not their shed busses) and the red FAULT light on the EMER ELEC PWR panel will be on during those 8 seconds. The RAT emergency generator is lost at landing gear down (A320) or about 125 kts (A319) and ND1 and MCDU1 will go out at that time due to loss of AC shed bus. On landing the DC BAT bus is automatically connected to the batteries when airspeed drops below 100 kts. When all AC is lost including the RAT emergency generator BAT 1 will supply AC ESS through the static inverter and BAT 2 will supply DC ESS. When the speed drops below 50 kts. the AC ESS bus is shed and power is lost to remaining CRT's (PFD1, ECAM upper). *Note:* min. RAT speed is 140 kts.

AC BUS 1 normally supplies power to AC ESS and DC BUS 1. If AC BUS 1 fails the pilot will press the AC ESS FEED pb. This will put the AC ESS BUS on it's alternate source, GEN 2 through AC BUS 2. When this is done the DC ESS BUS will become powered by ESS TR. DC BUS 2 will automatically supply DC BAT BUS and DC BUS 1 after 5 secs.

APU will carry all busses on ground but will not supply main galley shed busses inflight. Inflight if only one generator is supplying entire system then part (321: all galley power) of the galley load and passenger in-seat power supply is shed.

GEN 1 Line – If there is smoke in the avionics compartment the amber SMOKE light will come on in the GEN 1 LINE pushbutton. The procedure will call for the pilot to press the pb. This will open the GEN 1 line contactor and depower AC bus 1. GEN 2 will then automatically pick up AC BUS1 through the AC BUS tie. However, GEN 1 will still be powering two wing fuel pumps, one in each wing inner tank. *Note: this is not the complete smoke procedure, just the beginning that deals with the GEN 1 LINE pb.*

In loss of all AC (RAT only) emergency the APU is allowed 3 min. for start after EMERG GEN connects. The APU will not start inflight when on BAT only (this is due to the DC BAT BUS being disconnected during Electrical Emergency configuration below 100 kts.). Lights available in loss of all AC emergency are Capt. instrument lights, F/O dome light (if on DIM or BRT) and compass/ice light .

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Circuit breakers are color coded. Green are monitored by ECAM. All other colors are not monitored. The ECAM will display C/B TRIPPED ON OVHD PNL (or REAR PNL) if a green monitored breaker is tripped for more than a minute. Yellow breakers are pulled during the procedure for flight on battery power only.

Red capped breakers are NEVER pulled in flight. Red caps are installed on the wing tip brakes circuit breakers to prevent loss of flap asymmetry protection. All circuit breakers have a letter (vertical) and number (horizontal) code.

When on the gate with normal APU or EXT PWR the GEN 1 & 2 amber FAULT lights will normally be the only amber FAULT lights on in the overhead panel.

### FIRE PROTECTION

Both engines and the APU each have two identical loops, A & B and a computer- FDU (Fire Detection Unit). A fire warning is given when both loops reach the proper overheat condition. If one loop fails the other loop is able to generate the warning by itself. A fire warning is given if both loops fail within 5 seconds of each other. There is a red disc on the aft fuselage to show thermal discharge for the APU fire bottle. The engines each have two extinguishers, the APU one. Engines have sensing elements in three sections; pylon nacelle, engine core and fan section. APU has sensing element in APU compartment.

APU fire on ground will auto shutdown, sound nose wheel well horn and APU FIRE light will illuminate on external interphone panel. APU fire inflight must be manually shutdown (will not auto shutdown) and extinguished. *Note:* APU will auto shutdown in air for other than fire.

The front cargo compartment has two smoke detectors and the aft has four. There is one smoke detector loop in the forward cargo and two smoke detector loops for the aft cargo. If one smoke detector fails the system remains operational on the remaining detector. There is one extinguisher bottle for fore and aft compartments with one nozzle forward and two aft. Cargo fire gives: CRC, Master Warn light and Cargo smoke light.

ENG fire test: (7 items – 4 reds)

ENG 1 Test – press and hold

- ENG FIRE pb illuminated (red)
- SQUIB and DISCH lights illuminated (2)
- MASTER WARN illuminated (2) (red)
- CRC aural chime
- ENG 1 FIRE warning on E/WD (red)
- ENGINE page on SD
- FIRE light ENG 1 (on ENG panel) illuminated (red)

Repeat for ENG 2

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APU fire test: (BAT only 2 items – 1 red, AC 6 items – 3 red)  
APU FIRE Test – press and hold (APU will not shutdown during test)

- APU FIRE pb illuminated (red) \*
- SQUIB and DISCH light illuminated \*
- MASTER WARN lights illuminated (2) (red)
- CRC aural chime
- APU FIRE warning on E/WD (red)
- APU page on SD

\* BAT only (when doing Safety and Power On checklist on Battery only, no External power)

ENG FIRE pb pressed performs: (work down panel with 2,1,2,1,2 sequence – two on FIRE, one on HYD, two on FUEL, one on ELEC, two on AIR COND)

FIRE -	Silences CRC, Arms squibs	(2)
HYD -	Closes hydraulic fire valve	(1)
FUEL -	Closes low pressure fuel & engine IDG fuel return valves	(2)
ELEC -	Trips ENG GEN	(1)
AIR COND-	Closes engine bleed & pack flow valves	(2)

APU FIRE pb pressed performs: (work down panel with 3, 0, 2,1,2 sequence)-

FIRE -	Silences CRC, Shuts down APU, Arms sqib	(3)
HYD -		(0)
FUEL -	Closes low pressure fuel valve & APU fuel pump off	(2)
ELEC -	Trips APU GEN	(1)
AIR COND-	Closes APU bleed & Crossbleed valves	(2)

Smoke Detector test - press & release button for test. You should get (PH 3.4.1):

- DISCH amber lights illuminate.
- SMOKE red lights illuminate
- MASTER WARN light illuminate
- CRC
- CARGO SMOKE on E/WD

This test will run twice after you select it once to test both channels. *Note:* DISCH amber lights only on first test.

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### FUEL

Surge tank	Outer wing tank 1560 lbs. (N/A 321)	Inner wing tank 12,190 lbs.	Center tank 14,500 lbs.	Inner wing tank 12,190 lbs.	Outer wing tank 1560 lbs. (N/A 321)	Surge tank
A321 only: 2 Additional Center Tanks 10,500 lbs						

#### A319/320:

Total Left Wing Fuel 13,750	Total Center Fuel 14,500 lbs.	Total Right Wing Fuel 13,750
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#### A321:

Total Left Wing Fuel 13,750	Total Center Fuel 25,000 lbs.	Total Right Wing Fuel 13,750
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**Total Fuel – A319/320: 42,000 lbs., A321: 52,500** (memory limitation)

Fuel Philosophy: Fuel in center last, fuel in center burned first (PH 9.1.1).

Takeoff on center tank prohibited (PH 2.8.3)

The center tank pumps run at a higher override pressure so the center tank fuel will be burned before the wing tank fuel will be even though center and wing pumps are both providing fuel pressure to the manifold at the same time.

Fuel is kept in outer wing tanks as long as possible to reduce wing bending moment.

If both pumps in same tank fail, only the inner wing tanks can suction feed. Center tank fuel would be unusable.

APU fuel is drawn from the left fuel manifold. The APU normally uses the tank pump pressure but has its own fuel pump that it will use if no other fuel pump pressure is available.

Losing one center pump requires opening crossfeed valve (one ECAM chime)

Losing one inner tank pump just requires turning off the pump switch (no chime)

Losing two center tank pumps will make any remaining center fuel unusable.

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Losing two inner tank pumps will put that wing on gravity (suction) feed. There is a chart to determine safe altitudes for gravity feeding in the QRH pg. 39.

Normally fuel is run in Auto mode. This will run the wing tanks continuously and the center tank on a schedule. The Auto mode schedule for the center tank is to run the center tank pumps any time there is fuel in the center tank except when the slats are extended. Exceptions to the Auto schedule (PH 9.1.7):

- After engine start the center tanks will run for at least two minutes for a “test run” even if the slats have already been extended. If slats are not extended pumps will continue to run as normal until they are extended. The pumps will restart again after takeoff when the slats are retracted.
- After the center tanks run dry the pumps will continue to run for 5 more mins.
- If IDG return fuel fills the outer wing tank the extra fuel will spill over into the inner wing tank. If the inner wing tank fills completely up then the center tank pump on that side will be automatically turned off to allow wing tank fuel to be burned until 1,100 lbs. has been used. Then the center tank pump will turn on again. This prevents surge tank spillage.

The fuel in the outer wing tanks will gravity feed through two transfer valve openings when inner wing tank fuel level reaches 1,650 lbs. When either wing inner tank reaches the 1,650 lbs. level a signal is sent to latch open all the transfer valves in both outer wing tanks. This is a total of 4 valves, 2 in each outer wing tank. The transfer valves will remain open for the rest of the flight and will close on the next refuel operation. If fuel is “sloshed” during climb or descent it is possible for the transfer valves to be opened early due to a LO LEVEL alert.

An ECAM caution is given if during Auto mode the center tank has more than 550 lbs. of fuel while the left or right wing tank has less than 11,000 lbs. of fuel per wing. This would indicate that the normal Auto schedule was not being followed.

The Crossfeed pb is normally extinguished when the valve is closed. It will show blue ON when selected on and green OPEN when fully open.

There are two full levels for the inner wing tanks, a fueling full and an operational full. The fueling full is less than the operational full and that allows the extra IDG fuel room to collect in normal circumstances without triggering the center tank pump turn-off for IDG return fuel.

*Note:* In Auto the center tank pumps run all the time if center tank fuel is present so with all fuel pumps on if you are on the gate with APU running (slats up) you will be using center tank fuel. If operating in Manual mode the crew must ensure that the center tank pumps are off when the wing tanks are completely full or when the center tank is empty.

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*Note:* Unusable fuel is shown with a half amber box around the fuel quantity on ECAM. If the fuel quantity is in a degraded mode the ECAM fuel quantity will have dashes through the last two digits. Refuel is shown on upper ECAM memo when refueling door is open.

**A321 DIFFERENCES**

The A321 Center Tank does not have the same pumps as the A319/320 but uses jet pumps instead. Further, the jet pumps are “powered” by the fuel pumps in the main wing tanks and the jet pumps transfer fuel from the Center tank to the respective wing tank. The A321 wing tanks do not have an outer and inner tank and there are no transfer valves to open. All the wing fuel is in one wing tank.

*Note:* IDG return fuel is added to the wing tank as there is no outer tank on the A321.

There is no ECAM OTR TK FUEL XFRD memo on the A321 as there is no outer or inner wing tank (all fuel in one wing tank).

The A321 has two Additional Center Tanks that will automatically feed to the Center tank when the Center tank burns down to a certain level. The Additional Center Tanks do not have pumps but use cabin air pressure to feed the center tank through transfer valves. The ACT 2 will transfer fuel first followed by the ACT1. All fuel transfer is done automatically in the normal mode of operation. The automatic fuel transfer from ACT to Center Tank is noted on the ECAM as a green triangle between the ACT fuel indicators.

ACT 1 (foreward)
ACT 2 (aft)

*Note:* For the A321 all fuel is burned from the Wing tanks. Fuel must be transferred to a Wing tank for it to be available for use by the engines.

There is no ECAM CTR TANK FEEDG memo as the A321 never feeds from the Center Tank.

## **PNEUMATICS, AIR CONDITIONING & PRESSURIZATION**

The pneumatic system supplies high pressure air for:

- Air conditioning
- Pressurization
- Engine starting
- Wing anti-icing
- Hydraulic reservoir pressurization
- Aft cargo heat
- Water tank pressurization

High pressure air can be supplied by:

- Engine bleed
- APU load compressor
- High pressure ground connection

Controlled by BMC (Bleed Monitoring Computer)

Engine Bleeds close automatically when BMCs detect:

- A APU bleed valve open
- S Engine Start
- O Over temperature
- L Leak
- O Over pressure

The valve will also automatically close pneumatically when:

- Low pressure
- Reverse flow

And is electrically closed when:

- ENG BLEED selected off
- ENG FIRE pb selected

The APU bleed will close for leaks

The APU is ready for bleed when reaching 95% for two seconds or 99.5%. The AVAIL light will show in the APU start pb and green APU AVAIL will show on EWD display when APU gen is available for use.

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The crossbleed valve can be operated in automatic or manual mode. There are two electric motors for the valve, one for each mode. In automatic mode the crossbleed valve opens automatically when using APU bleed air. During normal operation the crossbleed is closed to isolate the two engine bleeds.

The crossbleed is manually set OPEN during the engine crossbleed start procedure.

The leak detection system uses a single loop for the pylons and APU to detect hot air temps associated with duct leaks. Dual loops are used for the wings. If both of the dual loops detect a leak a warning is given, unless there is a fault on one, then only one loop is required to give a warning.

If a leak is detected:

- The engine bleed air valve (APU bleed air valve) on that side is closed
- Associated ENG (APU) BLEED FAULT light comes on
- Crossbleed valve closes (except during engine start)
- Left wing leak only – APU bleed air valve closes (except during ENG start)

## PACKS

① *Airbus Gotcha'*: Do not use external conditioned air when using packs (Unfortunately, there is no cockpit indication of external air connected!

There are three air conditioning zones: Cockpit, FWD Cabin and AFT Cabin. The zones are controlled by having the packs deliver all air at the lowest temp requested by any of the three zones. Then hot air is added through the trim air valves to the other two zones as needed to meet temp requirements. A/C zone temp selectors have a range of: Cold 18°C/64°F, 12 o'clock 24°C/76°F, Hot 30°C/86°F

The AC pack can bypass bleed air around the air cycle machine (ACM) if the ACM fails and run the bleed air through the primary heat exchanger directly. This allows the pack to operate as a simple heat exchanger with reduced pack flow.

Pack flow will revert to HI during single pack operation or APU bleed source regardless of selector position.

The Zone controller can override pilot selected pack flow (HI, NORM and LOW) as needed to meet demands. It can also command higher APU speed or engine idle as needed.

One Zone controller with two channels. Failure of the primary channel will result in fixed temperature at 76° F with no optimization. Failure of the secondary as well will result in a fixed temp of 68° F pack 1 and 50° F pack 2.

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One Pack controller per pack. Two channels per controller. If primary fails the secondary the pack air flow will be fixed at the pre-failure setting. No further optimization is available. Further failure of the secondary will result in a fixed pack outlet temp of 59° F.

Pack controllers also regulate the cooling air flow through the ACM. During takeoff and touchdown the controllers close the ram air inlet flaps to prevent ingesting debris.

*Note:* The Airbus 319/320 can be dispatched with one pack INOP up to FL310 or below as per MEL 21-5201A

### *RAM air* (PH 10.3.6)

RAM air is available for cabin ventilation in the event of loss of pressurization or smoke removal. When the RAM AIR pb is selected the RAM air inlet opens.

When pressurization differential is less than 1 psi. the outflow valve will open to 50% to allow exhaust. If above 1 psi. then the outflow will remain normal.

## PRESSURIZATION

There are two identical independent pressurization systems. Control is normally fully automatic. The system has one control panel, two controllers, one outflow valve and two safety valves. The outflow valve has three DC motors: Primary, Backup and Manual. Controllers can operate in automatic, semi-automatic and manual modes.

**Automatic:** Controller automatically takes the destination field elevation from the aircraft database. The entire pressurization schedule is optimized by the system.

**Semi-automatic:** If the database is not available for some reason the pilot can select the landing elevation from the LDG ELEV knob by pulling the selector out of the AUTO detent and turning to the needed value.

**Manual:** Normally, the controllers take turns controlling by swapping after each leg. If the active controller fails the backup automatically takes over. If both automatic systems fail the pilot may control manually by pressing the CABIN PRESS MODE SEL to MAN. The primary and backup outflow valve motors are depowered and the manual motor is activated. Now the pilot can select vertical speed on the cabin using the MAN V/S CTL switch.

**Abort mode:** If the aircraft returns after takeoff the system will reset to departure field elevation.

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Ditching pb: The Ditching pb will close all exterior openings below the flotation line. This pb is also used during deicing to prevent deicing fluid from entering the aircraft.

① **Airbus Gotcha'**: on ground with Ditching pb ON and all doors closed & external low pressure connected a pressurization differential will build (PH 10.6).

