Embraer EMB190
Christoph Regli, 20.02.2024

Disclaimer

This summary contains information about the Embraer E190-100LR (E1) and E190-300 (E2) / E195-400 (E2) models operated by Helvetic Airways in a very condensed form. Its purpose is by no means to replace official airplane manuals or approved training or operational documentation. It is solely a private compilation of information and hints earned in different training, refresher and instruction situations, and flight duties. Please note that no distinction is made between information that is mandatory to adhere to, and other information that is more facultative and thus not compulsory to be followed.

There are different OM-B operator manuals for the E1 and E2 variants, the references differ, and it cannot be guaranteed that all distinctions are properly marked. Priority is given to E2 documents.

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TECHNICAL

14-01 **Structural Limitations**	14-02 **AMS**	14-03 **Autopilot**	14-04 **APU**	14-05 **ELEC**
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OPERATIONAL

Planning on GND	**Planning** inflight	**Fuel**	**M&B**	**Performance**	**Airports Runways**
Dispatch ATL MEL	**RVSM**	**PBN**	**CPDLC**	**Ops Notes**	**CRM**
GND Servicing	**Cold WX**	**T/O**	**APP**	**Low VIS**	**Visual**
Circling	**Stabilization Gate**	**G/A**	**Use of Automation**	**Expanded CL**	**FTL**

ABNORMAL

Abnormal Procedures	**Recall Items**	**QAC QRH**	**ENG Failure**	**Fire**	**Rejected T/O**
EGPWS	**TCAS**	**Upset**	**Unreliable A/S**	**ELEC**	**HYD**
Diversion	**Low Fuel**	**Driftdown**	**EMG Descent**	**EVAC**	**PAX**

1. TECHNICAL

14-01 AIRPLANE GENERAL DESCRIPTION

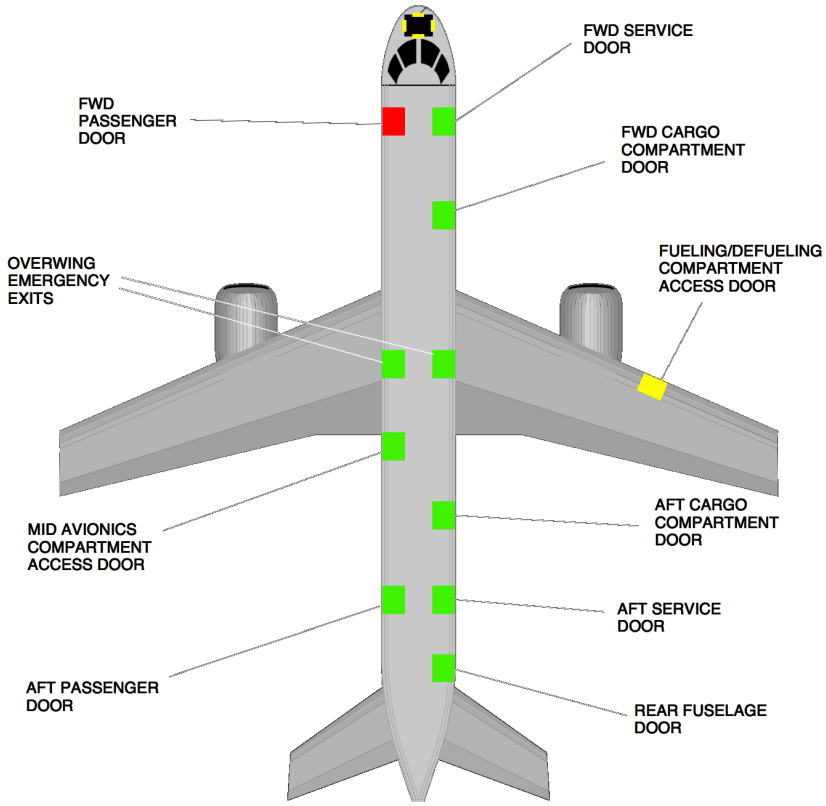
Variants	OM-B 2A1.8	**Briefing Part 4**: **Tail number**, system diff, limitations, procedures		
		E190-E1 (190LR)	E190-E2	E195-E2
		JVM - JVP (ex Niki)	AZA - AZH	AZI - AZL
	ICAO designator	E190	E290	E295
	ENG	CF34-10E5A1	PW1919G	PW1921G
	PAX	**112**	**110**	**134**
	Range	2'450NM	2'850NM	2'590NM
Structural Limits	MRM	**50'460**kg	54'200kg	61'700kg
	MTOM	**50'300**kg	**54'000**kg	61'500kg
	MLM	**43'000**kg	**49'050kg**	**54'000kg**
	MZFM	**40'800**kg	**46'700**kg	**51'850**kg
	Fwd cargo	1'850kg	1'590kg	2'375kg
	Aft cargo	1'650kg	1'910kg	2'555kg
Dimensions	Wingspan	28.72m	33.72m	35.12m
	Length	36.24m	36.33m	41.60m
	Height	10.57m	10.72m	10.77m
	Turn radius (lim)	**21.4**m (by tail)	**20.72**m (by wing tip)	**22.44**m (by tail)

	ENG clearance	0.51m	
	NLG to MLG	13.83m	(center to center)
	MLG width	**5.94**m	(center to center; wheel base)

Limitations	Speeds	M_{MO}	**0.82**
		v_{MO}	**300**kts ≤ FL80, **320**kts > FL100
		v_{RA} / M_{RA}	**250**kts < FL100, **270**kts / M **0.76** > FL100 (turbulent air penetration)
	Altitude	Max operating	**41'000**ft
	Load	F0	-1 .. 2.5g
		Any flaps	0 .. 2g
	TEMP	GND	-54 .. +52°C
		FL410	-70 .. -21.5°C

Doors

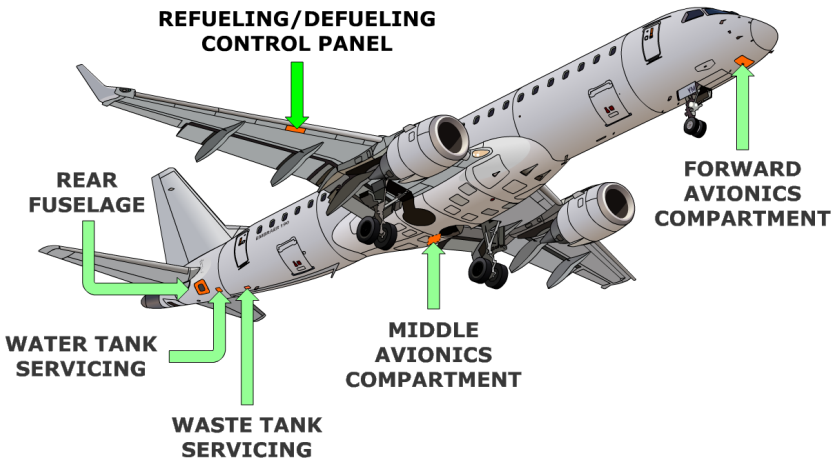
Layout:



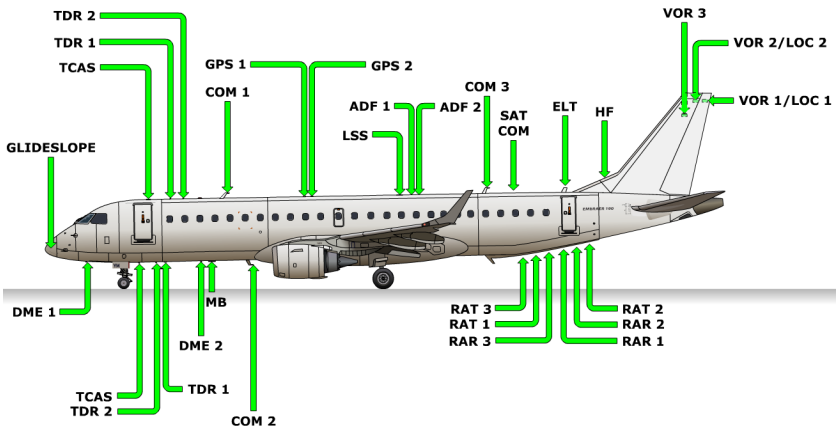
Passenger	2, LH, **vent flap** (no A/C pressurization > **0.5**psi if not closed), w/slides		
Service	2, RH, **vent flap** (no A/C pressurization > **0.5**psi if not closed), w/slides		
	WND limitation	**65**kts	
Operation	**Vent flap** lever, main lever, arming lever		
	All smaller handles up to disarm slide		
	Slides automatically disarmed if opened from outside		
	Close vent flaps overnight or if precipitation		
Indication	in cockpit:	E1	**Green** if **vent flap** closed
		E2	**Green** if **door** closed
Emergency	Type III, closable from inside only. Set **flaps 5**		

	E190	E195
Over-wing exits	2	4
Row(s)	**11**	**15/16**
Slides	No	Yes

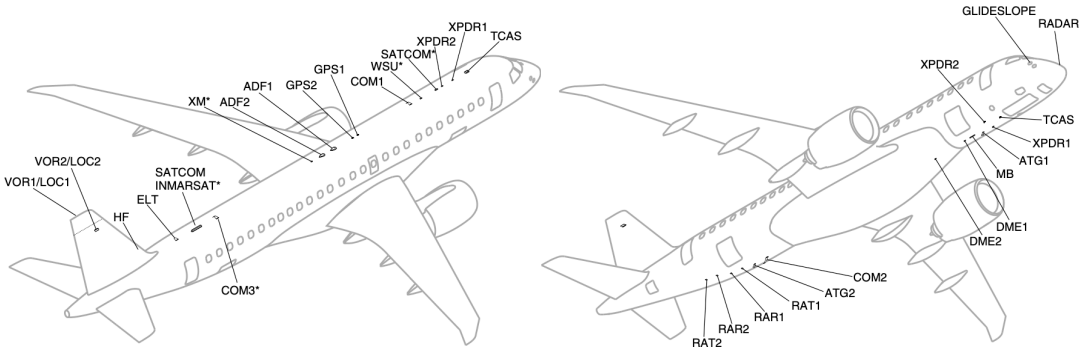
	Cockpit windows	Direct view windows can be used as **EMG exits**
	Limitation	Max SPD with open direct vision window: **160**KIAS
	Cockpit door	**INHIBIT** for 500sec, has to be pressed **within 30sec** after **EMERG ENTRY** on cabin panel If INHIBIT fails, the security lever locks the override switch, prevents door opening for 30sec LOCK to deactivate door latch, reset buzzer and EMERG ENTRY and green light on cabin panel
Cargo Compartments		Class C. Fire detection and extinguishing system
	Doors	Upper hinge and four lower locking hooks **Vent flap** (no pressurization > **0.5**psi if door not closed) **WND limitations** **60**kts open and locked **40**kts any intermediate position
	Forward	**Ventilation** (life animals or dry ice), 6 lights, 1 loading light Also refer to AOM 8-80
	Aft	5 lights, 1 loading light
Access Hatches		Layout:



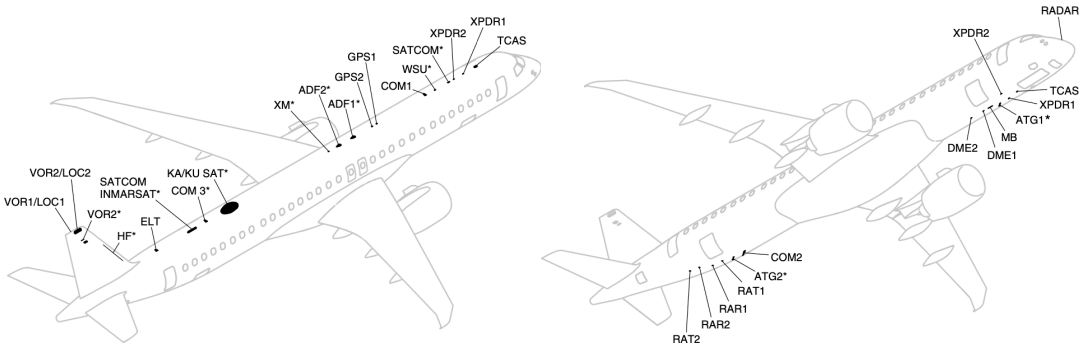
Antenna Layout E1



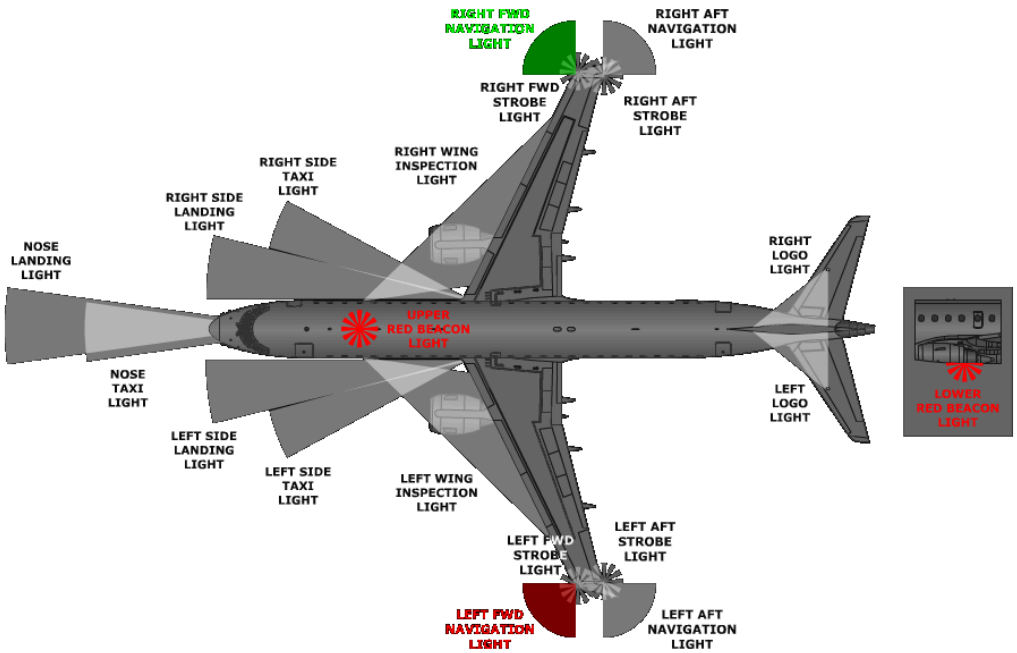
E190-E2



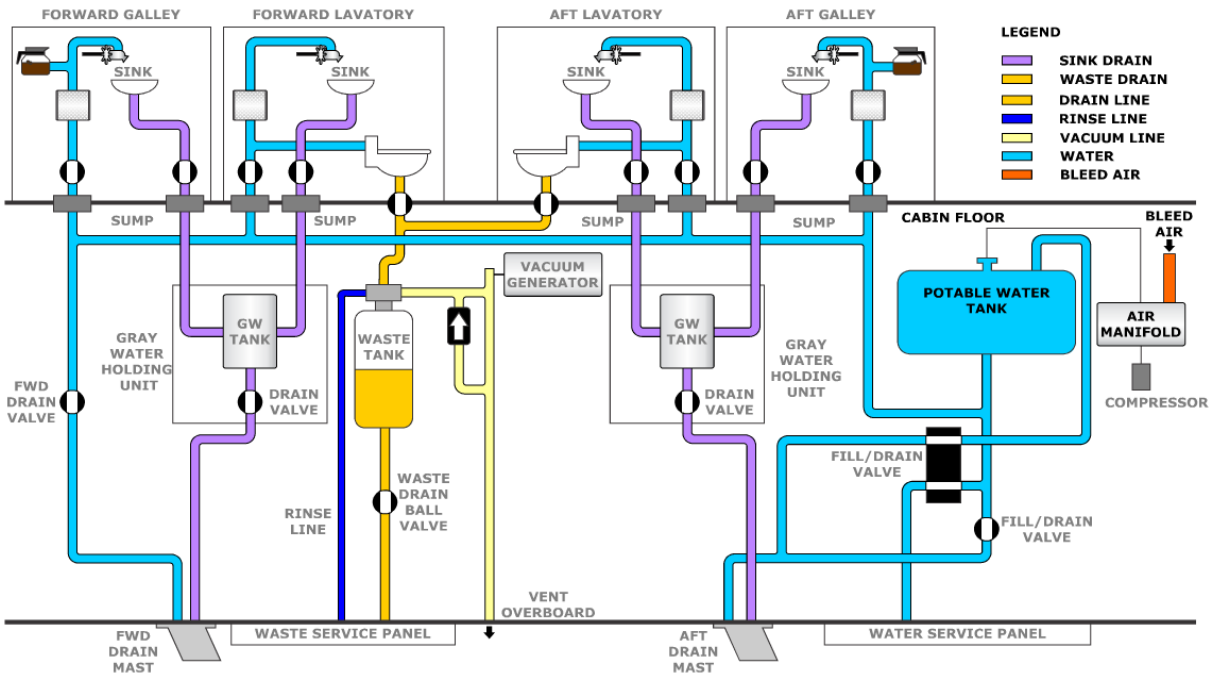
E195-E2



Exterior Lighting	Nose LDG light	RH. **AC GND SVC bus**. Illuminates only if **gear down**
	LDG lights	2. **AC bus 1/2**
	Nose taxi light	LH. **AC GND SVC bus.** Illuminates only if **gear down** Goes off during T/O (heat/VIB)
	Taxi lights	2. **AC bus 1/2**
	NAV lights	4 x 2 (PRI, STBY on separate SRC; ALL selectable on maintenance panel)
	ACL	4, together with the white NAV lights
	Over-wing EMG	3 near each over-wing EMG exit



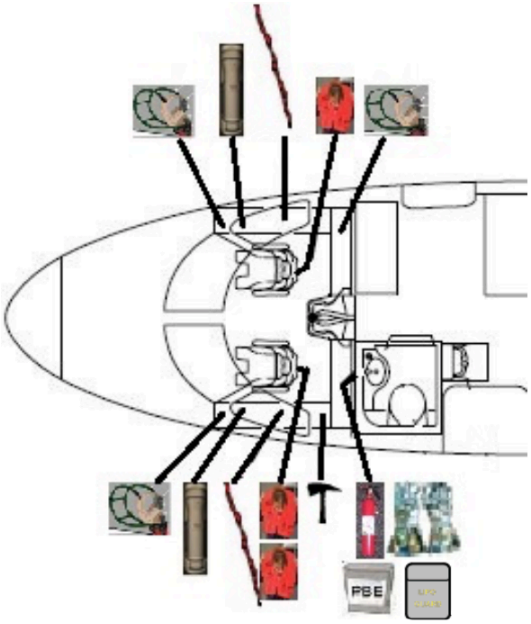
Interior Lighting	Cockpit	Chart (2), reading (3), dome (2, on **DC ESS bus 3**), flood/storm (2), integral (main, OVHP, pedestal) OVHP knob OFF: **Maximum intensity**		
	Cabin	Cabin (ceiling, sidewall), signs, reading, F/A call (2), **courtesy and stairway** (5; AUTO: PAX door; **RESET**: **5**min, HOT BATT bus 1), lavatory (2; ceiling, sidewall, on if occupied), galley (fwd, aft)		
		Rainbow light	Amber	Sterile cockpit (ENG start - FL100; FL100 - ENG shutdown)
			Flashing green	Cockpit call
			Flashing red	Cockpit EMG call
			Blue	PSU call
			Orange	LAV call
			Flashing orange	LAV smoke
		TEST	Reading, LAV, occupied, rainbow	
		PAX signs	Both come on if masks are deployed	
			NO SMKG	On PSU
			FSTN BELTS	On PSU and in LAV
		EMG EXT	2x3 ext, escape slides	
		EMG INT	OVHP cockpit, 6 EXIT locator/marker/identifier, flood (4+8) 6 ELPU, **10**min, charged by **DC bus 1** On if no power on DC bus 1 F/A panel overrides EMER LT ARMED TEST: EMER LT on for 1min **Photoluminescent** strips; red dots: end of way, Expose for 10-30min, **7**h luminescence	
		E2 EMG light SYS	INT/EXT, **ELS always to ARM**	
Cockpit	Lat/vert seat adj	Adjustment motors on DC ESS bus 3, mechanical backup		
	Rudder pedal	Adjustment motors on DC bus 2, **no** mechanical **backup**		
Cabin		"Double bubble". Ceiling 2m		
	Galleys	3 (2 fwd, 1 aft). 1 fwd oven, 1 aft oven		
	Lavatories	2, with integrated fire extinguisher		
	Water	Central tank for potable water (AOM 13-50; **drain** on N/S if < 0°C)		
		E1	Water quantity indication only on **aft FAP**; capacity **90**l	
		E2	Level indication on both **fwd and aft FAP**	
		Pressure for water tank via **bleed air**		
		WATER DUMP:	2 heated drain masts; inhibited if gear down or low drain TEMP	



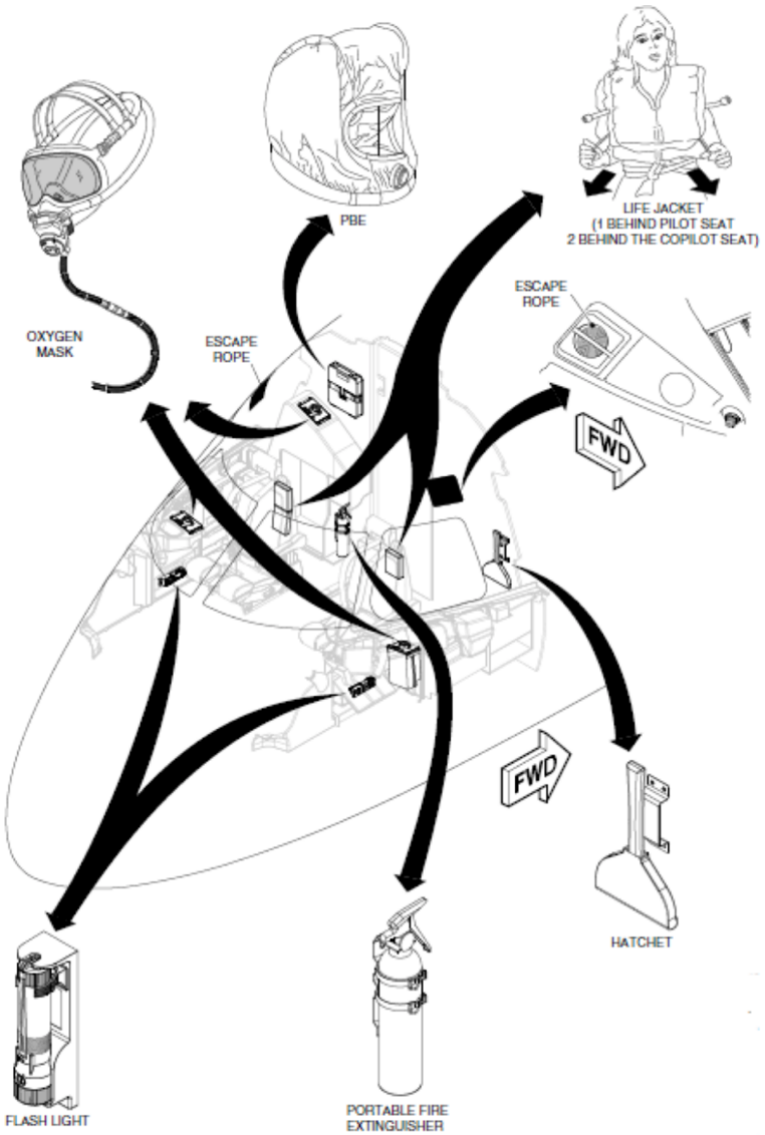
(OAW: no compressor)

	Waste	Waste tank, vacuum generator, service panel drain valve. Capacity **95**l
Emergency EQ	Cabin	CSPM 5 E1.3.1 / 5 E2.3.1 2 first aid kits, 1 EMG medical kit, **3 red crew life vests** (E1-B: **4**), yellow PAX life vests/5 spare/20 infant, 20 infant belts, 2 demo kits, 2 megaphones, 6 first aid OXY masks, **3 EMG flashlights** (F/A J/S) (E1-B: 4), 3 first aid OXY bottles 310l (E2: only 2), 3 fire extinguisher, 3 PBEs (check green/blue indicator), 1 dangerous goods kit, 3 pairs of gloves, 3 EMG/medical CL (E1-B: 4), **3 manual deploy tools** (to **open PSU** OXY) (E1-B: 4), 1 portable ELT, 5 spare seatbelts, 1 LIPO bag, **AED** (fwd; **X**: **Reset** BATT), [2 life rafts (fwd, aft; **10**min EMG light)]
	Cockpit	2 escape ropes, 3 red crew life vests (2 behind LSP), 3 crew OXY masks, 2 flashlights (check LED), 1 **halon fire extinguisher** (behind LSP; effective on fuel/oil/ELEC fires, displaces OXY, 10sec discharge; use **OXY masks** on **100**%, ventilate cockpit), 1 **PBE** (behind RSP; against smoke/toxic gases), 1 pair of gloves, 1 **fire axe** (behind LSP; for windshield), 1 LIPO bag

E1 CSPM 5 E1.3.3

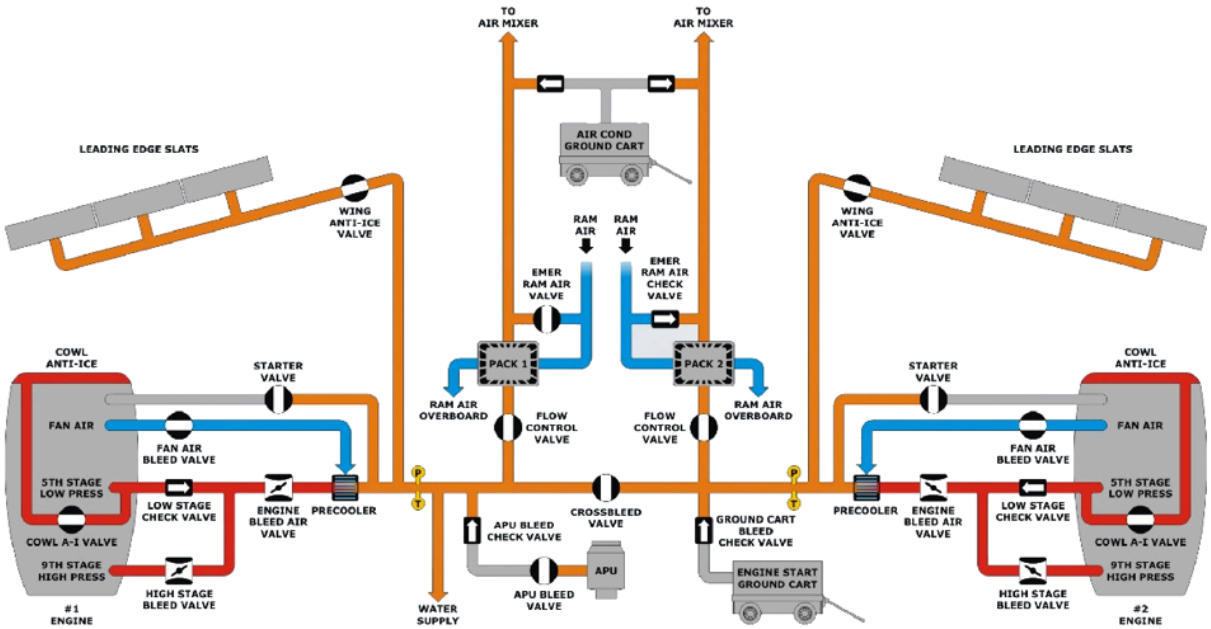


E2 CSPM 5 E2.3.3



14-02 AIR MANAGEMENT SYSTEM

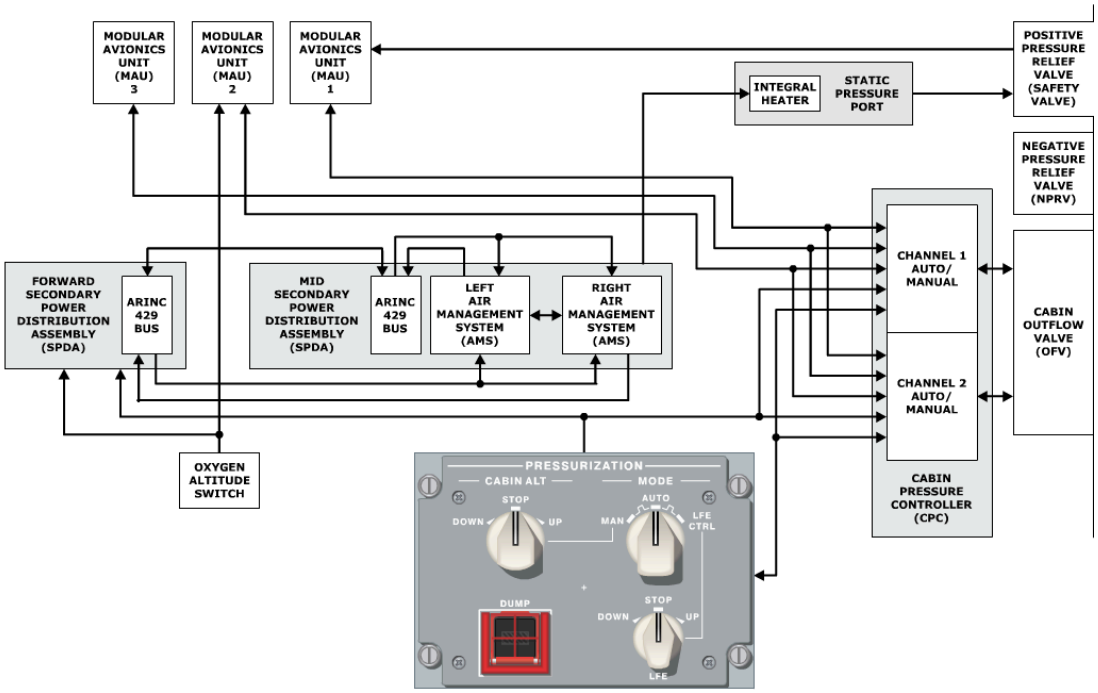
Air Management System		Bleed air ctrl, A/C control, hot air leak detection, crew OXY monitoring, wing A/I protection, ENG A/I protection, smoke detector fault detection, smoke detector isolation
	Components	**Pneumatic** SYS, **ECS**. 2 channels, both able to control the entire A/C SYS
	E2	Smart ECS (performance depending on number of PAX)
Pneumatic System	Purpose	Supplies high TEMP/high PRESS bleed air
	Architecture	LH / RH side, cross bleed valve (electrically controlled, pneumatically operated)



Consumers		ENG starting, wing / ENG A/I protection, ECS, **water** PRESS
Sources	**ENG**	LP / **5**th compressor stage, HP / **9**th compressor stage **alternately**
		LP to ENG cowl A/I and to check valve
		LP valve is always open; **HP** valve is pneumatically modulated according to PRESS sensor / required PRESS
		ENG bleed valve, ELEC controlled, pneumatically operated
		Low PWR settings HP valve is modulated according PRESS
		High PWR settings ENG bleed valve is modulated
		Pre-coolers Air-to-air heat exchanger, air from fan (if valve open, mostly on GND) or by ambient air from ram air inlet check valve, controlled by AMS
		AUTO mode **ENG** running, **no fire** in associated ENG, **no bleed leaks**
	APU	**LH** side. Primarily for A/C and ENG start. **Not for A/I**. **Check valve**
		AUTO mode APU bleed air **available**, no **bleed leaks** in APU or left bleed duct, ENG 1 bleed air **not available** (would have priority), A/I **not operating/failed**
	GND	External high PRESS GND cart. **RH** side. Primarily for ENG start
		Port on lower section of fairing. **Check valve**
Crossbleed valve		**AUTO** mode: Bleed source availability, MCDU T/O data, A/I requirements, phase of flight
		Normally closed; **open** if one side PRESS / other side no bleed air; ENG 2 start selected inflight; ENG 1 start selected inflight with APU bleed off
		2min after LDG, LH then RH AMS controller channel tests crossbleed

AMS controller	2 channels (LH und RH side), redundant Inputs: ENG/APU status, system demands, faults, manifold PRESS, valve POS, overheat leak detection, A/C pneumatic control panel	
Prio	On **GND**, only **one ENG and APU** running, PRIO is given to **APU** bleed air if crossbleed valve operates, opposite ENG bleed PRESS is below MIN for ENG start, < **50**kts, A/I not requested	
	Inflight start of ENG 1	If no wing A/I, ENG 2 bleed is used if avail
	Inflight start of ENG 2	ENG 1 or APU bleed is used
Overheat detect	**Leaks** and **overheat** conditions, **monitors 6 zones** on the aircraft (L/R A/I [**slat**], L/R air supply [bleed SYS / A/C], optional trim SYS [trim PRESS duct],APU [duct]) w/overheat sensor loops (dual redundant; salt filled, ELEC; overheat indication if both loops trigger)	
Indications	Amber duct line	**TEMP** exceeded limit
	BLEED 1/2 LEAK MC	If > 125°C. Amber striped bar If < 80°C, cycle BLEED button
	AMS CTRL FAIL MC	Both channels failed (FAULT: only one ch)