*Note*: If the pilot suspects that pressurization is not performing normally but has not yet failed press the MODE SEL pb to MAN for 10 secs. then return to AUTO. This will cause the systems to swap (PH 10.6).

Depressurization: When cabin exceeds about 11,000' the cabin may illuminate and Exit and all cabin signs illuminate automatically. Masks will drop at 14,000' and a PA regarding their use will automatically start. (PH 15.1.3, 5.15.1, 5.15.5)

## VENTILATION

The avionics are cooled through a system that uses two openings and two electric fans. Conditioned air is also available for backup if needed. Yes, a computer controls the whole thing (sigh). The intake is on the lower left side below the cockpit. A blower fan draws air in and the extract fan on the right side exhausts the air out from a port below the cockpit on the lower right side.

Open configuration: Only for ground operations, both the inlet and outlet vents are open and both fans operate. *Note*: during heavy rain operations on ground select EXTRACT pb to OVRD with both packs operating. This will prevent rain from entering the avionics bay. Return to normal auto operation once airborne (see PH 3a.2 for parameters).

Closed configuration: Inflight mode and very cold ground operations. Both vents are closed, however both fans run to circulate air past heat exchangers that are cooled by low outside skin temperatures. Some air exhausted through cargo underfloor.

Intermediate configuration: Only for use inflight when warm, same as closed except reduced opening to allow some additional exhaust of cooling air.

Abnormal configuration: Fault is detected in either the BLOWER or EXTRACT fan. Faulted fan is off. Similar to closed except air conditioned air is added to the circulated air. ECAM will direct configuration.

Smoke configuration: If smoke is detected in avionics both the BLOWER and EXTRACT fan will have amber FAULT lights on and the GEN 1 LINE pb (on EMER ELEC PWR panel) has amber SMOKE illuminated. Selecting BOTH fans to OVRD will cause the blower to stop but the extract to continue operating. Conditioned air is added to attempt to clear the smoke.

## HYDRAULICS, BRAKES & LANDING GEAR

There are three hydraulic systems: green, blue and yellow. All three systems are independent of each other and do not transfer fluid at any time. Each system has its own accumulator. Priority valves ensure proper pressure to critical users when system pressure is low.

Green system – 1 pump: engine driven. Two power sources: engine 1 pump & PTU

Blue system – 2 pumps: 1 electric and the emergency RAT. Two sources of power: electric pump & RAT pump.

Yellow system – 3 pumps: 1 engine, 1 electric & 1 hand pump. 4 sources of power: engine 2 pump, electric pump, hand pump and PTU.

Green is the “heavy” system with landing gear, flaps/slats, N/W STRG and Normal Brakes.

Blue is basically for redundancy with the only unique items on it being L & R spoiler 3 and the Emergency Generator which are “backup” items themselves.

Yellow provides the ground service items of parking brake and cargo door.

The RAT and Yellow electric pumps do not normally run during flight. A hand pump is provided on the Yellow system to provide the ability to open cargo doors with no electric power on the aircraft. Blue electric operates any time inflight and on the ground when at least one engine is operating.

The RAT hydraulic pump is for emergency use only and will only deploy manually for hydraulic problems. For electrical problems it will deploy automatically above 100 kts. with loss of all AC. *Note:* Min RAT speed 140 kts.

The PTU is able to transfer power but not fluid. It transfers power between the Green and Yellow systems (the two with the engine pumps and heavy consumers). The PTU can transfer power in either direction and is activated when a 500 psi differential is sensed between Green and Yellow. The PTU can also be powered on the ground by the Yellow electric pump to power Green hydraulic. Allows Yellow electric pump to power Green on ground.

The PTU is inhibited when

- First engine is being started. This is identified as when the nosewheel steering disconnect pin is in and one ENG MASTER switch is ON. (PTU operation is tested on second engine start)
- Cargo doors are operated (Yellow electric normally powers cargo doors, this prevents draining low output of electric pump or accidentally powering Green Hydraulic)
- Parking brake is ON and only one ENG MASTER switch is ON
- PTU pb is off

The engine pumps (Green and Yellow) each have Fire Shut Off Valves that close when the Engine Fire Pushbuttons are selected open.

## **Brakes**

The brakes are carbon, multidiscs actuated by two independent systems, Normal and Alternate. The normal brakes are powered by the Green hydraulic system.

Normal brakes are available when:

- The A/SKID & N/W STRG switch is ON
- Green hydraulic pressure is available
- The parking brake is OFF

A BSCU (Brake and Steering Control Unit) control all normal braking functions (anti-skid, autobrakes and brake temps.).

Minimum normal brake pressure is 2400 psi. w/ full pedal deflection (PH 3.4.1)

Anti-skid is deactivated below 20 kts.

Anti-skid may or may not be available when on alternate brakes. If antiskid is inop. then alternate brakes use 1000 psi max to prevent blowing tires.

The alternate brakes are powered by the Yellow hydraulic system and will automatically become selected if Green hydraulic is insufficient for normal brakes. Yellow brakes have the same capabilities as normal brakes except for autobrake capability.

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Alternate brakes can be used with or without anti-skid. Anti-skid during alternate brakes is inoperative when:

- Electrical power failure
- BSCU failure
- A/SKID & N/W STRG switch turned off
- Brake pressure supplied by Yellow accumulator only

Parking brake disables all other brake modes. Parking brake is on Yellow system

A pressure indicator on the instrument panel indicates Yellow accumulator pressure and Yellow left and right brake (parking brake) pressure on three needles.

Accumulators maintain good parking brake pressure for at least 12 hrs. The cargo door operation will restore parking brake (Yellow system) pressure.

Autobrakes are available on Normal Brakes (Green system) only. LO mode delays for 4 seconds after touchdown. MED mode delays for 2 seconds. MAX has no delay. Do not use MAX for landing, MAX is RTO only.

The Green DECEL light in the auto brake pb's indicates actual deceleration is within 80% of the selected rate (does not indicate that the autobrake is activated).

Autobrakes activate when ground spoilers are extended. On takeoff they are not armed until 72 kts. 2 SEC's are required for Autobrakes.

Brake Fans are installed in the main gear hubs. They will indicate an amber HOT when the brakes are 300° C or more. Brake temps are shown on the ECAM WHEELS page. An arc will appear above the hottest brake temp. If brake temp is above 300° C then the temp will turn amber. The brakes must be cooled below 300° C before takeoff. Pilot must manually select brake fans on.

*Note:* Fans should only be used to cool to about 250°

Hot Brakes (PH 3.15) Maintenance action is required if there is:

- 150° C difference in brake temps on the same strut *and* one brake 600° or greater *or* 60° or less
- a mean 200° C difference between different trucks
- fuse plug melted
- brake temp exceeds 900°

## Landing Gear

### The Airbus Landing Gear:

- Has enclosed gear bays
- Is held by mechanical uplocks
- Uses manual extension by gravity
- Has no mechanical or visual check for gear position
- Uses autobraking on the mains during retraction
- Has a brake band in the nose gear well
- Is hydraulically locked out from operation above 260 kts.

The LGCIU controls the Airbus landing gear operation. The SD will show 2 green down triangles on the WHEELS page for each gear down and locked. One green and one red triangle still indicates down and locked. Red shows gear in transit and no triangle indicates gear uplocked.

The gear doors will remain down after manual gravity extension.

The gear lights by the gear handle are powered through (hard wired) LGCIU 1, if LGCIU 1 is not powered the lights will not operate.

The gear handle has a red down arrow that will illuminate if gear is up with flaps 3 or FULL below about 700' (landing configuration). ECAM will alert.

### Nose Wheel Steering (PH 11.5.5)

Nose Wheel Steering gets inputs from: **Capt. & F/O steering hand wheels** (max deflection is 75°, starts reducing above 20 kts to 0° at 70 kts.), **Rudder pedals** (max deflection is 6°, starts reducing above 40 knots to 0° at 130 kts.), and **Autopilot**. A rudder disconnect is on the hand steering wheel for use during Flight Control Check. A lever on the nose gear deactivates steering to enable towing. A green NW STRG DISC message will show on ECAM and will turn amber on second engine start when lever is activated.

Nose wheel steering is enabled with hydraulic pressure when:

- Nose gear doors closed
- A/SKID & N/W STRG switch on
- Towing control lever in normal position
- At least one engine operating
- Aircraft on ground

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### FLIGHT CONTROLS

#### Flight Control Laws

Multiple failures are required to revert from normal law. "Multiple failures of redundant systems"

#### Normal Flight-

on ground	takeoff	inflight	landing	on ground
Ground Mode	Flight Mode	Flight Mode	Flare Mode	Ground Mode
Direct	blend from Direct to Normal	Normal	Normal with slight pitch down added at 50' for flare	Direct

**Normal Law:** for a given amount of sidestick deflection a given amount of G loading (pitch, elevators) or roll rate (roll, ailerons, spoilers) regardless of airspeed. Pitch is always kept in trim automatically. Flare mode gives slight pitch down after 50' for flare. Bank past 33° requires constant input or will automatically return to 33°. "Hard" protections. Green equals signs "="

#### Normal Law Protections (think of as "A320 mode"):

Bank	Yaw	Pitch	Low Speed	High Speed	Load
Roll rate proportional to side stick deflection 67° Max (at 45° autopilot disconnect)	Turn Coordination & Yaw Dampening	<b>Load Factor proportional to stick deflection</b> Max 30° nose up Max 15° nose down	Non overrideable AOA protection Alpha Prot Low energy warn. Alpha Floor Alpha Max	Non-overrideable nose up command prevents overspeed at Vmo/Mmo	Clean/Flaps 1 +2.5G/-1.0G  Flaps Extended +2.0G/-0.0G

**Alternate Law:** Flight control will revert to alternate law after multiple failures of redundant systems. Autotrim still available. "Soft" protections. No protection in roll, roll goes to direct. Pitch goes to direct for landing when landing gear extended (no "flare mode"). It is possible to be in Alternate law without speed Stability and/or Yaw Dampening. Aircraft can stall. Amber "X's"

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### Alternate Law Protections (think of as “737-300 mode”):

Bank	Yaw	Pitch	Low Speed	High Speed	Load
Roll Direct No protections	Yaw Dampening	<b>Load Factor proportional to stick deflection</b> No flare mode, goes to direct for landing	Low speed stability Overrideable nose down command to prevent stall	High Speed Stability Overrideable nose up command to prevent overspeed	Clean/Flaps 1 +2.5G/- 1.0G  Flaps Extended +2.0G/- 0.0G

**Direct Law:** Lowest level of flight control law. Proportional movement between sidestick deflection and flight control deflection. No autotrimming. No protections. The default mode on the ground in all cases (think about it, if you are on the ground you cannot have a G load or roll rate). This mode is most like a regular airplane (“DC-9 mode”). Amber “USE MAN PITCH TRIM”

**Abnormal Law:** This is entered by the aircraft being in an extreme unusual attitude (about double normal limits). When back to normal attitude aircraft is in Alternate Law except does not go to direct law on landing and no pitch protections. Computer reverts to Abnormal when it sees the aircraft in unusual attitude because computer logic says aircraft should not have been allowed by normal law protections into this attitude in the first place, therefore computer sees something is wrong.

**Mechanical Backup:** Pitch through horizontal stab trim, Lateral through rudders, Differential power. Both stab and rudder use cables going to controller and require hydraulic power. Bottom line here, very little “manual reversion” and if no hydraulic power you are a lawn dart. Red “MAN PITCH TRIM ONLY”

Fly-by-wire, no feedback except for rudder and horizontal stab trim

Two ELAC’s – Elevator, aileron and stabilizer control

Three SEC’s – Spoiler and standby elevator and stabilizer control

Two FAC’s – Electrical rudder control (other warning functions also provided)

FCDC’s (Flight Control Data Concentrators) process information from ELAC’s and SEC’s and send data to the EIS and CFDS.

*Pitch* – Controlled by elevators and horizontal stab. Electrically controlled by ELAC or SEC and hydraulically actuated.

*Elevator* – Each elevator has two hydraulic power sources and two actuators (one active and one in damping mode).

**Elevator priorities:**

ELAC 2 → ELAC 1 → SEC 2 → SEC 1

Left Elevator – Blue and Green hyd.      Right Elevator – Yellow and Blue hyd.

*Horizontal Stabilizer* – Electrically controlled by one of three motors or mechanically controlled by the pitch trim wheels (through cable) and hydraulically powered by green or yellow hydraulic. After touchdown the stab trim is reset automatically to zero.

**Horizontal Stab. Priorities:**

ELAC 2 → ELAC 1 → SEC 2 → SEC 1 (same as elevators)

Green and Yellow hyd., 3 electric motors

*Roll Control* – provided by ailerons and spoilers. Electrically controlled by ELAC (aileron) or SEC (spoilers) and hydraulically actuated.

*Ailerons* – Each aileron is powered by Green and Blue hyd. and has two actuators (one active and the other damping). The ailerons droop 5° when the flaps are extended. If both ELAC's fail then droop is deactivated and the ailerons streamline and only spoilers are used for roll control.

**Aileron priorities:**

ELAC 1 → ELAC 2

Green and Blue hyd.

*Spoilers* – Five spoilers are installed on each wing. From the wing root to wing tip they are numbered 1 through 5. All are used as ground spoilers. Numbers 2 through 5 (the 4 outboard spoilers) provide roll control. The middle three (2 – 4) provide inflight speed brakes. If a SEC fails the spoiler(s) it controls is automatically retracted (if extended) and that spoiler(s) deactivated. There is no reversion to other computers.

**Spoiler priorities:**

Spoilers 1 & 2 - SEC 3, Yellow and Green

Spoilers 3 & 4 - SEC 1, Yellow and Blue

Spoiler 5 - SEC 2, Green

## **Speedbrakes and Ground Spoilers**

Green SPD BRK memo on ECAM when speedbrakes extended. Flashes amber when thrust is applied with speedbrake extended.

Speedbrake extension inhibited when (SAFE):

S - SEC 1 & 3 fail

A - Angle of Attack protection active (a prot)

F - Flaps at FULL setting

E - Elevator (L or R) fails (spoilers 3 and 4 only)

(Note: PH does not list but TOGA selection will inhibit speedbrakes)

If speedbrakes out when inhibited they will automatically retract. Must restow speedbrake handle for 10 seconds to regain. Do not use speedbrakes below 1000' AFE.

If one speedbrake on one wing fails the corresponding one on the other wing will be inhibited for symmetry.

Ground Spoilers are armed by raising the Speed Brake Lever. The speed brake lever does not move with auto extension.

Ground Spoilers extend automatically:

Partial Extension – On landing –

Reverse selected on at least one engine with other at or near idle –and– one main landing gear strut compressed

Full Extension – On landing or on takeoff above 72 kts. (rejected takeoff) –

Both thrust levers at idle (spoilers armed) –or–

Reverse thrust selected on at least one engine with other at idle (spoilers ***not*** armed) and both mains compressed.

*Rudder* – Rudder controls yaw. FAC 1 & 2 provide electric control through trim motors and hydraulically actuated. Mechanically controlled by rudder pedals if FAC's fail. Rudder trim is automatic but can be done manually using electric RUD TRIM switch.

FAC – think of a southern Dragnet, “just the FACs y'all”

Y – Yaw functions, normal and alternate yaw

A – Airspeed (flight envelope protection - AoA, High and Low speed limits)

W – Windshear

L – Low Energy warning (speed, speed)

Alpha Prot - Angle of attack protection speed, top of amber tiger stripe

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A – Angle of Attack instead of Load Factor (g's)  
S – Speedbrakes retract  
A – Autopilot disconnects  
P – Pitch trim inhibited

Flaps have overspeed protection at flap setting 1+F so that at 210 KIAS the flaps will automatically retract to flaps 1. Slats have an alpha lock function that inhibits them from retracting from position 1 to 0 when at a high angle of attack or low airspeed. There are 4 Wingtip Brakes (WTB) that will lock the flaps or slats in case of asymmetry, overspeed, runaway or uncommanded movement. WTB's cannot be released inflight. If flaps locked out, slats can operate and visa versa.

Please note that on the A321 it is possible at very high gross takeoff weights that F speed will exceed the flap speed for 1+F. In this case the flaps will automatically retract and the pilot will select flaps 0 at F speed which will retract the remaining slats.