Pressurization From fwd bulkhead to aft bulkhead

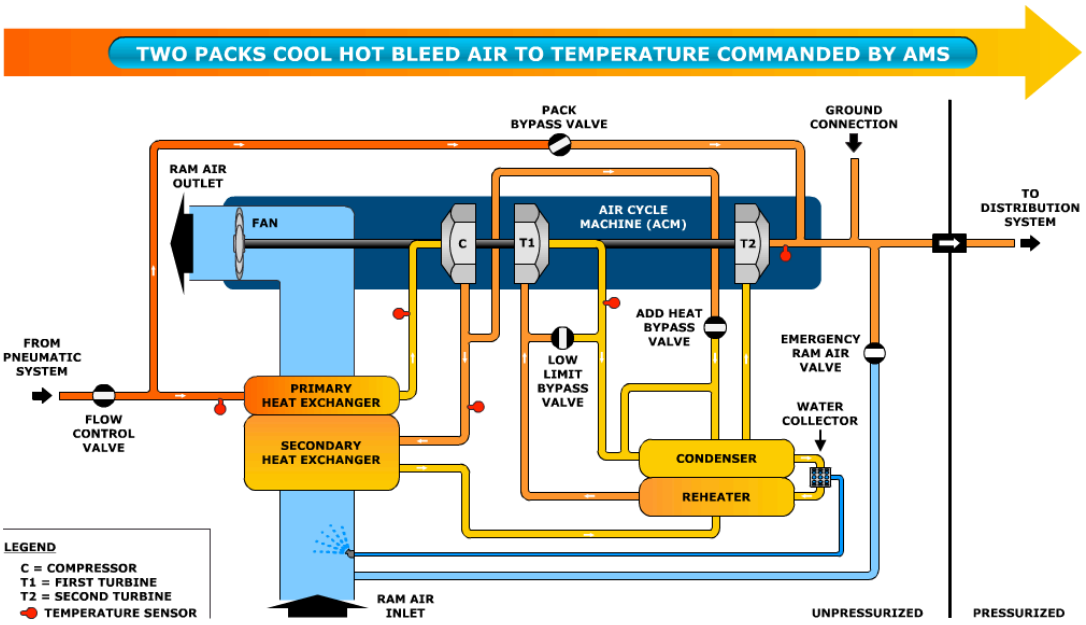


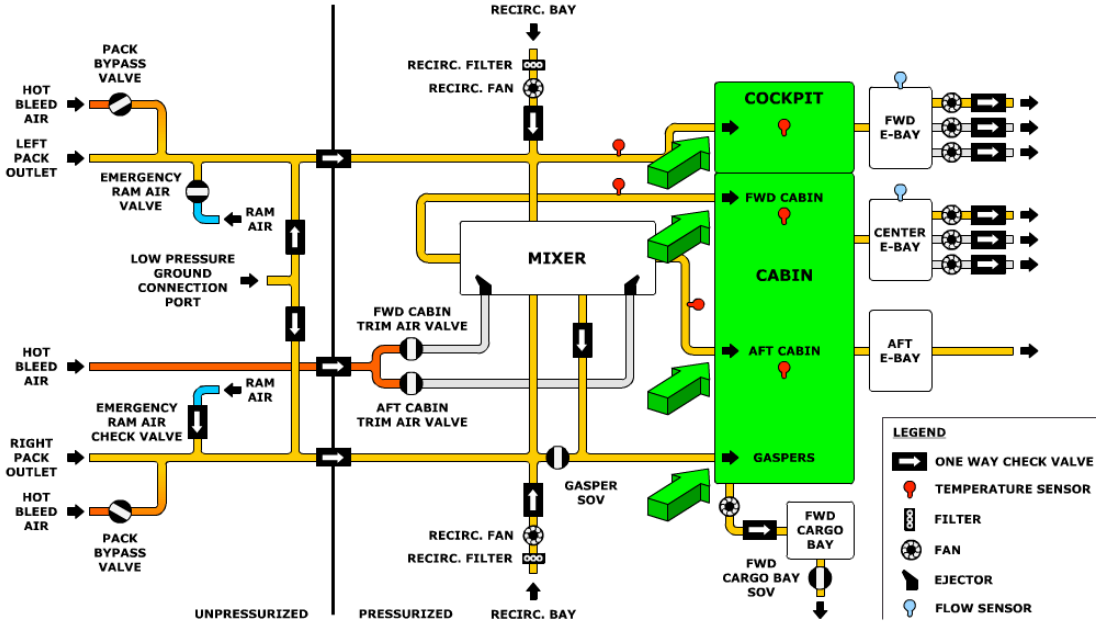
CPCS	CPC, cabin outflow valve, negative and positive PRESS relief valves, static PRESS port. ARINC 429 bus and discrete signals Inputs: ENG N2, LDG gear, FADECs, ADC, FMS (gross mass, LDG A/P ELEV)	
CPC	Fwd avionics compartment, 2 identical independent channels (1 master, 1 standby, alternating roles after each flight) Basic function: Modulates opening of OFV, AUTO or MANUAL	
OFV	Butterfly type, mounted on spar 1 of wing stub, ELEC actuator, driven by one of two DC motors (manual and automatic motor)	
Relief valves **Pos**	Positive PRESS relief valve: pneumatically-actuated, spring-loaded check valve, mounted on aft PRESS bulkhead, not controlled by CPC, responds to excessive positive differential PRESS (cabin PRESS too high). **MECH** connected to **static PRESS port** Can also act as a negative PRESS relief valve Normally closed, opens if Δp > **8.6**(6)psid, microswitch signals MAU 1 Also called "**safety valve**". Displayed on ECS synoptic page	
Neg	Negative PRESS relief valve: Mounted on aft PRESS bulkhead **Spring**/MECH. Limits negative Δp to **-0.5**psid	

AUTO mode		CPCS gets gross weight, CRZ ALT, DEST LFE (green: from FMS, cyan w/"M": from PRESS panel) Changes in CRZ ALT have to be entered in FMS If no FMS data: Ambient PRESS / default gross weight is taken		
7 modes	GND	On **GND**, **< T/O thrust**. OFV fully open	**-0.01**psid	-300 .. +500 FPM
	Taxi	Doors closed, > 60% N2	+0.11psid	-300 .. +300 FPM
	T/O	On GND, T/O thrust	**+0.15**psid	-400 .. +500 FPM
	CLB	**a**) FMS CRZ LVL available		-600 .. +750 FPM
		b) FMS CRZ LVL not available		-500 .. +750 FPM
	Abort	CLB stopped, CRZ mode not activated, PRESS ALT < 10'000ft, < T/O field ELEV	+5000ft	-600 .. +500 FPM
	CRZ	CRZ LVL reached or level-off	7.8/8.4psid	-300 .. +500 FPM
	DESC	Begin of DESC	> LFE	-750 .. -200 FPM
			< LFE	+300 .. +750 FPM
MANUAL mode		Both CPC ch stby, one ch to control OFV (**automatic** selection of ch) UP / DOWN to open / close OFV. Increments of 50ft		
DUMP cabin		OFV full open, **ECS packs** and recirculation fans disabled Can be restored **Only** works **in AUTO** mode (**2000FPM till 12'400ft**, then OFV closes)		
Indications		CABIN ALTITUDE HI MW	If ≥ **9700**ft or A/P ELEV > 9400ft / cabin ALT 500ft above	
		PRESN AUTO / MAN FAIL MC	2 channels failed	
		PRESN AUTO FAULT advisory	1 channel failed; still normally	
		Δp -0.3 .. +8.5psid, red if beyond		

Air Conditioning

Part of ECS. **ECS** is controlled by **AMS** (amongst pneum and PRESS SYS)
Normally, **pack 1** adjusts **cockpit** airflow, pack 2 adjusts cabin airflow





ACP Provide conditioned air to cockpit and cabin
Cooling hot bleed air to the duct TEMP requested by AMS; mixing pack outlet cold air and pack bypass hot air
One pack can supply all A/C and PRESS
Single pack operation: TEMP selector of that side is inoperative
One ENG can provide sufficient bleed air for both packs, via crossbleed
Dual heat exchanger, ACM, condenser and re-heater, water collector, low limit bypass valve, add heat bypass valve, TEMP sensors, RECIRC fan with thermal protection (fans will stop if both packs are off, during cabin warm-up, CGO fire, cabin PRESS DUMP, smoke in RECIRC bay)
Trim air SYS: 2 trim modulate valves, 2 ejectors, 3 dual TEMP sensors
TEMP controller: AMS commands 24°C if knob fails
AMS will close packs if no bleed air SRC, pack is selected off, associated bleed SYS duct leak, pack fault, starting of associated ENG
ECS OFF T/O with no APU bleed, packs remain off until **500**ft
(if APU on, expect pressure bump at 500ft)
FADEC may ask AMS for ECS off (depending on T/O data) ≤ **15'000**ft

- T/O: OEI and no APU bleed, TL max and no APU bleed, REF ECS OFF and no APU bleed, REF ECS OFF and REF A/I ALL. Packs **remain on** if OEI and APU bleed
- G/A: OEI and no APU bleed (≤ 9700ft), TL max and no APU bleed, TL max and wing A/I
- Recovery: TL < T/O / G/A, both ENG inoperative / A/C 500ft above T/O field ELEV, A/C above 9700ft / OEI / T/O field below 8000ft, A/C above 9700ft during OEI G/A, A/C above 15'000ft / OEI / T/O field above 8000ft

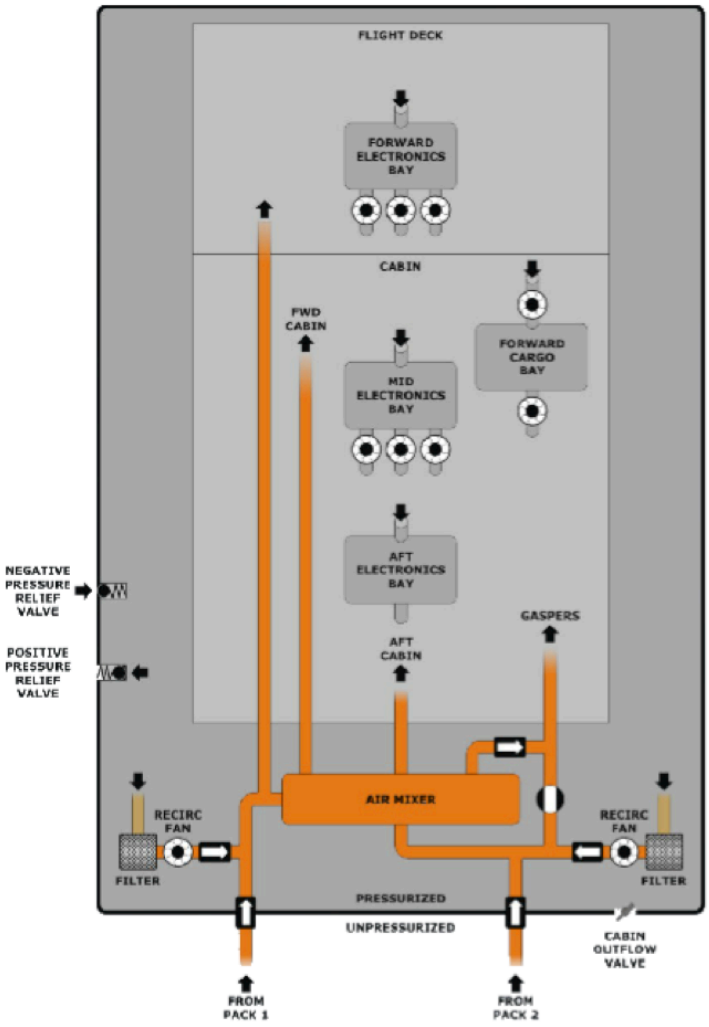
GND cart A/C GND cart for low PRESS conditioned air; directly to distribution SYS
GND connection port in the LH wing-to-fuselage fairing

Ventilation Cockpit/cabin air for vent of fwd/center/aft ELEC bays and fwd CGO

Ram air Ram air SYS for **EMG ventilation** if both **packs fail** / are turned **off** (flow control valve closed)
Open if packs are off (**smoke removal**) / failed and < **25'000**ft
EMG ram air **check valve** is **not** ctrld (no ELEC); **opens** when ram air PRESS is greater than cabin PRESS

Gasper SYS Conditioned air from mixer to pilots and PAX through eyeball outlets
From RH pack and RH RECIRC fan, gasper shutoff valve, normally closed, **opens** when gasper air supply TEMP > **35**°C

Trim air	Pack **1**	Into **cockpit** and into mixer	
	Pack **2**	Into mixer	
	Mixer	Into **cabin**, via RECIRC fan into cockpit	
	Cockpit/cabin	**52**% fresh air, 48% RECIRC air	
ELEC bays	**Fwd/center**: Cooled by air from cockpit (fwd) / cabin (center), **3** fans in parallel, fan **1 on** to cool / fans 2/3 standby		
	Aft: **No fan**; cooled by air flowing from PAX compartment		
CGO bays	**Fwd** bay is ventilated by a fan, air from the RECIRC bay (ECS)		
	Fan stops and **shutoff valve** closes if smoke has been detected		



Indications	AMS CTRL FAULT advisory	One channel failed	
	AMS CTRL FAIL MC	Both channels failed	
	FWD/CENTER E-BAY FANS FAIL MC	Fans to RECIRC bays	
	CRG FWD VENT FAIL MC	Fan failed or shutoff valve open when smoke has been detected	
	RAM AIR FAULT advisory	EMG ram air vent valve failed closed	

Limitations	Pneumatics	Single side pneumatic	**31'000**ft	1 pack inoperative (**AOM 14-02-15**)
	Pressurization	Max cabin ALT	8'000ft	
		Max Δ pressure	**7.8**psid ≤ 37'000ft	**8.4**psid above
		Max Δ overpressure	**8.77**psi	
		Positive PRESS relief valve	**8.6**psi	
		Negative PRESS relief valve	**-0.5**psi	
		Max Δ pressure for T/O / LDG	**0.2**psi	

14-03 AUTOMATIC FLIGHT

Automatic Flight Control System — FGCS, TMS
Controls PRI flight controls via A/P servos (1 aileron, 1 ELEV, 1-2 rudder)

E2 — Control via FCC
No movement of yoke/pedals (no servos); BOID fixing the yoke

Controls — Dual channel **guidance panel** (connected to FGCS), 2 quick DISC btns,

TCS — 2 buttons to temporarily disengage A/P

ALT	Maintains ALT at moment of TCS release
HDG	Returns to selected HDG
ROLL/VS/FPA	Syncs new values when released
LOC/LNAV/GS	Returns if captured

TO/GA 2 buttons

FMA — Magenta = FMS active, green = guidance panel active, white = armed, amber = alert, red = abnormal

	Col 1	Col 2	Col 3	Col 4	Col 5
	A/T modes	A/P, A/T engage status	FD SRC	FGCS lateral modes	FGCS vertical modes
Row 1 |	A/P APP status (only during APP)				
Row 2 |	Active A/T mode, A/P engage, active lat/vert mode				
Row 3 |	Armed A/T mode, A/T engage, armed lat/vert mode				

Flight Guidance Control System — A/P, FD, YD, automatic pitch trim

A/P — Single A/P, **2 channels** (active, standby, roles switched after each LDG)
Only available **inflight**. Auto disengage: Pitch trim, stick shaker, windshear warning; FBW direct mode, aileron/ELEV SYS disconnect, force on the controls, A/P monitoring failure

FD — Crossbar on T/O (pitch based), magenta diamond after T/O (energy based)
Automatically displayed when TO/GA pressed (GND or inflight), vertical or lateral mode selected, A/P engaged, windshear detected
FD on SRC side cannot be turned off

YD — "Dutch roll"; engaged when A/P engaged, can be manually engaged
Automatic engaged after power-up of either HYD SYS 1 or 3

Trim — **Automatic pitch** (horizontal stabilizer, to reduce aerodynamic forces)
When A/P engaged
Mach trim (horizontal stabilizer; "Mach tuck") when A/P off, M > 0.70, no trimming, no quick DISC button

Lat modes

ROLL — **Default**; wings LVL if bank ≤ **6**°, max **35**°
TO/GA on GND < 100kts; selecting vertical mode with no active lateral mode, deselecting active lateral mode. Deactivated when FMS CRS to intercept mode activated or different lateral mode becomes active

HDG — BANK: Max bank 17°
E1 **BANK only available in HDG** (**OEI**)
E2 As well in magenta source

LNAV — Via NAV button. After T/O max 30° bank
200ft automatically captured (FMS SRC)
Caution: ENG failure; only engage LNAV ≥ LVL off ALT during DEP

LOC/BC (LNAV mode) via APP button; automatically activates HDG, bank angle limit **35**° (LOC/BC APP: Use NAV/FPA)
Not possible to track a VOR/NDB radial, only LOC

TRACK Not pilot selectable. During T/O and G/A
Activated out of ROLL when A/S **> 100**kts and bank ≤ **3**° for > **10**sec
G/A: activated by **TO/GA button**

RLOUT, ALIGN During autoland (RLOUT: A/L 2 only)

Vert modes **Disarm ASEL** to enable setting of new vertical mode

TO **FD only**, **crossbar**, pitch attitude reference, based on flaps, mass, v_2
Activated on GND by TO/GA button
Pitch 8° .. 18°, SPD v_{Shaker}+10/3 (AEO/OEI) .. v_{FE}-5kts
Initially commands calculated pitch reference. Once airborne and > target SPD, it commands **v_2+10** (AEO) or **v_2..v_2+10** (OEI)
Replaced by FPA when A/P is engaged
If FD inoperative, fly **10**° pitch

FPA **Default** vertical mode. Green. **FPR** line is displayed. ±9.9° selectable
Use **in turbulent conditions** to avoid large pitch variations

ASEL Armed (white), captured (green), hold (ALT)

ALT Hold PRESS ALT

FLCH Selected SPD, controlled by elevator, climb/descend to selected ALT
Climb: Full throttles, descent: Idle throttles
M/IAS change at 29'000ft
Only use SPD brakes in FLCH (as VS mode increases TL)

VS -8000..6000FPM. Resolution 50/100FPM (> 1000FPM)

OVSP v_{MO}±5kts, M_{MO}±0.01. Previous vertical mode will be armed

PTH Path (including SPD reduction when passing FL100)
No **G/S intercept from above** if in PTH mode

VNAV When armed, activates when passing 400ft

- VARM Initial submode. FMS determines appr vertical mode
- VFLCH Auto by FMS (if > 1500ft / > 10NM), manually by FLCH
  Highest possible rate with given SPD; SPD_E
- **VPATH** 1°..6°, default 3°, selected manually / by FMS procedure / automatically by FMS. SPD_T, LIM if not sufficient thrust
  Missed APP ALT must be set after level off on MDA (VALT)
  DESC NOW: Initially **1000**FPM until on profile (appears 50NM before TOD)
- **VGP** For NPA using VNAV glide path submode; press APP within **30**NM from FAF, engages within 5NM. ASEL may be set to missed APP ALT when VGP engaged. ALT are compensated for **TEMP**; FLIGHT CONFIG 2/2 page

GS HDG is selected when APP is pressed

GA Initially commands **8**° ANU, then v_{REF}+20 (AEO) / v_{AC} (OEI), wings LVL
Pitch 8°..18°, SPD v_{Shaker}+10/3 (AEO/OEI) .. v_{FE}-5
TO/GA button to activate

WSHR Mode **not** selectable
Green on **PFD** if < 1500ft/AGL, A/P disengages, pitch limited to stick shaker angle, wings LVL. "Caution windshear" (increasing HWND, updrafts), warning 3x"windshear" (decreasing HWND/TWND, downdraft).
Activated if detected and **TO/GA button**, TL in TO/GA POS, FD mode T/O or G/A. A/P disconnects. RSV thrust activated, A/T to TO/GA
To exit: TL back to TO/GA POS, A/T on
Lateral mode not inhibited

T/O GND. ROLL/TO (TO/LNAV armed), **200**ft: LNAV captured

G/A TRACK / GA
TO/GA buttons: On aircraft (not on simulator): **FMS SRC** automatically

SPD SPD selection via FMS or manually (PERF INIT)
When FMS is controlling SPD: SPD protection modes "SPD reversion" and "latched SPD" (significant ΔSPD between modes)
VPATH descent too steep, FMS changes to VFLCH mode if > v_{MO}/M_{MO}+10, > v_{Gear}/v_{Flaps}+10, exceeding FMS ALT SPD constraint by > 5kts, < v_{Ref}-10

ILS Transition from FMS to ILS automatically via preview mode (**PREV**) or manually via **V/L** (E1) / **NAV** (E2) (VOR, LOC)
Auto ILS frequency and CRS selection if in FMS is PRI NAV SRC and A/C within **30**NM from DEST, PREV mode, auto-tuning enabled, **ILS**/**BC** is in active FMS FPL
APPR1 green once G/S intercepted and < 1500ft
APPR1 ONLY if RA/BARO to RA on one side
CAT II: RA/BARO to **RA**, MIN to ≥ **80**ft, NAV 1/2 on ILS, both IB CRS set, flaps 5, altimeters within limits (same settings on both sides required)
APPR 2 NOT AVAIL advisory if not this setting or a failure
APPR2 green once G/S intercepted, 800ft..1500ft and all criteria met
APPR: no autoland

A/L A/P will flare and land and remain engaged 5sec during rollout
With or without **A/T**. Dual rudder A/P servos required ("**parallel rudder**" for EO; engaging when autoland SYS engages or during G/A with A/P engaged; AUTOLAND 1 NOT AVAIL advisory otherwise)
Enabled when A/C powers up; can be **disabled** on MCDU SETUP
RA/BARO to **RA**, MIN to ≥ **50**ft

1500..800ft	ALIGN/FLARE armed
150ft	**ALIGN** captured, RLOUT armed, FLARE armed
50ft	**FLARE** captured, D-ROT armed
30ft	(**RETD** captured)
Main gear T/D	RLOUT and D-ROT captured
+**5**sec	A/P disengages

Autoland **SYS trims nose up at 800ft** (fail-passive; to prevent abrupt nose down movements should the A/P disconnect). < 50ft RA: Pitch trim is inhibited
Sim CAT III: First select CAT III. Once A/L engaged, select CAT I MIN
A/L 2: With automatic roll-out (n/a w/OAW)
E2: No trim up; different APP SPD philosophy

Thrust Management System
A/T SYS, ETTS, TLA trim function, TRS
Dual channel system (active, standby)

A/T SYS
Engages on GND if no A/T SYS failures, AT button pressed, both TL > 50°
Engages inflight if no A/T SYS failures, AT button pressed, ≥ 400ft/AGL
Disengages by AT disc button on either TL or by AT button on panel
Auto disengages after T/D, TL **> TO/GA**, REV deployed during rejected T/O, ΔTLA > 8°, SYS failure (aural alert, AT FAIL MC)

Modes
TO On GND, both TL > **50**°
HOLD Prevents undesired TL movement during T/O
Servos disengage ≥ **60**kts until **400**ft (set TL before that SPD)
SPD$_T$ SPD on thrust. FPA, VS, GS, **PATH**, GP, ALT, ASEL; or if **FD** is **off**
SPD$_E$ SPD on ELEV, fixed thrust setting. (VNAV) **FLCH**, **OVSP**
Small ΔALT SYS commands only necessary thrust to maintain predetermined schedule, based on V/S
Large ΔALT SYS commands idle for DESC and max thrust for CLB
Low SPD protection adjusting thrust to remain above MIN SPD:

> 30'000ft	F0: 2% over amber tape	> F0: 1.2v_S
≥ 20'000ft	F0: 1.2..2% over tape	> F0: 1.2v_S
< 20'000ft	F0: 1.2v_S	> F0: 1.2v_S

GA TL to TO/GA
RETD Idle during flare (**30**ft until T/D). Armed when **RA** is working, A/T engaged, LDG gear down, flaps 5 or full, RA < **150**ft
LIM A/T SYS has not sufficient authority to maintain selected SPD
SPD$_T$ OVRD when overridden by pilots. Once released, the TL will return