### **Sidesticks**

Perhaps one of the most distinctive and noticeable differences in the Airbus 320 series from other airliners is the sidestick. Most folks get comfortable with the sidestick within minutes. However, the computerized flight controls that the sidestick activate require some new features:

No feedback (feel) is given. Sidestick is spring loaded to neutral.

System algebraically sums the signals from both sticks if both are operated at the same time. However, the total input is no more than the max input from a single stick.

A red Takeover pb in the sidestick (also serving as autopilot disconnect) allows one pilot to override the other.

A green sidestick priority light will flash during dual input and an audio "DUAL INPUT" will be sounded.

The green sidestick priority light will flash in front of the pilot with control and a red arrow light will illuminate in front of the pilot who has been deactivated when one pilot has taken priority over the other.

Sidestick "locks" in place when on autopilot. Pilot action on sidestick (or trim wheel) at any time will disconnect the autopilot.

Last pilot to press Takeover pb has priority.

Pressing Takeover pb for 40 secs. will latch the priority condition (pilot does not have to continue to press Takeover pb). However, a deactivated sidestick can be reactivated by momentarily pressing the Takeover pb on either sidestick.

## INSTRUMENT / NAV / COMM

### **ECAM**

The ECAM (Electronic Centralized Aircraft Monitoring) system is made up of two primary components, two SDAC's (System Data Acquisition Concentrators) and two FWC's (Flight Warning Computers). A loss of only one SDAC or only one FWC will not result in any loss of function. The second computer can handle all functions alone. The SDAC's receive data from sensors and will send signals to 3 DMC's (Display Management Computer) which generate the screen image. The SDAC's also send signals to the FWC. The FWC will generate various warning/caution messages.

The E/WD (Engine/Warning Display) is the instrument panel display that shows normal engine readings and ECAM messages. The SD (System Display) is directly below the E/WD and normally shows system pages or status. For information on switching screens in case of failures see EFIS later in this section.

ECAM uses color to indicate the importance of the indication—

RED:	Immediate action required
ORANGE (AMBER):	Awareness but no action required
GREEN:	Normal operation
WHITE:	Titles and remarks
BLUE (CYAN):	Actions to be carried out or limitations
PURPLE (MAGENTA):	Special messages (i.e. inhibition messages)

*Note:* pulsing green or amber indications are approaching limits

If a FWC fails the Master Caution and Master Warning lights will indicate the failure (along with a warning from ECAM). The failure will be indicated by the upper or lower light in both the Master Caution and Warning light being out. If the #1 FWC fails then the captains upper lights would be out and the F/O's lower lights would be out. If #2 FWC fails the reverse lights will go out.

Loss of both FWC's will result in a loss of most warning capability. The dual failure of the FWC's will result in an amber caution with no aural.

ECAM system pages are controlled through the ECAM control panel. Captains will be using the mnemonic FHED to check systems prior to departure.

- F FUEL**, balance, configuration, quantity
- H HYD**, Hydraulics quantity (pointers in boxes)
- E ENG**, Engine oil quantity (min. 12.5 qts.)

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**D DOOR/OXY**, Doors armed, O2 pressure (note: overwing slides always armed)

*Note:* Press FUEL, HYD, ENG and then press ENG again to return to default DOOR/OXY page.

### ECAM Procedures

Upper ECAM (E/WD)	
Primary Failures underlined “ECAM Actions” <u>ELEC DC BUS 1 FAULT</u>	Secondary Failures starred Affected Systems *ELEC
Lower ECAM (SD)	
Procedures	Inop Systems
Status	Status

Work in a “Z” fashion from upper left, upper right, lower left, lower right.

When an ECAM warning occurs the first pilot noting it should read the title.

Appropriate systems page will be shown on lower ECAM (SD) to help identify problem area(s).

Then the PF should call “ECAM Action”. The PNF should read the full line of action items. Confirm all major actions before continuing to next, such as thrust lever movement, engine master shutoff, engine fire pb selection or IDG disconnect. As you complete the items listed in cyan (blue) they will be automatically cleared from the screen (think “Blue to Do”). Continue until you reach the next underlined item. Read through any boxed item (note: boxed items indicate failure of a primary system that will cause the loss of another system or systems on the aircraft). When reaching the next underlined title or the end of the procedure then proceed with clearing ECAM. Be sure to do ALL blue action items between underlined titles before proceeding.

If there are too many steps to all be on the screen ECAM will put a green down arrow to indicate that there is screen “overflow”. As you complete the items and they are cleared the overflow items will automatically scroll up onto the screen.

*Note:* you may not be able to clear all blue items. In some cases ECAM will not have a way to know that you have done an item, such as “contact ATC”. In these cases just clear ECAM when all items are done.

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When all action items finished the PNF asks, "Clear ECAM"? PF will reply, "Clear ECAM" if ready to continue. Be sure that no further cyan messages remain that can be eliminated before clearing. Some blue action items the computer cannot get feedback from, and these will remain on the screen. ALWAYS CONFIRM AN ECAM CLEAR.

If the problem stops while doing action items some action items may clear or change automatically. For example, if an engine fire goes out while running ECAM you will see the ECAM ENGINE FIRE go away, the red FIRE pb on the FIRE panel and the red FIRE light on the engine panel will go out and the LAND ASAP will change from red to orange.

When ECAM is cleared the next procedure will appear (additional primary failures are listed in the "stack" on the right) or if all procedures are done then ECAM will automatically present the first page of the affected systems on the SD. Affected systems (secondary failures) are listed in amber on the top right of the screen with an \*asterisk in front of them (\*F/CTL). After reviewing the screen you will clear it and the next system screen will be shown. After each screen you should ask and confirm ready to clear the screen.

Example: PNF will then review all affected equipment shown in amber on Flight Control side. When done PNF will ask, "Clear Flight Control"?

PF will reply, "Clear Flight Control" if ready to continue.

When all the affected system screens have been cleared the status page will come up automatically. If Status or Inop Systems takes up more than one page on ECAM there will be a green down arrow to indicate to "scroll" to the next page. In this case you will clear ECAM to scroll to the rest of the procedure. After using clear to see additional Status or INOP Systems pages you can press the STS key to see the first Status or INOP Systems page again.

PNF will then read all status items line by line. When done the PNF will ask "Clear Status"?

The PF will reply, "Clear Status" if ready to finish.

Additional information on ECAM warnings may be obtained from the Pilots Handbook, Chapter 21 if time permits.

A red LAND ASAP suggests landing at nearest suitable airport (more severe).  
An amber LAND ASAP suggests the pilot should consider the seriousness of the situation and suitability of the airport before landing (less severe).

Landing Distance Procedure – If the procedure directs you to do the landing distance procedure (LDG DIST PROC) then you will look in the QRH performance section for the

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model you are in (i.e. for A319 use A319 Performance) and find the LANDING DISTANCE WITHOUT AUTOBRAKE – CONFIGURATION FULL table. ALWAYS use the Config Full table, even if landing with less for the procedure. Find the applicable distance. Now take the reference distance and go the LDG CONF APPR SPD table on QRH pg. 52 or 53 (depending on whether A319 or A320). Please note that this is a reference distance only, if you have autobrake available you should use it!

Find the appropriate equipment failure in the table and note the actual flap lever position for landing. Please note that the actual flap and/or slat positions may not match the flap lever position depending on what procedures you are accomplishing. Now note any speed increment to be added. Finally note any landing distance multiplier. If there are multiple failures and you need to apply more than one equipment failure you may need to adjust your multiplier. If the multipliers all have asterisks take the highest multiplier. If any of the multipliers don't have asterisks then multiply the multipliers together and use the resulting number as the total multiplier.

Once you have determined the total multiplier you can multiply this number times the reference landing distance from the Config FULL table to find the minimum runway needed for the procedure(s).

Add the speed increment (if any) to VLS and add any wind correction (see QRH pg. 55 or 56 for instructions) and put the resulting VAPP in the MCDU PERF APPR page under the LSK 5L. When using speed increments ALWAYS USE SPEED SELECT on approach. Do not use managed speed when speed increments have been applied. Use the VAPP set in the PERF APPR to remind you what speed to select when on approach.

*Note:* ALWAYS use CONFIG FULL on the PERF APPR page when using the Landing Distance Procedures no matter what flaps settings are used as the numbers are all referenced to Config FULL charts. In other words DO NOT use Config 3 in the MCDU PERF APPR page if the flap lever is positioned to Config 3 and DON'T press the LDG FLAP 3 pb on the overhead.

*Note:* If ECAM directs to recycle Flaps/Slats – speed select below 200 kts. and select flaps 2

ECAM action should not be taken (except to cancel audio warning through the MASTER WARN light) until:

- The flight path is stabilized and
- The aircraft is higher than 1,000 AFE

## EFIS

A white diagonal line across the display means that the DMC (Display Management Computer) has failed. The CRT itself is still working. Just switch to the standby DMC on the switching panel to restore the displays as normal.

A failure of the DU Display Unit (display blank) means that you will have to swap screens to view all information. The PFD has priority over the ND and the EW/D has priority over the SD. This means that if the PFD display fails then the PFD will automatically display on the ND display screen. However, if the ND fails the PFD will remain on its normal screen. If you wish to view the ND you can press the PFD/ND XFR switch. In the same way the EW/D has priority over the SD. If the SD needs to be displayed use the ECAM/NC XFR switch on the switching panel to bring that screen up on the CAPT or F/O ND as selected. A failure of both the ECAM screens (EW/D and SD) will require use of the ECAM/ND XFR switch on the switching panel to view the EW/D screen on the ND display and by pressing the required system pb on the ECAM Control Panel you can view the SD info on the ND as needed.

The ND has two brightness controls, outer and inner bezel control knobs. The outer ND bezel controls brightness of the radar and terrain on the ND. The inner knob controls the brightness of all the other normal ND display. Note that if the PFD/ND XFR button is used the outer bezel is disabled and only the inner knob is available for brightness control.

STS in a white box will show on the bottom of the EW/D if there are any systems downgraded to remind the crew of any status information. If there is a system advisory message when the SD has failed the EW/D will flash a white ADV at the bottom of the screen to notify the crew to select the SD for viewing.

The current airspeed is indicated by a fixed yellow reference line. A yellow speed trend arrow will appear from the speed reference line to indicate the anticipated airspeed in 10 seconds.

Green Dot is a (gasp!) green dot on the speed scale and is available only when aircraft is clean (flaps 0). It shows best lift over drag speed (L/D) and is also called  $V_{FTO}$  (Final Takeoff speed). Green dot is used during normal takeoff and the engine-out maneuver and gives best angle of climb speed.

On the altitude scale the Landing Elevation is a blue line and is based on barometric information. The Landing Elevation is available only in QNH (below 18,000') and on approach.

Ground Reference display on the altitude scale is a red ribbon and is based on radar altimeter information. Radar altimeter readout comes on screen in green below 2500' AGL and goes amber (if DH is entered) when 100' above DH (CAT II/III). If an MDA has

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been entered the altitude (note: this is the normal altitude readout, not the radar altimeter readout) will turn amber below the MDA (CAT I / RNAV).

Magenta means managed and Blue means selected. For example if the commanded speed is by pilot action (speed select) the speed target index (speed pointer) will be blue. If the commanded speed is controlled by the FMGC (speed engage) the speed pointer will be magenta.

When a new altitude is selected the new target altitude will appear above (during climb) or below (during descent) the altitude scale. The new target altitude will move onto the scale once it is within the altitude scale range (about 600').

### Takeoff Warning

- Slats/Flaps
  - Pitch Trim
  - Speed Brakes
  - Sidestick Fault
  - Hot Brakes
  - Door Not Closed
- the following are only triggered when takeoff power is set*
- Parking Brake On
  - Flex Temp Not Set (not displayed if thrust levers set in TOGA detent)

### Altitude Alert

Altitude alert (tone and pulsing yellow altitude windows) is inhibited when:

- Slats are out and landing gear selected down
- Landing gear locked down
- Captured on glide slope

The tone is also inhibited when on autopilot and capturing a normal set target altitude, but pulsing yellow window is still effective.

### ***Windshear prediction and detection***

Windshear prediction is radar based and is available below 1500' AGL. It looks out to 5 nm ahead of aircraft. A warning message reading WINDSHEAR AHEAD will appear on PFD and ND. Color of the warning will be red or amber depending on level of warning. Levels include Advisory (display only) and the Warning and Caution messages have an aural warning alert as well. Predictive warnings are inhibited during takeoff after 100 kts. until 50' AGL and then again inhibited on landing once below 50' AGL. Windshear prediction uses the normal weather radar and there is only one radar installed. If the normal radar is turned off the windshear prediction will still operate normally if set to

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Auto. Prediction means that a possible windshear is ahead of you. Predictive windshear will not warn for CAT (Clear Air Turbulence), system must have precipitation to work.  
*Note:* Predictive windshear is inhibited during takeoff after 100 kts up to 50'!

Windshear detection is controlled by the FAC's and is based on GNADIRS information. Windshear detection means that you are IN a windshear. Windshear detection (when slats/flaps selected) is available 5 seconds after takeoff until 1300' AGL and is again available on landing from 1300' AGL until 50' AGL.

A red WINDSHEAR warning is shown on the PFD and an aural WINDSHEAR alert is given three times during windshear detection.

**Note: Windshear detection is NOT available until 5 secs. after takeoff!**

### GNADIRS

The Global Navigation Air Data Inertial Reference System (say that five times fast!) provides the FMGS with the data input it needs to navigate the aircraft. The FMGC decides which signals are most accurate and provide a "synthetic" (best guess) aircraft position after weighing all available data. The FMGC can also estimate the accuracy of its synthetic position due to available sensors and data. This information will be used during RNAV approaches. The IRU's have laser ring gyros that provide a stable reference signal as well as provide attitude information. Be very careful NOT to just turn off the IRU because it gives a bad nav signal. It may still be giving good attitude information and can be selected to attitude information only (ATT). The FMGC can track IR drift and predict aircraft position even when GPS or ground based (VOR/DME) signals are lost.

GNADIRS also provides the aircraft with needed air data information such as altitude, mach, temperatures, airspeed, etc. Failure of an associated air data reference DOES NOT fail the IR! The failed ADR can be turned off by deselecting its pb and still maintain all IR and GPS functions.

The system is very accurate and reliable with a high degree of redundancy using three GNADIRS units and multiple navigation signal inputs from GPS and IR. The FMGC also takes VOR/DME signals (PH 13.3.1, 17.3.1) into account along with the GNADIRS data to compute aircraft position. The third GNADIR is basically a standby that can be selected if #1 or #2 fail.

Amber FAULT light:

- Steady, IR lost
- Flashing, may be available in ATT only, NAV lost

White ALIGN light:

- Steady, in align mode (normal)

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- Flashing
  - align fault
  - No entry in 10 mins.
  - 1° difference in lat. & long. from shutdown position
  
- Extinguished, alignment is complete (normal)

**Note: DO NOT move aircraft during alignment.**

*EGPWS (PH 13.3.9)*

Enhanced GPWS provides all normal aural GPWS functions as well as the enhanced terrain avoidance features. The enhanced function is database (computer) driven but it is shown in a radar format. Please note that the radar is NOT being used for terrain detection but the DISPLAY will override the weather radar image display when the terrain on ND pb (TERR ON ND) is selected. If the TERR ON ND pb is not selected and a warning is generated the terrain display will come on automatically and override weather radar display. The Terrain “sweep” is a distinctive middle to the sides to make it obviously different from the normal radar. The enhanced terrain feature can be shut off using the TERR pb on the overhead without losing any of the normal GPWS functions.

*Standby Nav, remote tuning (PH 13.4.3, 3B.5.1)*

When normal radio navigation is not available you can use the backup nav mode, Standby Nav (STBY NAV), also known as remote tuning. Select Rose VOR for the ND. Press the guarded NAV button on the RMP and the green light will come on indicating that you are now using Standby Nav. To use VOR nav press the VOR button. Then tune the VOR frequency with the normal selector knob in the STBY/CRS window. Press to transfer the freq to active and now you can select the course on the STBY/CRS window using the inner knob of the selector.

To tune an ILS first select Rose ILS on the ND. Then press the ILS button on the FCU. Then press the guarded NAV button on the RMP. Then press the ILS button in the STBY NAV area of the RMP. Now tune the ILS frequency by using the normal RMP selector to tune the freq. in the STBY/CRS window. Then press the transfer button to make the frequency active. Now you can select the ILS course using the inner knob of the selector.