TLA trim function	Synchronizes N1 when A/T disengaged MCDU - TRS; defaults to ON whenever A/T is disengaged	
TRS	Determines appropriate max thrust for each phase of flight, based on A/C configuration and number of ENG. Refer to 14-06 ENGINE	

Limitations

Autopilot			E1	E2
	MEH		**400**ft	**200**ft
	MUH	CRZ, DESC	1000ft	1000ft
		APP	**50**ft	**80**ft (ILS/LPV) / **190**ft (NPA)
		Steep APP	167ft	122ft (3D) / 244ft (2D)
	T/O: LNAV autoactive		200ft	50ft
Autoland	G/S	**2.5** .. **3.25**° (E2: 3.5°)		
	RWY	Max ALT	7340ft (E1) / 7366ft (E190-E1) / 7249ft (E195-E2)	
		Max slope	-1%..1%	
		Temporarily: AZE + all E195: No A/L		

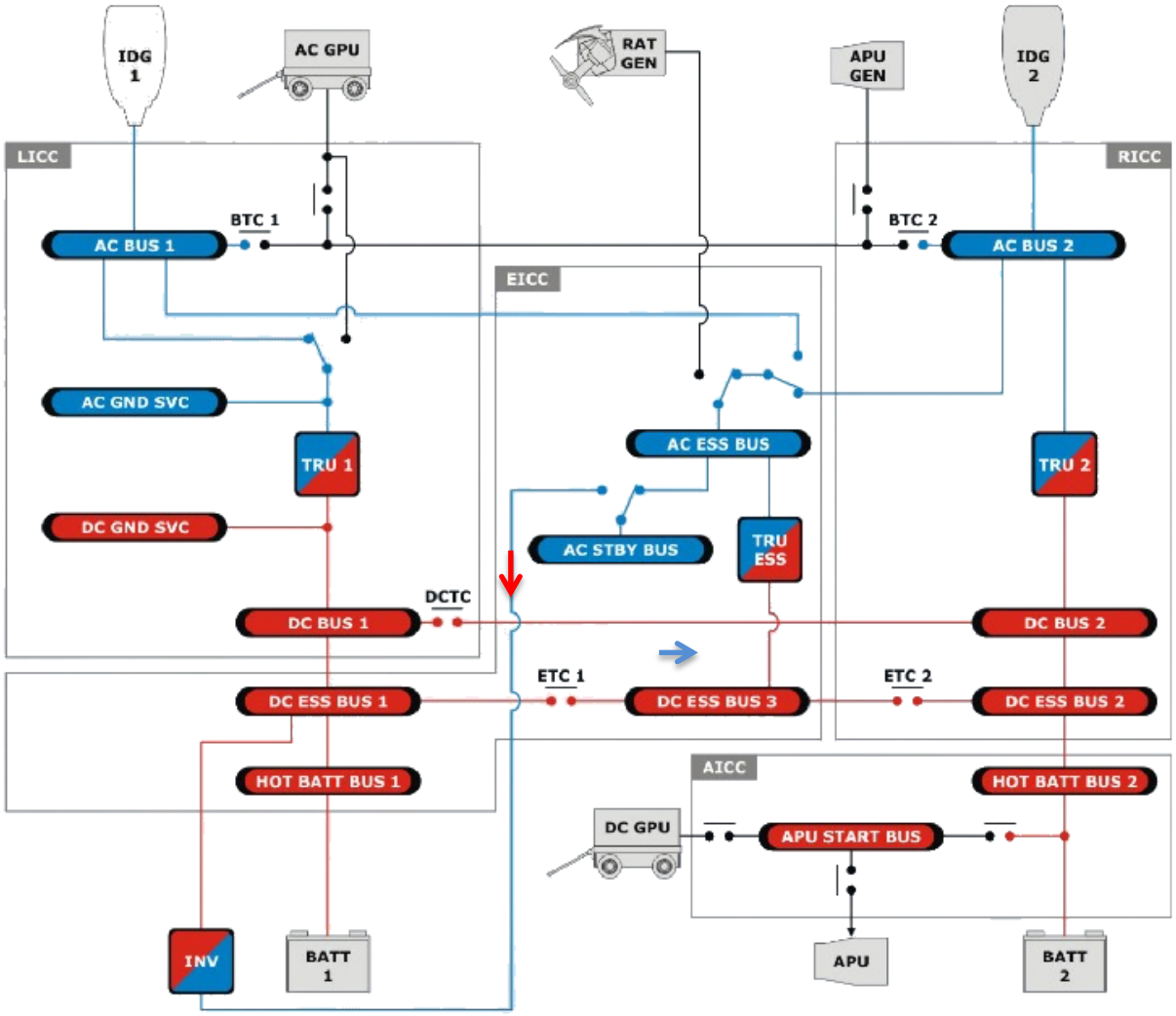
14-04 AUXILIARY POWER UNIT

Overview		Constant SPD gas turbine, single-stage compressor, combustion chamber, two-stage turbine Two access panels on bottom of compartment. Titanium firewall Upper RH of comp: Scoop for air for oil-air cooler and to cool starter Fuel from **RH fuel** tank
	E1	Hamilton Sunstrand APS2300
	E2	PW APS2600E. Air inlet door. Consumption: 90..100kg/h
	Components	Air inlet at bottom of APU compartment, FOD screen DC starter/GEN (28VDC, powers fuel module and starter controller fan; **starter** powered by **BATT 2**), IGN exciter, starter controller, 2 igniters, **12** fuel injectors, anti-surge valve (against compressor stall; closed on GND/open inflight), self-contained oil lubrication SYS in AGB, oil TEMP sensor (APU OIL HI TEMP MC if > 135°C; auto-shutdown on GND), dual oil PRESS sensor (across oil filter; APU OIL LO PRESS MC if < 35psig; auto-shutdown on GND), fuel module, **bleed valve** (closed if ENG bleed air is delivered, to prevent back flow to APU. Priority: ENG bleed air), AC GEN (115VAC **40**kVA, **no** IDG as APU modulates turbine SPD) FADEC (monitoring start/shutdown, fault detection and status)
	Starting	**Both BATT req** for start **BATT 1** powers DC **fuel pump** **BATT 2** is **disconnected**, energizes starter ctrl Wait **30**sec after EICAS energized before starting Sequence **6**% (GND) / **7**..**17**% (inflight) RPM IGN After **0.5**sec Fuel flow **50**% RPM **Starter cutoff** **3**sec after **95**% RPM **Bleed** air / **ELEC** PWR available
	Shutdown	OFF; APU SHUTTING DOWN status MSG, **bleed valve closes**, GEN goes offline, APU continues to run for cool down of **2**min, then fuel shutoff valve closes. FADEC is unpowered 2.5min after selecting OFF APU SHUTTING DOWN **message** disappears at the end of cool-down Shutdown **can be canceled** be re-selecting **ON**
	EMER STOP	White striped bar (lower half), **fuel shutoff** valve closes, **no cooling** Red striped bar (upper half) if fire has been detected
	APU FIRE EXT	Fuel shutoff valve closes, bottle discharges
	Auto-shutdown	On **GND** Overspeed, underspeed, FADEC critical failure, APU fire, high **EGT** TEMP, high oil TEMP, low oil PRESS, APU sensor failure Inflight Overspeed, underspeed, FADEC critical failure
	Indications	APU FAIL MC Auto-shutdown. Select OFF. No restart, unless this occurred during start cycle APU FAULT MC Abnormality. Auto-shutdown is inhibited inflight
	APU inop	CBs "APU FUEL SOV OPN", "ABC CMD PWR", "APU FADEC" out/locked

Limitations

Start		**No APU start during fueling**		
Starter		1st/2nd start attempt:	**60**sec on, **60**sec off	
		3rd start attempt:	60sec on, **5**min off	
RPM		≤ **108**%		
EGT	start	**1032**°C		
	continuous	**717**°C		
OAT	start	**-54** .. **+35**°C		
	continuous	acc A/C env	(-62 .. +35°C ≤ 33'000ft)	
		E1	E2	
ALT	Start	≤ **30'000**ft	≤ **39'000**ft	
	Ops, AC Pwr	≤ **33'000**ft	≤ **39'000**ft	
	Bleed air	≤ **15'000**ft	≤ **15'000**ft	for A/C
		≤ **21'000**ft	acc envelope	for ENG start

Electrical System		28V DC (blue), 115V/400Hz AC (red). **Min 22V**
		2 independent networks (L/R; DCTC, ETC)
		AC/DC pwr → ICC → **SPDA** ← MAU (computing power)
	E2	IDG - ICC - SPDA - MAU
		No AC STBY bus/inverter (E1: for ENG IGN; E2: IGN on DC)

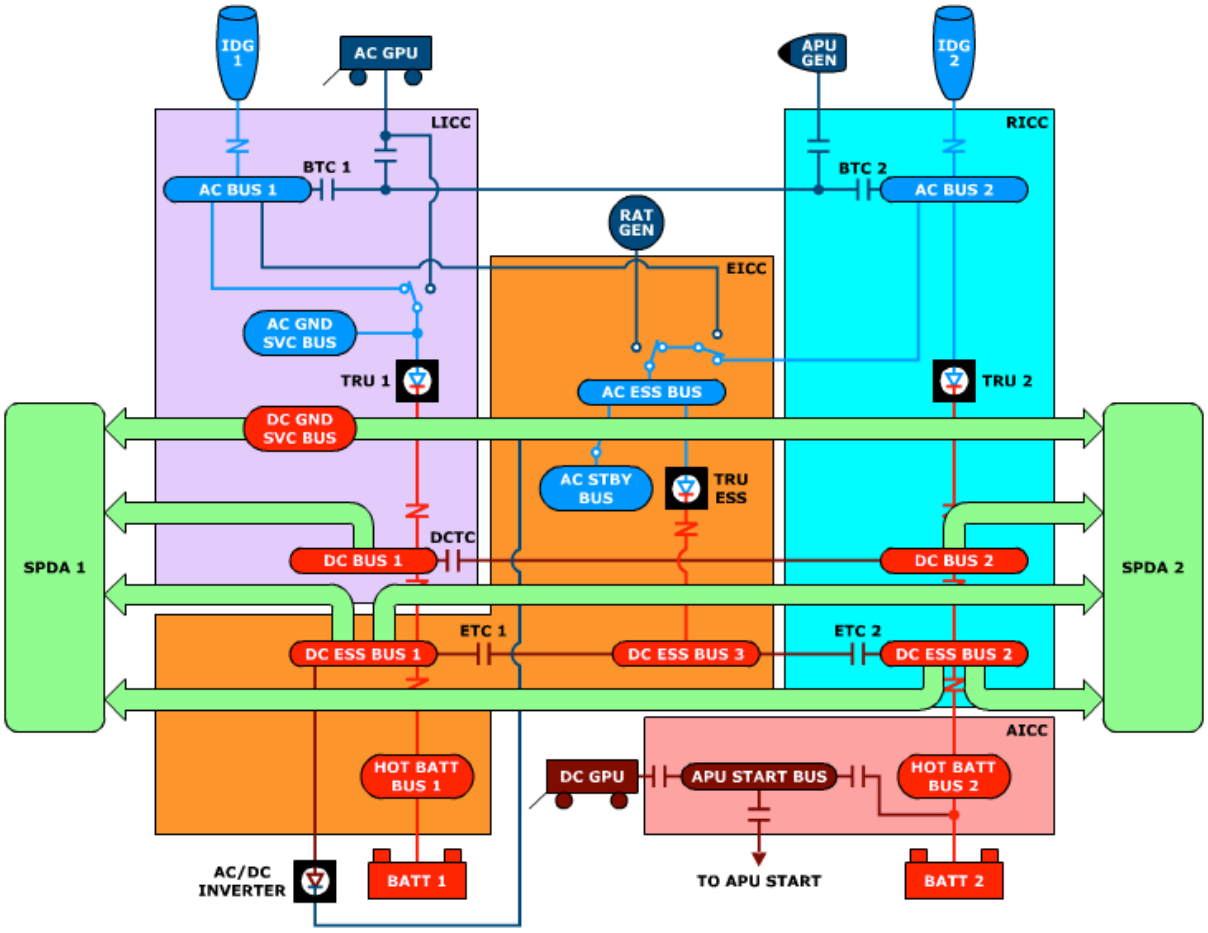


Electronic Bays	**Forward**	BATT 1	EICC	SPDA	MAU 1/2	3 ACE	FCM 1/2
	Center		LICC/RICC	SPDA	MAU 3	4 ACE	FCM 3/4
	Aft	BATT 2	AICC			2 ACE	

Buses	**AC buses**	AC buses 1/2, AC ESS bus, AC STBY bus, AC GND SVC bus
	Normal SRC	Onside **IDG**
	Other SRC (prio)	**APU** GEN, AC **GPU** (GND only), **opposite** IDG
		A single AC bus can supply the entire ELEC SYS
		APU GEN ON switches AC GPU offline
		NBPT connecting AC SRC momentarily in parallel (some ms) if possible
		Wait 30sec after N2 stabilization before switching off APU or disconnecting AC GPU
	EMG SRC	"Inner circle" only; only ESS and HOT BATT buses AC/DC **INV** from **DC ESS bus 1** (1 phase)
	No AC bus pwrd	**RAT**; **ELEC EMERGENCY** MW
	IDG 2 normally powers **AC ESS bus**	

DC buses	DC buses 1/2, DC ESS buses 1/2/3, HOT BATT buses 1/2, APU START bus, DC GND SVC bus	
	Normal SRC	**TRU** (3, 300A each)
	Secondary SRC	BATT
	To start APU	DC GPU (if no BATT)
IDG	**40**kVA **115**VAC **3** phases (E2: **50**kVA)	
	GEN/CSD (hydro-mech), air-cooled, GCU	
	Amber LED	High **IDG oil TEMP** (168 ± 5°C), IDG must be disconnected **manually**; **automatic** when ≥ **185.6**°C
	To disconnect	Hold knob in DISC for **1**sec (but < **3**sec) **Resettable on GND only** by maintenance Automatically if **shaft fails** or **TEMP** excessive
APU GEN	GEN, **40**kVA **115**VAC **3** phases, AGCU	
	(no CSD; APU runs at constant speed)	
	Available 3sec after 95% RPM	
	Amber X: APU failure. Amber dashes: Invalid information	
AC **GPU**	Receptacle LH of nose section (GND SVC switch). 3 phases	
	GPU CONNECTED MC if PKG brake released	
	Has priority over BATT	
GND SVC	AC switched off in cockpit, **AVAIL** inscription on OVHP / on AC GPU panel (fwd galley) **if** available and **V/A/Hz ok**. Powers **AC/DC GND SVC** buses (AC outlets, galley jug heaters, sidewall lights, CGO load lights)	
DC GPU	E.g. for **APU start** if cold WX (iso BATT)	
	Receptacle LH tail section	
	No AVAIL inscription; refer to MFD synoptic	
	GPU CONNECTED MC if PKG brake released	
RAT	RH of nose section. **15**kVA 115VAC 400Hz, **8**sec after deployment	
	Until then: **BATT** powers **DC ESS buses** and via **INV** the **AC STBY bus**	
	Automatic deployment if **no AC bus** is **powered** (**ELEG EMG**)	
	(**manual deployment** is possible)	
	Automatic variable pitch mechanism for constant speed	
	QRH ELEC EMG: **LDG configuration F3** (→higher APP SPD, **no A/L possible**) (F5 still selectable, but F3 remains indicated)	
≥ **130**kts	Powers AC ESS bus, AC STBY bus, DC ESS buses 3/1/2	
< 130kts	**AC ESS bus only**; BATT for DC ESS buses and AC STBY bus	
	Further SPD decrease: Load shedding, AC ESS bus off	
BATT	2 **NiCad** BATT, **22.8**VDC, **27**Ah. BATT 1/2: **fwd**/**aft** ELEC bay	
	Green if ≥ 18V. Red (+ OVERTEMP MW) if ≥ 70°C for 2sec	
	Constantly charged by any AC SRC	
	Provides **10**min in **ELEC EMG** until RAT jumps in;	
	BATT DISCHARGING MW	
	BATT 2 contactor will open during APU start	
	Use DC GPU when BATT not available or BATT 2 TEMP < **-20**°C	
	(TEMP limit for **APU start**)	
	AOM 13-70 2: **Remove BATT** if > 6h in < -25°C	
Instruments	DC ESS bus 1	EICAS, NAV1, DME1, COM1, DAP1, pitch trim 1
	DC ESS bus 2	MFD1, MCDU2, CCD1, DAP2, disp ctrl 1
	DC ESS bus 3	Pitch trim 2
	DC bus 1	PFD1, MFD2, MCDU1, CCD2, disp ctrl 2
	DC bus 2	PFD2, NAV2, DME2, COM2
	(**on-side PFD and opposite-side MFD** by same SRC)	

Power Distribution and Control	**4 ICC**. Each		AC/DC buses, thermal CB (remote), LRMU
	LICC		GCU 1, external power module
	RICC		GCU 2, APU GCU
	CBs monitored by MCDU, REMOTE CB TRIP advisory, reset GND only by maintenance		



	SPDA	**2** independent SPDAs (fwd/center ELEC bays)	
		Protection, logic control, power supply	
		ELEC remote CBs; REMOTE CB TRIP advisory; resettable by crew	
		Powered by 4 separate DC buses each:	
		AMS, OXY, ELEC, ENG IGN & starting, fuel, water, HYD, APU, A/I, fire protection, lighting. Load shedding: Galleys, right W/S heating	
		SPDA1	DC bus 1, DC ESS bus 1/2, DC GND SVC bus
		SPDA2	DC bus 2, DC ESS bus 1/2, DC GND SVC bus

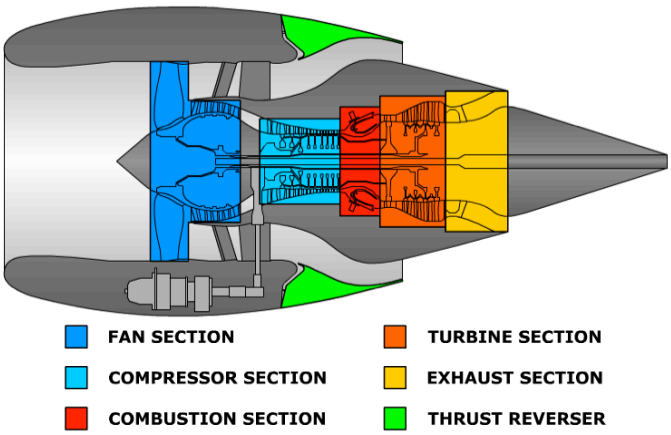
Circuit Breakers	Cockpit (2 panels)	Thermal	Non-remote
	ICCs	Thermal	Remote
	SPDAs	Electronic	Remote

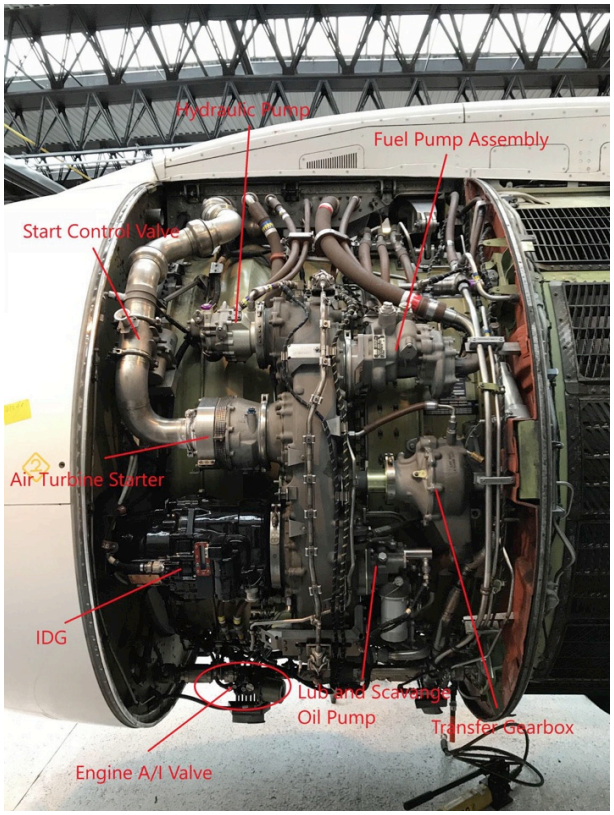
Built-In Test		To detect, locate, isolate faults
	Test types	Continuous, fault-initiated or initiated. Shown on EICAS/CMC
		For IDG GCUs, APU GEN GCU, external power module, SPDAs

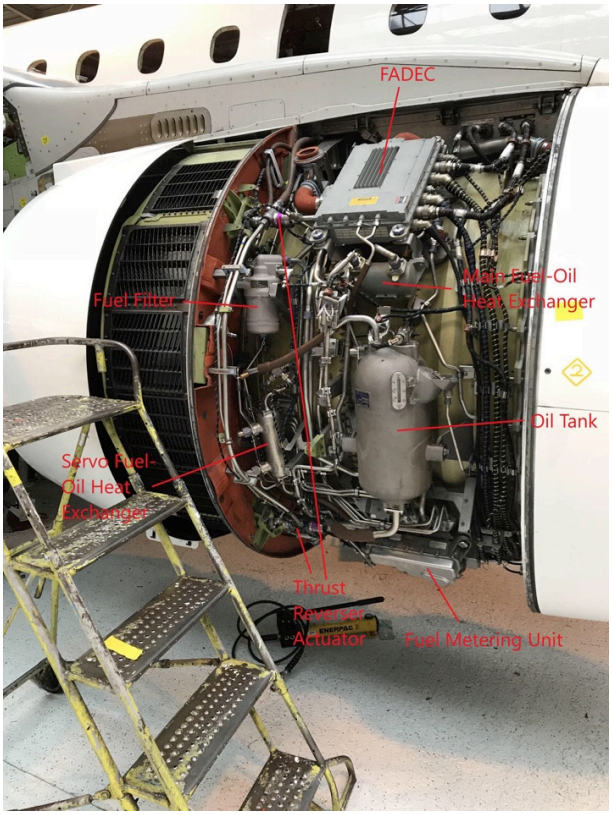
14-06 ENGINE

Type **E1**

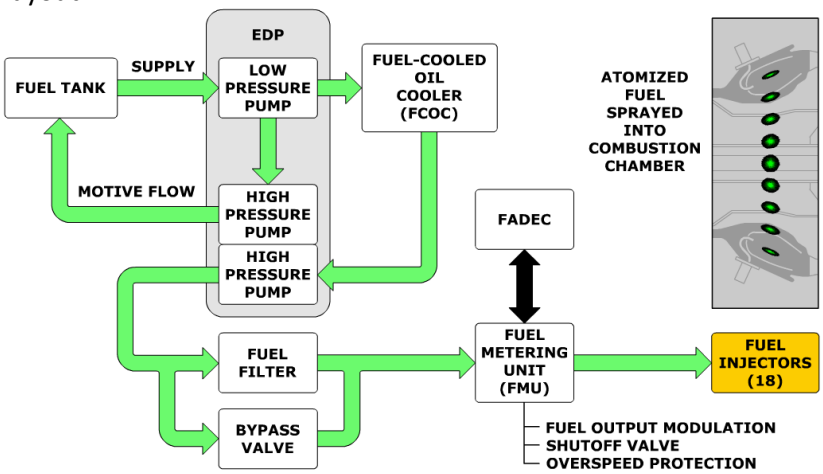
General Electrics GE CF34-10E5A1, 8391kg thrust / **18'500**lbs
(max **5**min **AEO** / **10**min **OEI**)
High bypass ratio 5.4:1, dual rotor turbofan
24 blade fan connected to **4**-stage **LP** turbine (**N1**)
9-stage HP compressor, driving a **1**-stage **HP** turbine (**N2**)
VSV controlling airflow through compressor, based on **N2**