*Note:* the ILS STBY NAV will display onside tuning on the PFD and offside tuning on the ND. This allows comparison of the signals during approach.

*Note:* If the STBY NAV is being used during the electrical emergency configuration only RMP 1 has power.

*RADNAV Nav, manual tuning: Select the RADNAV key on the MCDU. Enter the VOR ident on LSK 1R or 1L and the course on LSK 2R or 2L. Select VOR Rose for the ND.*

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*To manually tune an ILS use the same technique by putting the ILS ident on LSK 3R and then select ILS Rose for the ND. Press the ILS pb to see DME on PFD.*

*Communications (PH 13.5): Comms are monitored by ECAM for “stuck mike”. All RMP’s will tune any radio. ACP’s may be switched in case of failure using Audio Switching panel on overhead.*

### AUTO FLIGHT SYSTEM

First, a little general autoflight theory! The Airbus has three “layers” or levels control if you wish to call it that. The first or lowest level is manual control. This would be the pilot controlling through the sidestick and the thrust levers.

#### “Manual”

Pilot	
Flight Controls	Thrust

In this case the pilot is controlling any flight control movement by use of the sidestick, which sends its signals through the appropriate computers to the hydraulic actuators and finally the flight control itself. The pilot can command any flight control movement that stays within Flight Control Normal Law. The same holds true for thrust. The pilot can manually control the thrust levers to command any thrust level that stays within the normal engine operating parameters. This is hand flying as you have always done. Do not confuse the flight control computers (i.e. ELAC, SEC and FAC) with the flight management guidance computers (FMGC).

The next level of control is autoflight. This is when the autopilot and autothrust are engaged. In this case the pilot is controlling the aircraft through the settings on the FCU for the autopilot and the thrust levers. The pilot is telling the autopilot and autothrust directly what is wanted. For example, if a heading of 90 is required the pilot just sets a heading of 90 in the FCU and the autopilot holds that heading. If the pilot wants a climb of 1000 fpm then the pilot sets 1000 fpm in the FCU.

#### “Autoflight”

Pilot	
Autopilot	Autothrust
Flight Controls	Thrust

This level is basically the same as any other aircraft you have flown with autopilot and autothrust. The autopilot and autothrust are controlling through the same flight control system that the pilot uses when hand flying.

The final and most sophisticated level is computer guided. In this case the pilot enters the desired settings in the FMGC and the computer calculates the proper flight path and

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track. The FMGC then commands the autopilot and autothrust to properly maintain the computed track and path.

If the pilot wishes to make changes or revisions to the flight plan then it is done to the FMGC which then recalculates the needed information. For example, if the pilot wishes to change the flight plan route to go direct to a new fix, the new fix is typed into the MCDU and entered into the DIR page. The FMGC now computes the new course and commands the autopilot to turn to the new heading.

**“Computer Guided”**

Pilot	
FMGC	
Autopilot	Autothrust
Flight Controls	Thrust

Each higher level uses all the previous levels. In other words computer guided flight is also using the autoflight and manual levels. The pilot can always “drop down” from one level to a lower level by disengaging the appropriate equipment. For example, the pilot may be climbing under computer control in Managed Climb. By selecting a vertical speed of 1500 fpm on the FCU the pilot has now put the vertical path in autopilot control. The FMGC is not controlling the climb rate. If the pilot then disengages the autopilot the aircraft is now under manual control and the pilot is now manually controlling the climb rate.

Two things that should be pointed out. You can have various levels of control at one time. For example, the track may be computer guided by the FMGC while the vertical path is under autopilot control. Another example is when the pilot is hand flying but using autothrust (which is very common). In this case the flight controls are in manual but the thrust is in autoflight.

The other thing to point out is that when hand flying the pilot may use the Flight Director so that while the aircraft is under manual control the pilot is still getting autoflight or computer guided assistance.

*Autopilot (PH 14.1.6)*

There are two autopilots installed. Normally you will only use one autopilot at a time (Capt. using A/P 1 and F/O using A/P 2). However, for every ILS approach you will engage both autopilots (except, of course, when the second is inop.).

The autopilot can be controlled either directly from the FCU (Flight Control Unit) or through the MCDU and the FMGC. In both cases you must monitor engagement status on the FMA. The FCU has four places to make inputs, Speed, Heading/NAV, Altitude and Altitude Hold/Vertical Speed. In each case the knob for the selection can be pressed or pulled. Pressing the knob will tell the autopilot to use the FMGC for guidance. Pulling the knob will tell the autopilot to use a pilot selected value.

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When the autopilot is engaged (push) on the FMGC for a setting a white dot will appear on the LCD readout for that setting. If the autopilot is selected (pull) to a pilot set value the pilot value will appear in the LCD readout. Always confirm settings on the FMA at the top of the PFD.

**Speed:** Pull to select to KIAS or Mach by pilot, dial to needed speed. Press to engage in speed mode in FMGC

**Heading:** Pilot can dial to set desired heading then pull to select HDG mode. Pressing HDG knob will engage NAV and allow autopilot to track FMGC route.

**Altitude:** Value set by pilot, pulling will allow open climb/descent (full power climb, idle descent), pressing will engage to allow managed climb/descent on FMGC

**Altitude Hold/Vertical Speed:** Pressing knob will engage an immediate level off. Pulling knob will select vertical speed mode. Dial knob to select amount of climb or descent in hundreds of feet per minute.

Memory and Non-memory autopilot limits (PH 2.13.1)

After Takeoff (if SRS indicated)	<b>100' AGL</b>
Enroute	500' AGL (321: 900')
Non-precision approach	MDA
CAT 1 ILS Approach (no autoland)	40' below DA
Autoland	Touchdown
After a manual go-around	100' AGL

### Autothrust (PH 14.1.12)

The big picture on Airbus autothrust; During ground operations handle the thrust levers as on a "normal" aircraft. At takeoff push the thrust levers up to 50% on N1 until both engines stabilize, then push the thrust levers up to FLX/MCT (two clicks) or TOGA (three clicks). When LVR CLB flashes (about 1000') on the FMA reduce the thrust lever back to CL (one or two clicks). The thrust will now be controlled through the FMGC or the FCU. The thrust levers in normal operation will not move again until landing when at 50' the PF will reduce the thrust lever to idle and the autothrust will automatically disconnect at that point. There is no physical connection between the thrust levers and the powerplant. It is all done electronically which is called FADEC (Full Authority Digital Engine Control).

Thrust is now set by selecting Open Climb (OP CLB) or Open Descent (OP DES) or Managed climb or descent. Managed climb or descent means that the FMGC is controlling in either. Open mode simply means using either full climb thrust for climb or idle thrust for descent. Autothrust controls to a limit in Open, either the climb limit or the idle limit.

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The other “FCU” method to control thrust is to set vertical speed (V/S) which allows the thrust to maintain speed and climb rate is controlled through pitch. In this case autothrust is maintaining speed and is in Speed mode. Of course, during cruise and approach the altitude or glide slope is held through pitch with the autothrust maintaining the required speed. Managed thrust is controlled by the FMGC.

If you don't get anything else out of this little discussion please understand that the autothrust works in one of two modes, Open (controlling thrust) and Speed (controlling speed). Further, Open mode can be either climb or idle thrust.

Most of the time if you are going to have a problem it is in the Open mode (controlling to thrust). If you are having problems with thrust doing something other than what you think it should you can possibly try:

- Turn off flight directors (if hand flying), this will cause autothrust to go to Speed mode
- Select vertical speed (if in Open climb or descent), this will cause autothrust to go to Speed mode
- Select Speed Select (if in Managed speed), this will force the commanded speed to what you desire.

*Arm A/THR (autothrust):*

Arm on ground (with at least one FD on):

- Set thrust lever in FLX/MCT if FLX temp is set
- Set thrust lever to TOGA

Arm in flight:

- Press on the A/THR pb on FCU when thrust levers not in active range or setting thrust levers out of active range. Blue A/THR in FMA.

*Activate A/THR:*

Note: on ground you will set takeoff thrust to either FLX/MCT or TOGA which are manual thrust settings. When coming back to the CL detent after takeoff you are putting the thrust levers to the A/THR active range, thus activating autothrust.

- A/THR pb pressed on when autothrust in active range
- Set thrust levers to active range when A/THR pb armed
- ALPHA FLOOR protection activated

Disconnect A/THR:

- Press instinctive disconnect pb on thrust levers
- Place both levers to idle detent
- Press off the A/THR pb on FCU when system active (green light goes out)
- Set one thrust lever beyond MCT or both beyond CL detent when RA is below 100'

*Note: Pulling back the thrust levers from the CL detent during autothrust operation will allow the pilot to limit autothrust upper limit but autothrust is still active until levers are at idle. Chime and ECAM warning will sound every 5 seconds to remind pilot to either disconnect autothrust or reset thrust levers to CL detent. The proper way to disconnect autothrust and begin manual thrust operation is to bring thrust levers back until the TLA "donuts" are matched to thrust indicators and then press instinctive disconnect pb on thrust lever.*

① *Airbus Gotcha': Warning: If autothrust is disconnected and then thrust levers are pulled back from CL detent the thrust will immediately go the power selection commanded by the thrust levers and indicated on the TLA donuts. Be sure power is at the intended setting when A/THR is disconnected to avoid power surge.*

Alpha Floor – Angle of attack between Alpha Prot and Alpha Max at which the autothrust will command TOGA regardless of thrust lever position.

Alpha Floor will give(PH 14.1.12):

- A FLOOR in green with flashing amber box on FMA and in amber on E/WD
- TOGA LK in green with a flashing amber box around it on the FMA when the A FLOOR condition is left. TOGA thrust is frozen.

To cancel ALPHA FLOOR or TOGA LK disconnect the autothrust.

ALPHA FLOOR is available in NORMAL law only.

ALPHA FLOOR is disabled at 100' RA to let you land the aircraft.

ALPHA FLOOR is disabled if you press the instinctive disconnects for 15 secs.

THR LK – Thrust Lock occurs if the autothrust system fails. THR LK flashes on the FMA and ECAM memo displays AUTO FLT A/THR OFF. The thrust will be frozen at the last commanded setting until the pilot moves the thrust levers, then thrust will follow the movement of the thrust levers and be controlled manually.

① *Make your flight instructor happy!:* The following is in bold print because it will make your life easier. **Always match the TLA to the thrust before disconnecting (using**

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**instinctive disconnect pb), no matter what kind of thrust situation you are in. This works in normal autothrust, THRUST LOCK and TOGA LOCK. Although not always technically necessary, by matching TLA to thrust you always avoid any unintentional thrust “excursions” and use good practice. Think “Match and Mash”.**

During every approach you will need to confirm autothrust is in SPEED mode on FMA or off by 1000'

Missing Link or AP/FD & A/THR interaction (*PH14.1.5*)

Well, OK, it isn't *that* missing link but there is a link between the autopilot and/or flight director and the autothrust. The A/THR and the AP/FD work together to maintain speed and trajectory (altitude, glide slope, vertical speed). If one is maintaining speed the other will maintain trajectory and visa versa. If you think about it you are used to doing this yourself when flying manually. On climb you set climb power and maintain speed with pitch but when leveling for cruise at altitude you use pitch to maintain altitude and power to hold speed. The Flight Guidance acts in the exact same way. There are two basic ways the autoflight maintains control.

AP or FD in trajectory mode (example: altitude hold, V/S, G/S)	A/THR in SPEED mode maintain speed or MACH in cruise and approach
---	---

Or

AP or FD in SPD/MACH AP or FD adjust pitch to hold speed	A/THR in THR mode Steady thrust set to either THR CLB (OPEN CLB) or THR IDLE (OPEN DES)
---	--

There are times that the autoflight cannot hold what has been set and will have to change modes. This is called mode reversion when the modes change automatically without the pilot calling for it. This is both a part of normal flying and also part of the system to prevent flight outside the envelope.

An everyday example is during a climb the autopilot normally will control pitch to keep speed in OPEN CLB and the autothrust will maintain climb thrust (THR CLB). On approaching level off at the target altitude pitch will now revert from speed to vertical speed and thrust will revert from climb thrust to speed. This will be true even if the pilot reselects a new altitude before the level off is complete. The vertical speed mode will remain until the pilot reselects something else.

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Basically, be aware that if the autopilot is controlling pitch then the autothrust is controlling speed and visa versa. Only one controls pitch or speed at a time, never both controlling the same thing together.

A common reversion mode is if the aircraft is climbing in Open Climb or Managed Climb and the pilot is suddenly given a new altitude. The new altitude is below the current altitude. The mode will revert to V/S set to the current vertical speed upon reversion. The pilot can then change the vertical speed to a descent or select Open Descent.

Reversions can also happen when hand flying if you don't follow the flight director. If in Open climb or descent and you allow the speed to hit max or min the autothrust will go to SPEED mode and attempt to regain the selected speed while the flight director bars will be removed! Turn OFF FD when hand flying!

① *Airbus Gotcha': or How to be an Airshow Pilot:* You are hand flying with the flight director on (bad thing!). You are getting ready to level off just prior to the Final Approach Fix on an approach. However, you are not quite level at the set altitude and the FMA does not yet show ALT\* for capture. You are slowly leveling off just a little high without realizing it and as you have been in Open descent the thrust remains in the commanded idle. Speed decays to below  $V_{LS}$ . Suddenly climb thrust is commanded even though you are now wanting to continue descent. Sounds like a flyby to me!

### FMA – Flight Mode Annunciator

The FMA allows the pilot to know what modes the autoflight systems are in and what can be expected. There are times when changes will occur in the modes without pilot action. This mode reversion cannot be tracked on the FCU, you must look at the FMA to know what is actually happening. The FMA is broken into columns as shown below:

COLUMN NAMES				
THRUST	VERTICAL	LATERAL	APPROACH CAPABILITY STATUS	AUTOFLIGHT ENGAGEMENT STATUS

COLUMNS					
ROWS	THR	VERT	LAT	APP STAT	ENGAG STAT

Each column has rows for messages and memos. There are up to three rows available for each column to use. The first three columns, Thrust, Vertical and Lateral have have the following rules:

Top row, Green - Active

Middle row, Blue or Magenta – Engaged

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ACTIVE, ENGAGED MODES	MAN THR	ALT*	NAV	CAT 3	AP 1+2
ARMED MODES		G/S	LOC	DUAL	1FD2
MEMOS, SPECIAL MESSAGES	LVR ASYM	SET HOLD	SPEED	DH 100	A/THR

Bottom row, Messages about flight control first priority

Bottom row, Messages about FMGS have second priority

This is what the FMA looks like at the top of the PFD:

THR IDLE	ALT*	NAV	CAT 3	AP 1+2
LVR ASYM	G/S	LOC	DUAL	1FD2
			DH 100	A/THR

The FMA is at the top of the PFD and allows the pilots to see exactly what the various modes of the auto flight system are. The above examples are just given to allow you to see what type of messages would be in the FMA, not an actual flight situation. A starred message (ALT\*) means that portion is in the process of capturing. A boxed message means a reversion has just taken place. The PH has a complete list of all messages and meanings (PH 14.2.1).

### Oxygen

Crew oxygen is supplied from one cylinder. A green over pressure disk is located on the outside of the aircraft skin below the Captains windows. Blowout of this green disk indicates thermal discharge. Crew oxygen is turned on using a pb in the overhead panel. Crew oxygen pressure is indicated on the SD and if low the pressure indication will have an amber box around it. However, the Airbus low pressure is not the same as the US Airways limit, therefore the amber box should be ignored and crew action to check pressure is not required until pressure is less than 1000 psi. A chart is available on PH pg. 3-34 to indicate amount needed for number of crewmembers. Masks are full-face and have clear "tear-off" strips. If face mask has surface contamination, the tear-off strip can be removed to clear an area to see through.

Passenger oxygen is chemical generated. Masks will automatically deploy when cabin altitude exceeds 14,000'. Oxygen generators last approximately 13 minutes. When masks are deployed a pre-recorded PA announcement is automatically broadcast on their use. Passenger oxygen SYS ON light only means that the signal was sent, some masks may not deploy and F/A's may have to manually open.

## POWERPLANT

(non-memory)

319: CFM 56-5B6/P rated at 23,500 lbs. thrust  
320: CFM 56-5B4/P rated at 27,000 lbs. thrust  
321: CFM 56-5B3/P rated at 32,000 lbs. thrust

Max Starting Temp: 725° C  
Max Continuous Temp: 915° C  
TOGA Temp: 950° C (5 mins.)

Single engine taxi prohibited (PH 2.14.4)  
12.5 qts. Min for dispatch (PH 2.14.5)  
FADEC controlled (Full Authority Digital Engine Control) (PH 16.1.3)

Each FADEC is a two channel computer with one channel active and the other used as backup. Each FADEC has its own alternator that powers it once N2 is above a certain value. If the alternator fails normal ships power will take over.

Three idle modes:

- Modulated: Varies with demand, in flight with flaps at 0
- Approach: Depends only on altitude, activated when flaps not at 0
- Reverse: Selected when on ground and thrust levers at idle, slightly higher than forward idle.

Five Thrust Lever Detents:

- TOGA: Takeoff go-around
- FLX/MCT: Flex takeoff, Max continuous
- CL: Climb thrust
- IDLE: Idle thrust for forward and reverse
- FULL REV: Maximum reverse thrust

Continuous ignition provided automatically (with Mode selector in NORM) when:

- Engine ANTI ICE on
- Engine flameout inflight detected
- EIU fails

Continuous ignition may be selected manually by positioning the ENG MODE selector to IGN/START

Normal Start Sequence:

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*Note:* start ENG 2 first to pressurize Yellow Hydraulics for parking brake

- ENG Mode selector to IGN/START (wait 15 secs. before ENG Master ON)
- ENG Master switch to ON
  - At 16 % ignition ON
  - At 22% starts fuel flow
  - At 50% start valve closes, ignition off
  - Engine idle should stabilize at about 58%
- ENG mode selector to NORM

Normal Idle – 2,4,6,6 – Approx. 20% N1, 400° C EGT, 60% N2, 600 lbs/hr FF

Manual Start Sequence:

- ENG Mode selector to IGN/START
- ENG MAN START pb ON
- At Max Motoring (min. 20% N2) select ENG Master switch ON
  - Fuel and ignition will begin when ENG Master selected ON
  - At 50% start valve closes, ignition off
- At idle, about 58%, ENG MAN START pb OFF
- ENG mode selector to NORM

N2 background “grays out” during start, return to normal when stabilized at idle  
Ignition A or B will show on SD during normal start, A & B during manual start

*Note:* Run engines at or near idle for 2 mins. and run engine for 5 mins. before applying takeoff thrust, run engines at least 3 mins. after landing.

### [APU \(PH 16.3.X, 7.1.X\)](#)

APU can supply can electrical up to 39,000' and supply full electrical load up to 25,000' and bleed air up to 20,000'. Electrical takes precedence over bleed air. APU bleed is NOT permitted for Wing anti-ice. The APU is fed fuel from left fuel manifold. If no other fuel boost is available the APU will activate a separate dedicated APU fuel pump. In flight (above 100 kts.) on bat only the APU will not start (RAT failed). With RAT (loss of GEN 1 & 2) the APU is allowed 3 minutes for a start attempt.

The APU can supply the entire electrical system on the ground. In the air the APU will not supply the main galley shed busses.

The APU will auto shutdown and fire the extinguisher bottle on the ground but not inflight. Inflight the APU must be manually shut down and extinguished for fire. If the APU SHUT OFF pushbutton on the external panel or the APU FIRE pb on the overhead FIRE panel is pressed the APU will shutdown but the extinguisher will not automatically fire. *Note:* APU will auto shutdown inflight for reasons other than fire.

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The APU generator will automatically come online if engine gens. or external is not already online. The APU is ready for bleed and electrics when reaching 95% for two seconds or 99.5%. The AVAIL light will show in the APU start pb and green APU AVAIL will show on EWD display when APU gen is available for use.

APU bleed may be selected on whenever needed and APU will allow bleed to come online after allowing time for EGT to stabilize. On shutdown the APU Master is pushed off. The APU will continue to run for cooling period before shutting down. If the APU Master is pressed back on before the APU shuts down the APU will continue to run. When shutting the APU down for the Parking & Securing checklist wait 2 mins. after APU Avail light goes out before switching batteries off. If APU is left running, leave batteries on for fire protection.

### FMS

A little general theory: All FMS systems that I have used function or think in a “Mode” pattern. This is to say that the FMS must always be in a mode or phase and be aware of what the aircraft is doing to “know” what mode it should be in. The FMS will have many different ways to identify a mode change but it will need to change modes during every flight. The pilot should be aware of the modes and their changes. The Airbus is no different. For vertical planning the FMGC has modes called Flight Phases that are named Preflight, Takeoff, Climb, Cruise, Descent, Approach, Go Around and Done. In addition the FMS needs to know when the aircraft is in taxi, engine-out and landing modes. With the pilot entering the proper needed data during initialization the FMS is able to properly plan and control a flight through all the necessary phases or modes.

Further, the pilot must enter a route of flight to allow for lateral planning. This will also involve modes, in this case, takeoff runway, SID (if applicable), enroute, STAR (if applicable) and approach/go around and landing runway. The pilot will enter the needed route data before flight and modify it in flight as necessary.

Some changes the pilot will make are considered Strategic (entire flight) and some are Tactical (current flight phase or mode). As you learn the different functions of the FMGC and the Autoflight system be aware of whether a function is Strategic or Tactical.

If a page is longer than one screen can show you will use the scroll or slew keys (up/down arrow keys, ↑↓) to show additional information. If there is more than one page to a key you can press the NEXT PAGE key to see the succeeding pages. Sometimes additional information can be accessed from a page and you will see an on screen prompt ( <, >, or \* ) to present that new page. See PH 17.6.1 for full information.

*FMGC Stuff:* Now for some general info on the FMGC!

*F-Plan Key:* When you select the F-Plan key the default (normal) Flight Plan view will have the FROM waypoint at the top of the MCDU screen (first line). The next (second) line will be the TO waypoint and all succeeding waypoints will continue down the

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screen. The FROM waypoint is usually the last VOR or intersection you crossed but it can also be PPOS (Present Position) or T-P (Turning Point). PPOS simply means that you are not on any nav segment and the FMGC is just tracking where you are with no nav guidance available. This will occur after takeoff when the runway is automatically cleared and you don't have a nav segment to join yet. T-P will show when you use the Direct function, which we will go over later. The second line is the TO waypoint and is in white while most of the rest of the lines are in green. However, it is possible that a pseudo waypoint may be on line two and therefore it may be white but not the TO waypoint. We will go over pseudo waypoints later as well.

You can always scroll up or down on the F-Plan page but the FROM will always be at the top when you select the F-Plan key. Think of the FROM as being what is behind you. Think of the TO as being what is just ahead of you. The FROM is important because to use lateral navigation you must define a nav segment for the FMGC to follow and this means that you must have two points for any given nav situation to define a segment. This will become more clear when we go over Reroutes.

DISCONTINUITY is a line that shows two points are not joined and they do not form a segment. If DISCONTINUITY is showing then the FMGC will NOT continue to the next waypoint. This is something that you want if you will be given radar vectors at a certain point. You will most commonly see DISCONTINUITY after the runway when initializing when you will expect radar vectors to your first fix and after the last fix on your route prior to beginning your approach. There are times when you will need to clear a DISCONTINUITY and we will look at that in a moment.

The scratchpad is the bottom line of the MCDU and is where you will enter data. After you type info into the scratchpad you will then select it up into the FMGC by using the LSK (Line Select Keys) on either side of the MCDU. Note that you cannot select data from the FMGC into the scratchpad. You will also get various warnings in the scratchpad and they can be cleared by pressing the CLR key in the bottom right hand corner of the keys.

*AIRPORT Key:* The AIRPORT key simply allows the pilot quick access to any airport that is entered into the flight plan. This would include the departure airport, arrival airport and the alternate airport. Press this key and the display will place the next available airport in the FMGC flight plan on the first (top) line in the MCDU. This just gives the pilot a fast way to "scroll" the flight plan display to the next airport.

*NEXT PAGE Key:* The NEXT PAGE key gives access to additional information for some screens when there is more than can be shown on one screen. Think of NEXT PAGE as scrolling horizontally. The F-PLAN and INIT screens use the NEXT PAGE function. When there is more than one page the pages are referred to as PAGE A and PAGE B as in INIT PAGE B. This would require you to select INIT and then press NEXT PAGE to access INIT PAGE B.

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- *Keys:* The  $\uparrow\downarrow$  keys (up/down arrows, slew keys) allow the pilot to scroll a page vertically. You will also use them for changing values. This is most commonly used when adjusting the LAT/LONG that is stored for the airport to the gate value when initializing on INIT. You will also very commonly use them for scrolling the F-Plan screen to see waypoints that continue in the flight plan beyond the MCDU screen display.

*DIR Key:* The DIR key allows the pilot to go direct to any waypoint entered. The TO waypoint will become whatever is entered as the direct and the FROM waypoint will become a T-P (position the aircraft is at when the DIR is entered).

*PERF Key:* The PERF key allows the pilot to see and enter data for the various phases of flight. You will use this key when initializing to enter takeoff information, changing climb, cruise and descent speeds and entering approach data. Only the preflight and done phases do not have pages. Press the PERF key and then press the LSK at the bottom of the screen to move to the next or previous phase page.

*RADNAV Key:* The RADNAV key stands for Radio Navigation and is the page to check when you wish to determine which nav aids are being tuned. Normally the Airbus will autotune the radios and you will not be aware of what nav aids are being utilized. However, there are times that you will need to “lock” a frequency for tuning, such as when a DME is used for departure on a SID. Just press the RADNAV key and then type the nav aid identifier (you may also use the frequency by using a leading slash, for example /115.0) in the scratchpad. Then select the identifier to the VOR1 or 2 LSK at the top of the MCDU. This will keep that side tuned to that frequency. You can use the DDRMI to see raw data. The “locked” identifier will be in LARGE letters.

*FUEL PRED Key:* The FUEL PRED key allows the pilot to view fuel prediction info on destination, alternate and fuel management data. This is the page to use to enter Weight and Balance data. If the INIT page B is showing on the MCDU on engine start the FMGC will automatically “rollover” to FUEL PRED for weight data to be entered. Gross weight and CG data are entered on LSK 3L. For example, 144,190 lbs. with a MAC of 23.2 would be entered as: 144.2/23.2

*INIT Key:* The INIT key is used when getting ready during preflight. You initialize the FMGC from this page. This page will be gone over in more detail later.

*SEC F-PLN Key:* The SEC F-PLN key allows the pilot to have a second flight plan to use for what-if scenarios or to load anticipated changes that might occur in the primary flight plan. You are able to copy the primary flight plan in order to make changes to it or you can program a new flight plan.

① *Airbus Gotcha:* If Secondary flight plan is different from Active flight plan you must be on Heading to activate.

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**DATA Key:** The DATA key will allow the pilot to view the various sources of data for the FMGC and determine whether it is valid or not.

**MCDU MENU Key:** The MCDU MENU key allows selection whether to work in FMGC or ACARS or another area such as AIDS. Only one MCDU can be set to ACARS at one time. If the opposite side is selected to ACARS then you will “locked” out of ACARS until it is selected back out of ACARS.

**CLR Key:** The CLR (clear) key is a delete key. You can use it to delete characters or phrases in the scratch pad or to delete data from the FMGC. To clear the scratch pad just press the CLR key and the last entered character will be deleted. If you continue pressing the entire phrase in the scratchpad will be cleared. The CLR key can also get rid of warning messages. To delete data entered into the FMGC press the CLR key while there is nothing in the scratchpad. CLR will be entered into the scratchpad. Now select CLR to the LSK that corresponds to the data you wish to delete. This is how to delete a discontinuity. Press the CLR key and then press the LSK that corresponds to the discontinuity and it will be deleted with the waypoints on either side of the discontinuity now joined as a segment.

**Pseudo Waypoints:** OK, besides just sounding weird what are pseudo waypoints anyway? Basically they are lines of information on the Flight Plan page that are not something that you can navigate to. They are mostly to do with vertical profile information and are therefore not for lateral navigation. Pseudo waypoints will consist of the following:

T/C – Top of Climb

T/D – Top of Descent

S/C or S/D – Start of Climb or Descent for Step Climb/Descent

SPD LIM – Speed Limit

DECEL – Deceleration to approach phase

I/P – Intercept Point

Please note that while you cannot navigate laterally using the pseudo waypoints they will show on your ND using various symbols. If a pseudo waypoint is on the second line of the MCDU it will be white even though it cannot be the TO waypoint. The MCDU logic simply makes the second line white whether it is actually the TO waypoint or not.

Initializing the FMGC:

When initializing the FMGC during pre-flight use these pages to enter data:

DIFRSIFP

D DATA  
I INIT PAGE A  
F F-PLAN

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R RAD NAV  
S SEC F-PLAN  
I INIT PAGE B  
F FUEL PRED  
P PERF

The training dept. uses DIFSIP but I add a few letters to help in line operation. Use what they want during training and then decide if you wish to add your own.

*Note:* Allow at least 3 minutes after initial power up on a cold airplane for all internal tests to be completed before pressing buttons. (PH 3.4.1)

DATA:

Press DATA key, then A/C Status. Check database validity and dates. Enter BIAS from flight plan on PERF for performance factor on LSK 6R.

INIT Page A:

Press INIT key. Enter the city pair codes in FROM/TO. For example, for Charlotte to Phoenix use KCLT/KPHX or use company route number such as KCLTKPHX1. If company route is available and correct you may insert it. Otherwise press return.

Enter the alternate city code. Example: for Greensboro use KGSO.

Enter flight number. Type in USA followed by the flight number. For example for flight 121 type **USA121**. *Note:* USA is just to help identify the flight number

Check lat/long coordinates. If gate coordinates are available use the scroll keys (up/down arrow keys, ↑↓) to adjust coordinates. It is safer to use the airport coordinates from the database and to scroll in the gate adjustments as this avoids the pilot typing in gross errors that are not caught.

Cost Index. Enter 70 unless release specifies 35.

Cruise flight level. Enter intended cruise altitude on the CRZ FL (350 for 35,000') and modify the anticipated cruise temperature with /TEMP (/49 for minus 49).

Press the ALIGN IRS key (LSK 3R). ALIGN IRS should be pressed within 15 minutes of turning GNADIRS to NAV to avoid excessive drift. DO NOT move aircraft during align process.

F-PLAN:

Press F-PLAN key to program the filed route. Do a lateral revision from the departure airport. To do this press the LSK 1L on the left side of the MCDU next to the departure

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airport code. Then select DEPARTURE. Now select RWY for anticipated departure runway, then SID if needed and TRANS if needed.

① *Airbus Gotcha'*: Delete the pseudo altitude waypoint for the runway (not necessary for FMS departure routes). Be sure to leave a discontinuity between the runway and the first fix (again, not if using FMS departure).

Insert first fix or waypoint in flight plan route. If there is victor or jet airway routing from the fix then use a lateral revision to enter the needed airway. For example for a route from BOS VOR on Jet 75 that ends at CMK press the left LSK next to BOS in the flight plan. Now enter J75/CMK in the VIA/ GO TO. Then INSERT if OK. Any fix that is a direct with no published route you can simply press on the next line. For example to go direct from BOS to CMK simply press CMK on the line below BOS LSK. This will place CMK after BOS in the flight plan as the next fix.

Note: pressing a fix on top of a fix places the new fix ahead of the previous one and a discontinuity is in between the two fixes now. You will need to clear the discontinuity if you want to join the fixes to make a segment.

Enter any vertical restrictions (cross LAX VOR at or above 10,000') by typing the altitude in the scratch pad and pressing it on the right LSK for that fix. You can also enter a vertical revision by pressing the right LSK for that fix and putting it into the proper field. If you have an at or above clearance put a + in front of the the altitude before entering it (use – for at or below)

Example: at or above 10,000' use +10000, at or below FL240 use –240.

Enter any anticipated arrival and approach by pressing the left LSK (lateral revision) for the destination airport. Enter appropriate Arrival, Transition and Runway Approach and Insert if OK.

Check distance at bottom of F-Plan page against the total distance showing on Release. This is a gross check and should be close but does not need to be exact as arrival and approach routings may add mileage not on release.

**RAD NAV:**

Press the RAD NAV key and be sure that if a DME mileage is needed during a departure that you enter the ID for the station here. For example, when doing the HORNET departure off of 18R you need the CLT DME 1.6 nm fix. Press CLT into the 1L or 1R LSK (Capt. or F/O) to “lock” CLT into the autotuning. The DME mileage will be shown on the DDRMI DME readout. If you are not using a DME for departure make sure that no station is “locked” by ensuring that the stations are in “little” letters instead of “big” (or bold) letters. This will ensure proper autotuning of the VOR's. If you do “lock” a station for departure make sure that you clear it after takeoff. *Note:* if the DME is from

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an ILS then press the ID for the ILS into the ILS/FREQ on LSK 3L and press the ILS pb to display the ILS DME on the PFD (not DDRMI). If nothing is showing in the RADNAV page then check to make sure that STBY NAV is not selected on the RMP. I suggest making RADNAV part of your personal 10,000' check.

**SEC F-PLAN:**

Press the Sec F-Plan key. Press the LSK for Copy Active. This will give you a "practice copy" of the flight plan with which you can later play "what if" scenarios with if you should so choose or to enter possible route changes (such as different than filed arrivals) to quickly activate as an active flight plan if needed.

*Note:* If Secondary is different from Active flight plan you must be on Heading to activate. If Secondary has been copied then PERF will be available as a prompt on SEC page.

**INIT Page B:**

Press the INIT key. Press the NEXT PAGE key. This will take you to the second INIT page. Check that the reserve time is 45 min. on FINAL/TIME line.

**FUEL PRED:**

After engine start you will use the FUEL PRED key to enter W&B. Enter the actual gross weight (RAMP weight) from the W&B printout. Also, enter the CG and you will not have to enter the fuel as the FMGC reads it on it's own. Example:

133.6/24.8

*Note:* If you receive the Weight and Balance printout before taxi you can go enter the available Performance numbers on the PERF page and then go back to the FUEL PRED page after engine start to enter the W&B numbers.

**PERF:**

Press the PERF key and you will now be on the PERF TAKEOFF page. Enter V1, V2 and VR speeds on their LSK's. Enter FLEX temp if needed. Enter THR RED/ACC (thrust reduction/accelerate) and ENG OUT ACC altitudes from W&B printouts. Enter the flaps setting and stab trim settings in units of UP or DN on the FLAPS/THS LSK (example: 1/0.5DN or 2/1.0UP). If using an intersection departure enter the distance from the end of the runway to the intersection on the TO SHIFT LSK. Now type the "0" speed in the scratchpad. Select NEXT PHASE and put the "0" speed in the CLIMB \*SPD LSK.

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When taking off from an intersection you should enter the amount of distance the intersection is from the end of the runway. For example, in PIT it is common to use runway 28L intersection P. From the Jepps Airport Advisory pages you can determine the distance available for takeoff (or just ask Ground Control!). Subtract that from the full runway length and you have the intersection 1500' from the end of the runway. Enter 1500 on the TO SHIFT LSK.

*Note:* If you enter data on the PERF page before the W&B numbers are put in the FUEL PRED page you will not have the "0" climb speed available. You will need to return to the PERF page to enter this speed after entering W&B numbers in the FUEL PRED page.

If approach data (PERF APPR) is not entered within about 150nm of destination then MCDU will give error message saying so.

① *Airbus Gotcha'*: If not within 200 nm of destination then aircraft will not initiate descent in PERF DESCENT mode. Descent will be made in PERF CRUISE mode. During descent in cruise mode the FMGC will not "see" crossing restrictions in the flight plan.

① *Airbus Gotcha'*: The aircraft will not initiate descent automatically when reaching a descent point (known as T/D or Top of Descent). The pilot must set in new altitude and then push the ALT knob to enter Managed Descent.

① *Airbus Gotcha'*: The pilot cannot change the Descent data once the FMGC is in Descent Phase. If you wish to make a change to the FMGC descent speed once you are in Descent Phase, enter a new cruise altitude below your current altitude into the PROG page. This will cause the FMGC to revert back to Cruise Phase and allow you to enter a new descent speed in the PERF DES page.

The FMGC may plan a much slower speed for descent in Descent Phase than in Cruise Phase. If the aircraft begins a descent and enters the Descent Phase when you wish to make a faster cruise descent you can enter a new cruise altitude on the PROG page below your current altitude. The FMGC will now revert back to Cruise Phase until crossing the new altitude. Be aware, however, that the FMGC does not "see" crossing restrictions when descending in Cruise Phase and will only descend at a set vertical speed.

① *Airbus Gotcha'*: Managed Climb/Descent is not available on heading. You must be on NAV to use Managed Climb/Descent.

① *Airbus Gotcha'*: When the aircraft is in HDG mode and the pilot enters direct to a waypoint the autopilot will automatically engage NAV with no other action on the pilot's part. In other words, the autopilot will change modes automatically from HDG to NAV when a DIR is entered in the FMGC. The point here is to be sure of where the waypoint

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is when you enter DIR as the airplane will automatically turn to the new waypoint as soon as it computes the new course. DIR will always turn the shortest distance to the point. If the aircraft begins to go the wrong place or turn the wrong direction (for example turn left instead of an assigned right turn) use HDG mode until you can correct the problem.

① *Airbus Gotcha'*: WARNING: Do not use the UPDATE AT LSK on the PROG page! The Update At feature (PH 17.6.44) will shift the FMGC to the new position. This will destroy the accuracy of your FMGC. *Note*: it does not affect the IRU's.

① *Airbus Gotcha'*: Changing the arrival or runway after putting in crossing restrictions will delete the crossing restrictions and you will have to re-enter them.

To enter a new waypoint you have several options. Of course, you can always just type in the name if you know it, in this case BURLS intersection on the SHINE arrival into CLT. If you do not remember the format for creating a new waypoint just type HELP and press a LSK just as you would enter a waypoint. You will then be shown the three formats for new waypoints to be entered.

LAT/LONG (latitude / longitude)                      Example: 3551.5N/08158.3W

P/B/D (Place / Bearing / Distance)                      Example: CLT/314/64

P-B/P-B (Place – Bearing / Place – Bearing)                      Example: CLT–314/HMV–171

*Note*: waypoint “slewing” or uptrack/downtrack on the course using a + or – is NOT available. Use a P/B/D on the course if possible.

*Note*: In the flight plan on the MCDU a P/B/D is shown as a PBD. The pilot created waypoints will be numbered so the first PBD is shown as PBD01 and the second as PBD02 and so on. The P-B/P-B waypoints are shown as PBX so they appear as PBX01, PBX02 and so forth. LAT/LONG waypoints are shown as LL01, LL02 and so forth.

To make a lateral revision to flight plan (F-PLAN button selected on FMGC) press a LSK on the left side of the MCDU (LSK 1L through 6L). To make a vertical revision press a LSK on the right hand side of the MCDU (LSK R1 through R6).

To enter a new destination (diversion not to alternate) use a lateral revision on any waypoint in flight plan (NOT current destination) and then enter NEW DEST on LSK 4R.

To enter holding into flight plan use a lateral revision on intended hold point then press the HOLD LSK on 3L.

① *Airbus Gotcha'*: Autopilot must be in Heading Select to delete a TO or FROM waypoint.

### **REROUTES NOTE: YOU MUST BE ON HDG TO CHANGE A TO OR FROM WAYPOINT**

One area that gives many new Airbus pilots problems is making changes to the FMGC flight plan once under way. There are several very common ways to enter reroutes into the FMGC, depending on the nature of the reroute.

**Direct:** Press the DIR key and type in the fix (VOR or intersection). Press the LSK 1L key to enter the fix. The FMGC will automatically enter a T-P (turning point) to create a FROM waypoint and the fix that is entered will become the TO waypoint.

**Direct then as filed:** Use the above method or press the DIR key and then find the cleared fix in the flight plan. Press the LSK next to the desired waypoint and it will become the TO waypoint. Using either method all waypoints before the fix are now cleared and the remainder of the flight plan will be available as filed.

*Note:* if you are on heading when DIR is used the mode will change to Managed automatically (in other words, when you go direct in heading mode the aircraft will automatically engage NAV and go to the direct fix).

**Heading to intercept then as filed:** Select the cleared intercept heading on the HDG selector on the FCU. Then you must determine if the segment you have been cleared to join exists in your flight plan. If it does you only have to clear any waypoints that are ahead of the segment until you have the proper fix as the TO waypoint. Use the CLR key to clear any unwanted waypoints then engage NAV.

If the needed segment is not available you must build it. As above first select the intercept heading. Then type in the fix that will become the FROM. Remember, in this case you have to create a NAV leg (segment) that does not currently exist in the FMGC. After typing the new FROM select it to the LSK 2L key and it will become the TO. Now enter the TO fix on the next line if it does not already exist. This creates the new leg segment. Now clear the T-P (turning point) on 1L (clearing the T-P allows each fix to move to its proper TO and FROM position). You can now add any other needed fixes until on the original route. Then clear any remaining discontinuities. Then engage Managed NAV.

**Offset:** To parallel your current course use a lateral revision at the FROM waypoint. Type in the amount of distance (up to 50 nm) to the side you wish to parallel the current course and right or left of course. For example for 20 miles left of course type 20L and for 35 miles right of course type 35R. Now select the amount into the OFFSET prompt on LSK 2L. You can see the anticipated new offset course on the ND. If you wish to adjust it press ERASE and type in the new amount. Once satisfied with the new course

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press INSERT. Aircraft will take a 45° cut to the new course. To resume the original course access the same OFFSET prompt and clear or go DIRECT to a fix on the original flight plan.

**New SID:** Press the LSK 1L key for the departure airport. Now select DEPARTURE, then select the departure runway. If you are using a SID select the appropriate SID (note: you may have to scroll to see all available SIDS). If there is a transition to the SID you can select it on the right side of the MCDU. Once everything is selected press INSERT.

**New STAR:** Find the destination airport in the Flight Plan (you can scroll or use the AIRPORT key). Press the left LSK for the airport for the lateral revision page. Now select ARRIVAL on LSK 1R. Select the appropriate STAR (*NOTE:* you may have to scroll to see all available STARS). Now select any transition as needed on the right hand side of the MCDU. When all has been selected press the INSERT prompt on the 6R LSK. If a transition is used that is already in the flight plan then there will not be a discontinuity to clear in the flight plan. However, if you do not have a transition then please be aware that the arrival and the flight plan will not have a common point and therefore will have a discontinuity.

**New Route:** To enter a new route you will program just like you did for the flight plan initialization. Take a lateral revision (left LSK) from the last common fix. Then use the VIA/ GOTO in the following format J75/BOSOX. If the new flight plan ends in a common fix then there will be no discontinuity and no fixes to clear. However, if the routing results in no common fix then you will need to go back and clear all the old fixes.

**Holding:** Press the left LSK for a lateral revision at the holding fix. If the fix does not appear in your flight plan (you are really having a bad day!) then use DIR first to enter the fix. Now press the HOLD selection on LSK 3L. If the hold is as published then check all data on the DATABASE HOLD page and if it is all good then press INSERT on LSK 6R. If you need to make changes or there is no published hold (COMPUTED HOLD) then make the needed changes to the Inbound Course, Turn Direction (L or R), and the time or distanced needed for legs. Once all data for the hold is good press the INSERT selection on LSK 6R. For immediate hold, take lateral revision at FROM waypoint and select <HOLD.

**New Destination:** Make a lateral revision from any waypoint in the flight plan (not an airport) by pressing the left LSK for that waypoint. Now select the NEW DEST prompt by typing in the new airport identifier (example: KCLT for Charlotte) and pressing the LSK 4R key. You may now go to the flight plan to modify the arrival information as needed for the new destination.

**New Alternate:** Press the left LSK for a lateral revision from the destination airport. Then select the <ALTN prompt on LSK 5L. Enter the new airport identifier on the blue line on LSK 3L over the old alternate or in the brackets if there was no alternate. Now press

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LSK 3L again to select the new alternate. Now press INSERT. Alternate should now be entered in the flight plan and on the FUEL PRED page.

### TAXI

No more than 40% N1 for breakaway thrust without clearance. (PH 18.2.3)

Max taxi speed on straightaway – 30 kts.

Max taxi speed on turns approx. 10 kts.

Minimum pavement width for 180° turn: 100' (A321 105')

During taxi in icing conditions longer than 30 mins. run-up engines to at least 70% N1 for approx. 15 secs. to shed fan ice (PH 3.6).

*Note:* Do not exceed 75% N1 (A321 70%) on both engines with parking brake ON (PH 3.6).

### TAKEOFF

① *Make your flight instructor happy!:* When setting power for takeoff, the thrust levers should be set to 50% on the TLA (doughnut) and once both engines stabilize at 50% then position both levers to FLEX or TOGA. The 50% setting will be at about the H on the thrust lever index where the pedestal says A/THR (to give you an idea of how far forward the thrust lever goes). Make an initial setting on the thrust levers and then adjust on the TLA to 50%.

Do not use aileron into the wind during a crosswind (PH 18.3.4). During a takeoff with crosswind exceeding 20 kts. or CG more than 34% (PH 18.3.2) apply full forward sidestick to be taken out by 80 to 100 kts. Ensure the aileron is neutralized by looking at the “control pointer cross” on the PFD or relax the sidestick to center during the takeoff roll. This will ensure that you do not have any roll in the initial rotation and liftoff. During crosswind takeoff when selecting TOGA power after engines stabilize at 50% then increase to 70% N1 and stabilize, then increase to FLEX or TOGA by 40 kts. ground speed.

① *Airbus Gotcha':* It is possible for the F/O to occasionally enter the wrong W&B data. An easy way for both the Capt. and F/O to double-check their work is to look at the Gross Weight shown in the bottom right hand corner of the SD after engine start and W&B is entered. This number should be very close to the Ramp weight shown on the W&B printout and similar to the TPS numbers. If you manage to still takeoff with the wrong gross weight entered, you will eventually get a gross weight mismatch error message once the aircraft has computed its inflight weight. To correct this just enter the proper weight in the PROG page after subtracting the current fuel used from the original Ramp weight.

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① *Airbus Gotcha'*: If on taxi out you do not have the V speeds showing in your PFD (after entry in MCDU), make sure that your Flight Director is turned on.

On takeoff, PF should have the F-PLN page, PNF the PERF-TAKEOFF page

Use a radar tilt of 5-8° UP if radar required during takeoff. (PH 3.8 pg. 3-46)

Normally set a departure heading for selection at 400'. *Note*: set the heading you will need at 400'. If you are using a SID departure where NAV is required engage NAV prior to takeoff and NAV mode will engage at 30' automatically. (PH 17.4.3)

Use ARC or ROSE NAV on takeoff on your EFIS ND settings. Do not fly around in PLAN. Only use PLAN as a momentary reference inflight.

*RTO – Rejected Takeoff* (PH 18.3.6)

ECAM will inhibit all warnings/cautions that are not paramount from 80 kts. to 1500' AGL.

- The captain calls the "reject". F/O verify braking and notify tower
- Thrust Levers idle (when the thrust levers go to idle the ground spoilers extend, which then trigger the autobrakes)
- Monitor autobraking (brake manually only if autobrakes do not function)
- Select Full Reverse
- Maintain slight forward pressure on sidestick
- Stop aircraft
- Inform passengers and flight attendants

*Note*: If necessary, maximum reverse may be used until aircraft comes to complete stop.

## APPROACHES

Approved Approaches (FOM 5.10.3): ILS, ILS/DME, LDA, LDA/DME, RNAV, ASR. *Note*: LDA approaches must have Glide Slope (POH 18.6.8)

Before any approach you must enter the applicable approach data (PH 3.12 & PH 18.x) and then activate the approach on the PERF APPR page of the MCDU.

Activating the approach will drive managed speed to approach speeds. Suggest activating the approach when out of 10,000' and on selected speed.

Airbus training suggests Flaps 3 as preferred landing flaps where able.

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*Note:* If flaps 3 is to be used then CONF3 should be selected on PERF APPR page (PH 17-145) and the overhead GPWS LDG FLAP 3 pb OFF (PH 3.12).

When using approaches that utilize barometric settings (MDA, DA) such as ILS CAT I, LDA and RNAV the minimums setting is on the MDA line (line select key 2R) on the PERF APPR page. Autocallouts are not available at 100 above and minimums when using the MDA setting.

When using approaches that utilize radar altimeter (DH, AH) such as ILS CAT II and CAT III the minimums setting is on the DH line (line select key 3R) on the PERF APPR page. Autocallouts will be made at 100 above and minimums.

① *Make your flight instructor happy!:* Use Noun/Verb when commanding changes on the FCU (Flight Control Unit) (POH 18.1.3). For Example:

“Speed Select 170” – pilot selects new speed of 170

“Speed Engage” – speed controlled by FMGC, known as managed speed.

“Heading Select” – selects heading to previously dialed or current heading “Heading Select 280” – pilot selects new heading of 280.

“Nav Engage” – track controlled by FMGC route

Speed	“Speed Select” or “Speed Engage”
Heading/Nav	“Heading Select” or “Nav Engage”
Open/Managed Climb (Descent)	“Open Climb (Descent) Select” or “Climb (Descent) Engage”
Vertical Speed	“Vertical Speed Plus (Minus)” or “Altitude Hold”

- Select is always knob pulled to you (pilot is “taking” the control of the autopilot). When using select if you are changing the amount from what is in the window then say amount after saying select.
- Engage (Hold) is always knob pushed away from you (pilot is “giving” control of autopilot to FMGC).

① *Make your flight instructor happy!:* When putting the landing gear up, disarm the ground spoilers by pressing the speedbrake handle down. When putting the landing gear down arm the ground spoilers by pulling the handle up.

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① *Make your flight instructor happy!:* When extending flaps to the final position say “Flaps Full” not Flaps 4, and when retracting flaps to the fully retracted position say “Flaps 0 (zero)”, not Flaps Up.

① *Make your flight instructor happy!:* When making any change in modes such as arming an approach or turning off the flight director or autopilot make sure you look at FMA (at the top of the PFD) to see what mode you actually are in.

On every approach be sure that by 1000'-

- Speedbrake is stowed
- SPEED is showing in FMA or autothrust off
- Not on Open Descent (inside FAF for instrument approaches) (PH 2.13.2)

① *Airbus Gotcha':* If you find that you cannot get the proper ILS frequency and course showing on the PFD when you select the ILS pb, then check your RAD/NAV page and see if a navaid has been entered and is locking out autotuning. Also be sure that an RMP NAV pb is not selected as this will turn on the NAV backup mode and disable FMGC tuning. I have also seen this simply “glitch” and not display when it should. We were able to fix it by reselecting the runway/approach.

On all instrument approaches (except CAT II,III) PNF calls “100 above”, then at minimums, “Minimums, runway in sight” or “Minimums, no contact”. PF responds to minimums calls with either “Landing” or “Go Around”.

Remember: **WAFPPP** for working in the sim.

### Weather

**Advise** (ATC, F/A's, company)

**F–PLN** (insert new destination if needed, then new approach)

**PERF** (ACTIVATE and CONFIRM, then insert approach data on PERF APPR)

**PROG** (if RNAV approach, insert .3 nm RNP)

**PRELIMINARY** (call for Preliminary Landing checklist)

All approaches must be briefed on the following 6 – 3 – 2 outline (PH 3–52, FOM 5.10.1). Use the following aids during your approach briefing:

### Approach chart:

- Approach name and runway
- Approach chart date
- Highest MSA
- TDZE
- Final approach verification altitude (not required for visuals)
- Required visibility (not required for visuals)

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### **PFD (be sure ILS pb is selected for ILS):**

- ILS frequency (does not apply for RNAV approaches)
- Final approach course
- DA, DH or AH as applicable (not required for visuals)

### **F-PLN page:**

- Glide path angle
- Missed approach procedure review (not required for visuals)

also include in brief any other considerations such as noise, windshear, anti-icing, runway conditions, 10-7 page engine-out procedures, etc.

*Note:* for RNAV approaches be sure to enter 0.3 RNP on the PROG page to ensure FMGC accuracy prior to the approach. Be sure to check that the 0.3 is showing on both MCDUs.

## **ILS APPROACHES**

ILS pb should be selected before approach briefing so pilot can read ILS freq., and course off of PFD. This allows the pilot to double-check the actual ILS being used as well as ensures that the ILS pb is selected before the approach begins. If wrong ILS freq. is showing make sure that RADNAV ILS is cleared.

*Note:* if ILS pb is not selected when approach is armed then ILS will flash in amber on the PFD

DA - If the approach uses a DA then the barometric altimeter is being used and no autocallout will be made for 100 above or minimums. Enter DA information in MDA position on approach page in MCDU (PERF APPR).

DH or AH - If DH or AH is being used then radio altimeter is being used and autocallouts are available for 100 above and minimums. Use the DH line select key for entry of minimums information in MCDU (PERF APPR).

When cleared for approach press the APPR pb on FCU. Then press to engage the second autopilot on FCU. Both autopilots should be engaged for ILS approaches. Note blue GS and LOC on FMA indicating glideslope and localizer are armed for capture.

## **CAT II/III APPROACHES**

Captain must brief:

- F/O must make 400' Land Green.
- 100 Above procedures (Captain - "Continuing")
- Minimums procedures (Captain - "Landing" or "Go Around")

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Note: any RA not AUTH approaches are based on inner marker. You may use the inner marker GS crossing altitude in the MDA as a reminder.

AH stands for Alert Height and allows for continuing the approach only on electronic indications (no visual confirmation of runway environment required). The Airbus 320/319 requires that CAT 3 Dual be annunciated in the FMA before AH is used. When entering Radar Altimeter information in the FMGC on the Approach page use 100' in the DH window for the AH. Autocallouts will be made at 100 above and Minimums as DH is being selected on the Approach page. This will allow the pilot to have a reminder at 100' AGL but the approach may be continued as long as all indications are normal and the reported RVR remains at or above the minimum for the approach. This means that the runway may not be seen by the pilots before touchdown. When shooting a CAT II or III approach the PF must make callout of *CAT 3 dual (or single)* or *CAT 2* based on FMA information when armed for approach. *NOTE: Above 8,200' AGL (max valid radar altimeter range) FMA will show CAT 1, confirm FMA below 5,000' AGL.*

If CAT 3 Dual is not shown in the FMA (for example CAT 3 Single or CAT 2 Single) then DH must be used if doing a CAT II or III and runway must be seen. Dual will be shown when both autopilots are in use, and Single when only one autopilot is in use or loss of some other required redundant system. Engine-out approaches limited to CAT IIIA (CAT 3 Single, requires 50' DH). Captain retards throttles on the 10' "Retard" callout, disconnect autopilot by 60 kts. on runway.

The autoland fail light will flash red if the following conditions occur below 200' while in LAND mode (PH 14.1.6):

- Both AP's off below 200' RA
- Excessive LOC ( $\frac{1}{4}$  dot – above 15' RA) or GLIDE (1 dot – above 100' RA) deviation – LOC and GLIDE scales flash
- Loss of LOC (below 15') or GLIDE (below 100') signal
- Difference between radar Altimeters is greater than 15' (FD bars flash)

## RNAV APPROACHES

All RNAV approaches must be flown with autopilot and flight director unless no ILS is available and both autopilots have failed, then a manual FD RNAV is permitted.

RNAV approaches only use one autopilot. Second autopilot will not engage.

Enter 0.3 for required accuracy on PROG page (only needs to be entered on one MCDU but make sure that the new value shows on both sides). This lowers the FMGC "tolerance" from an enroute value to an approach value. RNAV approach must have a HIGH nav accuracy showing with 0.3 nm value on the PROG page in FMGC before beginning the approach. Less than required accuracy will create a NAV ACCURACY

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DOWNGRADE message on MCDU. This is done to ensure that the FMGC generated position is accurate enough for an RNAV approach.

When cleared for the RNAV approach press the APPR pb on FCU. Do *NOT* select the ILS pb! ILS pb will disable the RNAV indications and flash amber V/DEV on the PFD.

Ensure APP NAV and FINAL are showing on FMA

Ensure the “hockey stick” (descent arrow symbol) is visible on ND for start of descent. Remember “High Hockey Finals”

*Note:* vertical guidance from F/D and “brick”, lateral guidance from F/D and ND.

3-2-1 – plan to extend landing gear at 3 miles from FAF, extend flaps 3 at 2 miles from FAF and extend flaps FULL at 1 mile from FAF.

At start of descent ensure that missed approach altitude is set. Ensure FINAL is now showing on FMA.

When visual on runway is acquired turn off autopilot. Autopilot will automatically disconnect at DA minus 50’ if not already disconnected.

*Note:* PNF makes 100 above and minimums calls. Do *NOT* make the 500’ above speed and sink callout as most RNAV minimums are at about the 500’ mark.

① *Airbus Gotcha’:* Be sure to get down to final approach altitude prior to FAF to capture from below!

## **LDA APPROACHES**

LDA approaches use same procedures as ILS approaches, LDA must have glide slope, LDA in database as LOC. KDCA Roselyn LDA is NOT authorized.

## **ASR APPROACHES**

Ask for approach minimums for category C (A321 D) aircraft and missed approach procedure. Controller will give you MDA and Descent Point (final approach fix) and one mile prior to DP. Ask for other fixes to plan for configuration (i.e. 10, 5 & 2 miles from DP). Use “dial ahead” on altitude. For example, when at initial altitude set MDA before reaching DP. When at MDA, set to missed approach altitude. Round MDA up to next highest hundred (example: MDA is 740, set 800). Max 1000 fpm descent. Use V/S (vertical speed) only, do not use Open Descent. Turn off both Autopilot and Flight Director to descend below MDA.

## ENGINE-OUT APPROACHES

All single-engine approaches follow the same procedures as normal two engine approaches except that Flaps 3 will be used in all cases. The aircraft is certified for autoland with single engine operation down to CAT IIIA single which will require a DH of 50'.

① *Airbus Gotcha'*: If an engine-out condition is detected by the FMGC the appropriate performance page will be brought up on the MCDU with an amber EO CLR\* on LSK 1R (PH 17.6.39 & 18.3.7). This is asking if you wish to force the FMGC back to normal two engine data. If you press the EO CLR you will clear out the engine-out condition and the FMGC will revert back to the normal two engine data. Of course if you get a spurious EO CLR\* during normal operations then you would want to clear the engine-out performance from the FMGC, which is why the prompt is there. The point here is during engine-out operations do not press the amber EO CLR\* LSK!

### **Visual Approaches**

① *Airbus Gotcha'*: Both Flight Directors should be turned off when cleared for visual approach and hand flying. This will ensure SPEED is showing for Thrust on the FMA and will help avoid unwanted "thrust excursions". Once established on the final if you have instrument guidance (either ILS or RNAV) you may turn the F/D's back on and select APPR *if* you will follow the Flight Director.

Open descent prohibited below 1000' AGL on a visual approach (PH 2.13.1)

When using speed select (manual speed selection – blue bug) I suggest the following speed ranges for a given flap setting. Note that this is based on my observation of managed speed, not on a written profile, and is simply my suggestion of comfortable speed ranges for a given flap setting. Of course you are able to select from  $V_{MO}$  down to  $V_{LS}$  whenever needed but the following are suggested as flexible and comfortable speeds to use in line operations. As well, by using these "ranges" you have a visual reference in front of you at all times:

- Flaps 0 – down to green dot
- Flaps 1 – below green dot speed down to S speed (green S)
- Flaps 2 – below VFE NEXT (amber equals sign) down to F speed (green F)
- Flaps 3 – below VFE NEXT (amber equals sign) down to F speed (green F)
- Flaps Full – before 1000', below VFE NEXT (amber equals sign) down to F speed (green F)
- Managed Speed – before 1000'

The alternate ILS technique (PH 18.6.6) works well for conservative Visual approaches as well (assuming on glideslope). Use the glideslope intercept altitude from your approach briefing:

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- By 1,500 ' above glideslope intercept altitude – flaps 2 (turning base)
- 1,000' above glideslope intercept altitude – gear down (Dot and a half G/S)
- 500' above glideslope intercept altitude – flaps 3 (Half dot G/S)
- Through glideslope intercept altitude – flaps FULL (G/S intercept)

## **GO AROUND**

Set thrust levers to TOGA, this will activate go around mode and (if turned off) will turn on Flight Director. Go around flaps are to select one step up from the approach flap setting (i.e. if flaps Full, then select flaps 3, if flaps 3 then select flaps 2). During acceleration when at F speed go to flaps 1 whether you are at flaps 2 or 3.

*Note:* If performance is not an issue during go-around the thrust levers may be brought back immediately to the CLIMB detent once the go-around mode is activated. Once TOGA is used please note that autothrust is now manually set and WILL NOT reduce until brought back to the Climb detent by the pilot (as during a normal takeoff). This means that the autopilot (or flight director) will not level out at a set altitude. If you are rapidly approaching an altitude in TOGA you must bring the thrust levers back to the Climb detent. Even if you level off manually the thrust will continue to accelerate the aircraft until reduced by the pilot to the Climb detent. The long and short here, if you TOGA on go around be ready to reduce thrust sooner than normal if leveling at a low altitude.

## **LANDING NOTE: THESE ARE MY PERSONAL TIPS AND NOT NECESSARILY PROCEDURES.**

Bring thrust levers back to idle with no delay at the end of the runway or the 50' call. The aircraft has plenty of airspeed and energy with managed speed being flown and you will not need to delay thrust reduction to ensure proper flare in normal conditions. Don't let nose drop when normal nose down pitch is added at 50' in flare mode. I was used to flying smaller (and shorter geared!) jets and found it helpful to move my aim point on the runway from the 1000' marker to halfway between the 1000' and 1500'. Try to have the flare started by the 10' call.

On touch down use positive nose down to lower the nose. Be careful not to let the nose ride up when reverse is selected. Select Full Reverse as you lower nose. As the aircraft slows through 80 knots slowly push the thrust levers back toward idle reverse so as to be at or near idle reverse at 60 knots. Be sure you push the thrust lever all the way back through the detent into forward idle. Then retard the lever again against the stop to ensure minimum forward thrust in idle.

Flaps 3 landings will tend to float more than Flaps Full. Be very careful when using Flaps 3 on shorter runways that you ensure touch down in a timely manner. Aircraft

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seems to level out in flare with Flaps 3 more quickly than with Flaps Full. Use a more “subtle” flare with Flaps 3 than with Flaps Full.

**Crosswind Landings – *Despite rumors, the Airbus uses conventional crosswind landing technique. Two points however; first, as the Airbus uses roll rate for the ailerons the pilot cannot HOLD the sidestick in the crossed control position. The sidestick must be released once the bank angle is established. Think of “bumping” in the needed bank. It is more intuitive than it sounds! Second, the sidestick is as sensitive in the flare as in cruise. Care must be taken to use measured inputs to the sidestick. The PH recommends aligning the aircraft with the runway centerline during the flare with the rudder. Maintain the aircraft on the centerline with roll control. Release all roll input when the aircraft is on the ground.***

**WINDSHEAR (PH 18.8.X)**

Takeoff – use TOGA, use longest suitable runway, use Flaps 1+F

Landing – Use Flaps 3, consider increasing approach speed

During a windshear encounter the PF should call: “Windshear, TOGA”.

The PNF should call altitude from radio altimeter and climb/descent trend:

“300’ descending, 200’ descending, 400’ climbing”, etc. Follow Flight Director.

Do not change gear/flap configuration until safe.

**EGPWS (PH 18.9)**

TOGA thrust, Autopilot off, Sidestick FULL AFT until at safe altitude. Don’t change gear/flap configuration until safe.

**A TO Z - ABBREVIATIONS & ACRONYMS**

(complete list found in back of PH)

The really short list of Airbus acronyms and abbreviations:

(before you get to it try to figure out what THS is)

ACM – Air Cycle Machine

ADIRS - Air Data Inertial Reference System

ADIRU - Air Data Inertial Reference Unit, now replaced by GNADIRS

AMU - Audio Management Unit

ASAP – as in LAND ASAP, As Soon As Possible (this really is listed, I'm not making this up)

A/SKID - Anti-skid

BSCU - Brakes Steering Control Unit (computer)

BTC - Bus Tie Contactor

CFDS - Centralized Fault Display System

CRC – Continuous Repetitive Chime, used to be called the fire bell.

DDRMI – Digital Distance and Radio Magnetic Indicator (RMI with DME)

DMC - Display Management Computer

DU - Display Unit (CRT, or "TV screen")

ECAM - Electronic Centralized Aircraft Monitoring

EIU - Engine Interface Unit

ELAC - Elevator Aileron Computer

EO - Engine Out

E/WD - Engine/Warning Display, upper display for aircraft systems.

FAC - Flight Augmentation Computer

FOM – Flight Ops Manual

FCU - Flight Control Unit (autoflight panel)

FMGC - Flight Management Guidance Envelope Computer

FMGS - Flight Management Guidance Envelope System

F-Plan - Flight Plan

FPA - Flight Path Angle

FWC - Flight Warning Computer

FWS - Flight Warning System

GCU - Generator Control Unit

GLC - Generator Line Contactor

GNADIRS – Global Navigation Air Data Inertial Reference System, GPS, Air Data information and Inertial attitude/guidance all in one.

IDG – Integrated Drive Generator (the old CSD and generator all in one unit)

INIT - Initialization

L/G - Landing Gear

LGCIU - Landing Gear Control Interface Unit (I think this one is extra credit, we just called it the linguini)

LSK - Line Select Key (keys used on MCDU screen)

MCDU - Multipurpose Control and Display Unit (this is the actual box used to enter data into the FMGC, you getting all this?)

ND - Navigation Display (has all those nice little pictures on it to let you know where you are)

N/W – Nose Wheel

pb - pushbutton

PFD - Primary Flight Display (the display you will look at the most, has airspeed, altitude, attitude, heading and more)

PH – Pilots Handbook

PTU – Power Transfer Unit, pump that is able to transfer power (but not fluid) between the green and yellow hydraulic systems

QRH – Quick Reference Handbook

RAT - Ram Air Turbine, a backup pump for blue hydraulic

RMP - Radio Management Panel

SD - System Display, lower display for aircraft systems.

SDAC - System Data Acquisition Concentrator

SEC - Spoiler Elevator Computer

SFCC - Slat/Flap Control Computer

SRS - Speed Reference System

THS - Trimmable Horizontal Stabilizer (did you guess it?)

TLA - Thrust Lever Angle, the TLA indicator is a white “donut” on the N1 gauge.

TRU - Transformer Rectifier Unit, also known as TR, transformer rectifier

UTC - Universal Coordinated Time (a politically correct way to say Zulu or GMT)

WTB – Wing Tip Brake

XFR - Transfer

ZFCG - Zero Fuel Center of Gravity

ZFW – Zero Fuel Weight

These are just my short list of favorites and there are many others but for the most part these should get you by.

Bonus – what persons names are on the Airbus instrument panels?

Answer – Max, Norm, Rose, Agent 1 & Agent 2, Rat Man

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**FOM STUFF**

Minimum F/A staffing

	Standard Complement	Minimum for boarding and deplaning	Through flights with passengers onboard
A319, A320	3	3	1
A321	4	4	2

**FUEL**

Variance: 1% or 500 lbs. whichever is greater

Fuel Vendor Fuel Slip Tolerance:

Gallons: 150                      Liters: 600

*Note: Fuel slip may not be passed through sliding cockpit window*

Captain may increase GATE RELEASE fuel as needed. Relay new fuel amount to dispatcher. Dispatch will check new fuel amount for load problems then contact departure station. If fuel decrease is needed then dispatch must agree.

*Note: Do not takeoff with less than T.O. MIN Fuel*

When refueling with passengers on board a flight attendant must be stationed at main door and jetway or stairs must be attached to aircraft.

Standard Operating Weight (SOW)

A319 – 91,000

A320 – 95,000

A321 – 112,000

Loading Last Minute Baggage

Right engine must be shut down. Load forward compartment only.

**MANUAL BACKUP FLIGHT RELEASE FUEL**

Reserves: 4500 lbs.

Approach: 600 lbs.

Taxi-out: 30 lbs./min.

APU burn: 200 lbs./hr.

## TAXIING

The captain is NOT required to stop only because a passenger leaves seat during taxi. Use judgment to determine if stopping will create a greater possible hazard. When able stop and re-seat passenger

If low visibility use SMGCS if published for RVR 1200 to 600. Below 600 RVR SMGCS is REQUIRED to taxi.

Operations will cease when:

- Dry snow up to 2 inches
  - Wet snow/slush/standing water – up to ¼ inch
- (note: operations may continue with up to ½ inch with dispatch concurrence)

Nil Braking action:

Do not operate on any part of airport that has NIL braking action report unless by Non-US Airways pilot. Then only with concurrence of dispatcher and:

- Greater than 8,000 ft. runway
- Crosswind not over 15 kts.
- Captain not on high mins.

## STANDARD TAKEOFF MINIMUMS

1 statute mile or RVR 5000

*Note:* If published Takeoff minimums are higher than standard you must use the higher published minimums.

## LOWER THAN STANDARD TAKEOFF MINIMUMS

Chart lists required RVR's for Domestic and Canada. This information is normally available on Jepp charts for airport and in QRH OPS DATA. Also, note required lighting and runway markings for specified RVR.

*Note:* Captain must always make takeoff if less than 1600 RVR or ¼ mi.

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Takeoff Alternate

Declare a takeoff alternate anytime weather conditions at the departure airport are below CAT I landing minimum. Takeoff alternate must be within 1 hr. from departure airport with one-engine inoperative. For planning purposes use:

Type Aircraft	Ave. KIAS	Distance NM	Fuel Flow lbs./hr.	Assumed Altitude
A319	320	373	6,900	11,000
A320	320	368	6,900	10,000
A321	320	373	8,200	11,000

Headsets / Boom Mikes

Headsets and Boom Mikes must be worn below 18,000 ft.

Oxygen

When one pilot leaves their station the remaining pilot must wear an oxygen mask when above FL250.

**MAX HOLDING SPEEDS AND LEG TIMING**

Through 6000 ft.	200 KIAS, 1 min.
Above 6,000 through 14,000 ft.	230 KIAS (210 KIAS where published), 1 min.
Above 14,000 ft.	265 KIAS, 1 min. and 30 secs.

**DESTINATION WEATHER**

Destination weather must be at or above the lowest authorized landing minima, compatible with aircraft type, at ETA. In addition, apply 15% additional runway if destination airfield is forecast to be wet or slippery at ETA.

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### Alternates

Alternate weather minima (AWM) apply for both destination and takeoff alternates. Minima is based on straight in precision or non-precision approaches. For airports with at least two appropriate approaches the approaches must be to separate, suitable runways.

*Note:* IFR alternate weather minima are restrictive for dispatch (filing) purposes. Once committed to an alternate airport, standard approach minima apply.

Facility	Ceiling	Visibility
1 nav aid	CAT I HAT + 400 ft.	CAT I visibility min. + 1 sm
2 or more nav aids	CAT I HAT of highest of the two approaches +200 ft.	CAT I vis. mins. to highest app. mins. + 1/2 sm
CAT II/III with 2 or more nav aids (note: single engine CAT II/III required)	CAT II 300 ft. HAT	RVR 400
	CAT III 200 ft. HAT	RVR1800

Alternate is required unless weather for destination at ETA  $\pm$  1hr. is at least:

- Ceiling: 2000 ft. above airport elevation
- Visibility: 3 sm.

Alternate weather must meet or exceed AWM for the planned approach at the ETA. A second alternate will be filed if weather at both the destination and first alternate is "marginal".

### MEDICAL DIVERSIONS

Captain must contact MedLink prior to diverting. Flight Attendants can initiate call to MedLink by calling on GTE Airfone with \*872 (\*USA). Pilot can use phone patch to (602) 239-3627.

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### AUTHORIZED INSTRUMENT APPROACHES

ILS, ILS/DME, LDA w/ glideslope, LDA DME w/ glideslope, ASR, RNAV

#### CAT I/II/III OPS

CAT I

CAT II

CAT IIIA Fail-Passive, employs decision height (DH)

CAT IIIA Fail-Operational, employs an alert height (AH)

CAT IIIB Fail-Operational, employs an alert height (AH)

#### Approach Minima

Approach/ Min. Alt.	TDZ Req. Vis.	MID	RO
Circling/ Pub. MDA	3 sm visibility, min. ceiling 1000' 1000' HAA or MDA whichever is higher		
Non-precision/ Pub. MDA/DA	RC 2400 – ½	A May sub if TDZ is inop	A
CAT I RNAV / Pub. MDA/DA	RC 2400 – ½	A May sub if TDZ is inop	A
CAT I ILS/ Pub. DA	RC 1800 – ½	A May sub if TDZ is inop	A
CAT II / 100' DH	RC 1600	A	A
CAT II / 100' DH	RC 1200	A May sub if RO is inop	RA
Canadian CAT II / 100' DH	RC 1200	RC 700	
CAT IIIA / 50' DH (single) 100' AH (dual)	RC 700	RC 700	RA
CAT IIIB / 100' AH (dual)	RC 600	RC 600	RA
CAT IIIB / 100' AH (dual)	RC 300 <i>Note: 1 RVR</i>	RC 300 <i>may be</i>	RC 300 <i>temp. inop.</i>

C = controlling, R = required, A = advisory

Use CAT C for straight in approaches (A321 CAT D), CAT C for circling unless app. speed is greater than 140 KIAS, then use CAT D (FOM 5.10.2)

Amended Release

A release must be amended or re-released when:

- 6 hrs. passes from ETD without aircraft proceeding under its own power (International only).
- a change is made in-

T.O. MIN FUEL, DECREASE IN GATE RELEASE FUEL, DESTINATION (REQUIRES RE-RELEASE), ALTERNATE, NEW AIRCRAFT, MEL/CDL, REMARKS

- Flight takes off and returns to airport of departure (except when part of original release)

Definition of Dispatch

Aircraft pushed back, taxied or towed from blocks for purposes of flight. See table in FOM for dealing with MX discrepancies after dispatch.

Weather Below Minimums)

You may not begin an approach (pass the FAF) with out reported visibility (RVR) at or above the minimum visibility for that approach. If you are already on the final approach segment and visibility is reported less than required for that approach, you may continue the approach but you may not go below landing minimums unless the visibility is reported at or above the required minimum visibility.

F/A Emergency Notification – TEST Questions

- T – how much Time
- E – type of Emergency
- S – brace Signal
- T – Take special instructions

Least Risk Bomb Location

LRBL is center of RH aft door

Takeoff Performance System

The TPS departure plan is highly recommended but NOT required for departure. The TPS contains airport performance data and will help the crew in determining what power and flap configurations will be needed for departure. As long as a valid W&B message for the correct runway is received the TPS is not needed.

If the W&B is sent with proper weights but not the correct needed runway the pilot may use the TPS data for the needed runway assuming that the actual W&B takeoff weight is at or less than the TPS data. PTOW stands for Planned Takeoff Weight and ATOW for Assumed Takeoff Weight (2000 lbs. difference).

ATC Clearance

Request clearance no earlier than 20 mins. prior to departure time.

Departure clearance is good for 2 hrs. past scheduled departure time.

Call Clearance Control to extend valid clearance time if necessary.

If ATC changes the routing from what is filed the changed routing is shown as:

\*\*\*\*\*REVISED SEGMENT\*\*\*\*\*

on the PDC printout. The revised segment is what should be programmed into the FMGC.

High Min Capt.

*Note:* Notify dispatcher of High Mins. status if High Mins. will affect operations.

**High Mins. CAT I limits:**

- During first 100 hrs. as Capt. PIC (does not include IOE time) use table on FOM 4-78 illustrating exemption 5549 to determine status

**High Mins. CAT II/III limits:**

- 100 hrs. PIC in A320/319/321
  - No CAT III
  - For CAT II - Use table illustrating exemption 5549 to determine status

Low Time F/O

*Note:* Notify Captain at beginning of trip, low time F/O may fly a “monitored” CAT II/III approach.

During F/O’s first 100 hrs. (including IOE) Captain must make the takeoff or landing if:

- Contaminated runway
- RVR less than 4000 or  $\frac{3}{4}$  mile vis or less
- Braking action less than GOOD
- Crosswind exceeds 15 knots
- Special Qualification Airport
- Windshear
- Always at Captains Discretion

*Note:* Captain must always make takeoff if less than 1600 RVR or  $\frac{1}{4}$  mi. visibility

Pairing Limitations

US Airways will not pair two pilots together who individually have less than 75 hrs. in type and position.

Consolidation of Learning

Pilot must accumulate 100 hrs. in type and position (including IOE) within 120 days of Type Rating or Proficiency Check. May be extended to 150 with Line Check.

**Cockpit Door:** *(it isn’t FOM material but I couldn’t find anywhere else to put it)*  
*(insert key with teeth down)*

to unlock from outside cockpit door:      turn key left  
to lock from outside cockpit door:        turn key right

to unlock from inside cockpit door:        push lock down to show green  
to lock from inside cockpit door:        push lock up to show red

## **LOGBOOK STUFF**

Ensure that yellow page has been removed for any item signed off by mechanic. White page stays in logbook.

Full power takeoffs must be logged every 30 days or 150 takeoffs. The pilot will be notified in the release paperwork if a maximum thrust takeoff is required by the phrase "MAX THRUST DEMO REQUIRED" on the TPS departure plan. The result (successful, unsuccessful or not attempted) must be noted in the logbook.

Pilot **MUST** make logbook entry for MEL items if FR is noted for Follow up Required. (PH 11.5.5) If M notation then Maintenance will complete required actions and if O notation flight crew will complete required Operational items.

CAT II/III Recertification – see FOM 11.7

ADIRS accuracy – (PH 3.16) this check is done by Captain on every Parking Checklist, to be done within two minutes of aircraft stop. Use chart on PH 3.16 to determine acceptable limits. OK if 5 miles and 15 knots or less in all cases. Use Data Key, Position Monitor to determine NAV accuracy. If ground speed on ND's & IRU 3 TK/GS exceeds 15 knots, enter logbook entry for maintenance to track and verify, if exceeds 21 knots enter logbook entry for IRU removal.

Hot Brakes – (PH3.15) Maintenance action is required if there is:

- 150° C difference in brake temps on the same strut *and* one brake 600° or greater *or* 60° or less
- a mean 200° C difference between different trucks
- fuse plug melted
- brake temp exceeds 900°

Any higher inspection will take the place of a Daily check.

see FOM 11. 3 for full list of logbook requirements

**A319 / 320 / 321**  
AOM

**Line Fixes**

NOTE: on ground Flight Crew can reset any computer EXCEPT (PH 3b.2.1):

- ECU (engine control unit) and/or EIU (engine interface unit) while engine is running.
- BSCU (Brake Steering Control Unit) while taxiing, set parking brake first

**To reset CB in air check chart listed in PH 3b.2.1**

① *Airbus Gotcha'*: Never pull the following CB's in air:

- SFCC (Slat/Flap Control Computer)
- ECU and/or EIU

**Reset MCDU / FMGC**

- Captains – on overhead panel – MCDU – CB# B1, FMGC – CB# B2
- F/O's – behind F/O – MCDU – CB# N20, FMGC – CB# M17

① *Airbus Gotcha'*: only reset one FMGC at a time in the air

**Reverser unlocked message on engine start**

1. Engine Master OFF
2. Reset Engine Mode selector to NORM for 10 secs., then IGN/START  
If this doesn't work then:
3. Turn on ENG FADEC GRND PWR on overhead maintenance panel, then off

**GPS Primary Lost showing on both ND's after IRU's align**

If the GPS signal is not available after the IRU's align a possible fix is:

1. Data Key
2. Position Monitor
3. SEL NAVAIDS
4. DESELECT \*GPS showing (if SELECT \*GPS is showing press LSK to change it)  
this line shows what WILL BE selected.

**Printer "spewing" maintenance codes after shutdown**

- MCDU Menu
- AIDS
- Programming
- Password SFIM
- Report Inhibit
- Print NO (green)

*Note: when changing printer paper roll make sure that the printer latch is completely secured or printer will not function. Press SLEW to check.*

**No Water Pressure**

If water has been serviced and there is no water pressure on ground (with APU bleed on) then check the F/A CIDS panel. If red SYSTEM INOP light is on then press the WTR SYSTEM DEPPE button.

**No data showing on RADNAV page (after GNADIRS is aligned)**

Make sure that the STBY NAV guarded NAV pb is not on (green light off).

**CREDITS and COPYRIGHT**

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