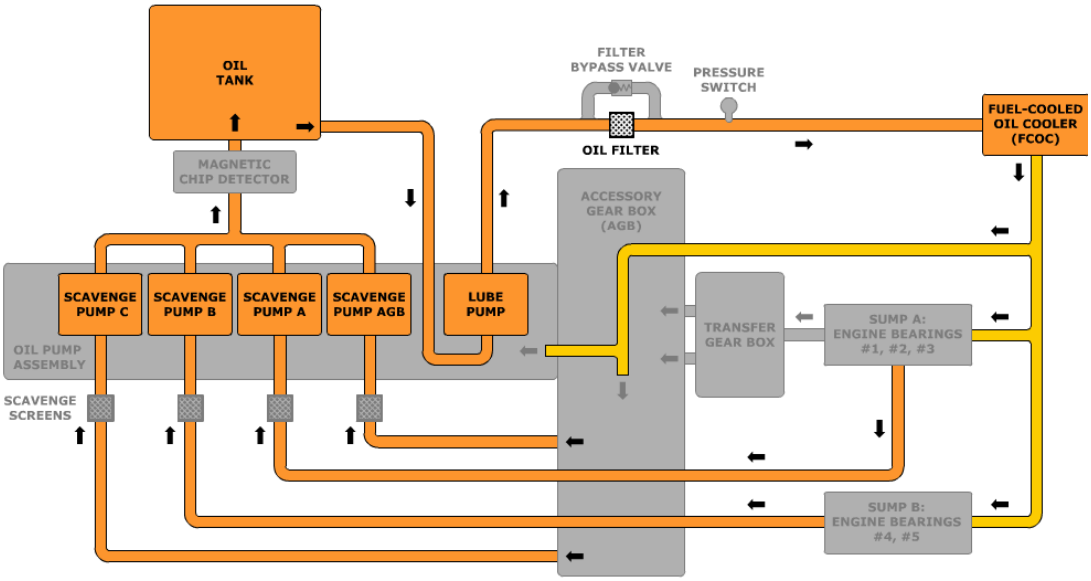
	E2	PW1919G (E190-E2), PW1921G (E195-E2) High bypass geared turbofan N1 is geared, LP compressor linked to LP turbine
	ITT sensor	Aft of combustion chamber ITT indication, hot start logic, flame out / overheat detection
	AGB	Lube/scavenge oil **pump**, HYD **pump**, fuel **pump**, **IDG**, **PMA** Contains the ATS (driven by pneumatic, rotation transmitted through radial shaft drive to N**2**)
FADEC		**2 channels** each (secondary on standby; swapped at each ENG start)
	Tasks	Maintains requested N1, ENG protection (N1 limit), ATTCS Additionally: **N2 overspd protection** (**shutdown** if 3x ≥ **102**% in **30**sec)
	Power	Initially powered by **DC ESS** bus 1 (channel 1) / DC ESS bus 2 (channel 2) When N2 > **50**%, **PMA** takes over (normal PWR SRC of FADEC)
	Inputs	ENG (N1; T2 ENG inlet air TEMP), TLA
	Outputs	FF via FMU, inlet guide vane and stator vane angles via variable geometry valve, bleed air extraction via bleed air valve, T2 sensor heating, thrust reversers actuation, **SCV**, energizes IGN
	Idle SPD calc	GND idle SPD — Min stable ENG thrust level Flight idle SPD — Depending on ALT and bleed air req (ECS, A/I) **APP idle SPD** — Inflight, < 15'000ft, flaps > 0, LDG gear down **Final APP idle SPD** < 1'200ft/AGL, LDG configuration Flight and APP idle values are increased in icing conditions **Final APP** idle value is not increased - observe cyan min N1 dash (A/T does not consider min N1 for A/I)
Fuel System		Layout:



FCOC	Heat exchanger (maintains oil TEMP and heats engine fuel to prevent freezing)
Bypass	Bypass valve in fuel filter (ENG 1/2 FUEL IMP BYPASS MC)
FMU	Shutoff valve for normal shutdown, overspeed protection Fuel to variable stator vane actuators

Oil System

Cooling, lubrication to N1 (3) and N2 (2) rotor shaft bearings and AGB, transfer gear box, oil pump assembly
Oil is pressurized by **lubrication pump**, when core ENG is running



Bypass: Bypass valve in oil filter (ENG 1/2 OIL IMP BYPASS advisory)
Cold start relief valve after filter (not shown above), opens during cold ENG start, returns oil to the tank when viscosity is high
2 sumps in ENG collect the oil after lubrication
Scavenge screens before scavenge pumps trap oil contaminants
Before routed back to oil tank: Magnetic chip detector

Ignition System

Dual redundant IGN SYS per ENG: 2 IGN exciters, 2 IGN leads, 2 IGN (A/B)
Inflight: **FADEC** can control IGN SYS even if IGN switch if OFF
Both IGN: ENG airstart, ENG flameout, missed light-off, cold soaked/high ALT conditions on GND, IGN selecter to OVRD
OVRD: IGN energized when ENG is running
IGN 1A/2A powered by SPDA 1 on **AC STBY** bus / DC ESS bus 1/2, IGN 1B/2B powered by SPDA 2

Engine Start

SRC GND

APU, opposite ENG, GND cart
Cart shall be parked at **LH** side, prefer RH ENG start (less PRESS on LH ENG)

SRC inflight

Opposite ENG, APU, windmilling
TL must be **idle** for start/shutdown (ENG 1/2 TLA NOT IDLE advisory)

7% N**2**

IGN (**1** igniter on GND, **2** inflight), **oil PRESS** latest **10**sec after N2

20..**25**% N2

FF Inflight crossbleed — FF on If N2 < 15% after 15sec
Inflight windmilling — FF on if N2 > 7.2% or after 15sec, HYD closed

No FF if ITT > **120**°C (automatic monitoring for high ITT prevention)
If no light-off within 15sec, FADEC stops IGN/FF and dry motors for 30sec (unless STOP is selected), then IGN/FF on again
Manually abort within 15sec after fuel or if starter limit exceeded (**90**sec)

35% N2

N1 rise, latest at **50**% N2

50% N2

Acc to GND idle SPD, **SCV closes** (ENG 1/2 START VLV OPEN MC otherwise)
PMA powers FADEC. Self-sustaining N2

Stable N1 **2**6..27%, ITT **4**60..520°C, N2 **6**2..65%, FF **2**50kg/h

Abort start
No positive **oil PRESS** within **10sec after N2**
No **N1** before **starter cut-out** (**50% N2**; TWND)
No **ITT** increase **60sec after fuel** (or **15sec** after fuel is re-applied)

Engine start **E2**
Duration 30..78sec; motoring at N2 8..11% ("rotor bow")
IGN/FF at 18% N2
AES or WML indication
LSP: Check **oil level**

Abort if
No acceleration from fuel on to idle within 120sec, no oil PRESS within 10sec after N2, no N1 increase after 45% N2, ITT exceeds start limit, oil PRESS below ENG limits, ELEC/pneumatic or starter malfunction before starter disengagement

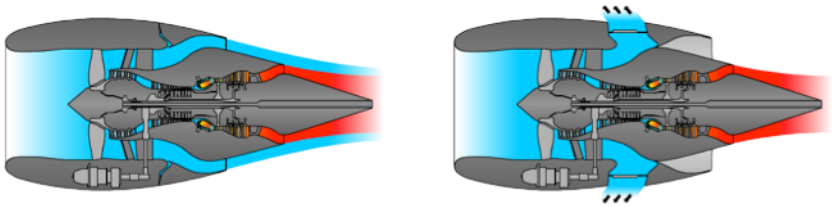
FADEC

On GND
Protects for **hot start** (ITT > **740**°C), **hung start**, **no light-off** (does not protect for no **oil PRESS**)
Auto-relight attempts are terminated if N2 < **52**%

Inflight
No FADEC protections. Manually abort in 30sec if no light-off
WML label near N2 if ENG is windmilling (**auto-restart**)
Abort if no **auto-relight** within **30**sec or N2 < 7.2%

Thrust Reversers

HYD actuated, on GND only



MIN REV (spring loaded) - MAX REV
FADEC has interlock function against inadvertent reverser deployment
ENG remains at idle thrust until the REV is fully deployed (green REV label)
After ENG failure, REV can only be selected within **30**sec
If one REV fails with MAX REV selected for both ENG, the operating REV will only produce MIN REV thrust. If MAX REV selected only on ENG with operating REV, then MAX REV thrust is produced
If REV is deployed **inflight**, thrust is limited to **idle**

Thrust Management System
Dual redundant, only 1 channel at a time

Thrust ratings

[klbf]	**E1**	E**190**-E2	E**195**-E2	AEO/OEI
T/O-1	**18.5** / 18.5	**19.8** / **21.7**	21.7 / 23.3	
T/O-2	17.1 / 18.5	17.9 / 19.8	19.8 / 21.7	
T/O-3	15.5 / 16.7	17.1 / 17.9	17.9 / 19.8	
GA	17.1 / 18.5			
CON	16.3 / 16.3	18.9 / 18.9	20.3 / 20.3	
CLB-1	16.0	18.9	20.3	
CLB-2	14.0	17.2	18.4	
CRZ	13.8	18.9 / 18.7		

		E190-E2	**CLB-1** leads to higher thrust at lower FL (then it changes) **Not recommended to change inflight**	
		E195-E2	**CLB-1** Maximum CLB rate **CLB-2** CLB thrust derated from CLB-1 **Not recommended to change inflight**	
		Flex T/O	max. 60% of T/O-1, max. 75% of T/O-3 (E1: max 25%) For TO-1/2/3. Assumed TEMP higher than ambient TEMP Limited to **5**min **Max reduction 25**% of max rated T/O thrust, or CLB-2 + 1% N1 (the higher) **Not** allowed on **contaminated** RWY, not if **WS** expected	
	TLA		Travels 81.5°, **5** detents: MAX (82°), TO/GA (and max continuous, 75°), IDLE (22°), MIN REV (12°), MAX REV (0.5°)	
	Mode values		Depending on A/S, ambient conditions, bleed air configuration	
	Mode selection		Depending on phase of flight, number of ENG operating, A/C config THRUST RATING SELECT / MCDU TRS. Manually selectable underlined: Take-off (reserve) TO-1 (RSV), TO-2 (RSV), TO-3 (RSV) Go-around (reserve) GA (RSV) Maximum continuous CON Maximum climb CLB-1, CLB-2 Maximum cruise CRZ	
	Defaults	CLB-1	If higher than selected T/O thrust: CLB-2 default (CLB-1/2 selectable if in AUTO mode)	
	changes to CLB	FD on	LDG gear retracted, > 400ft/AGL, change in vert mode	
		FD off	LDG gear retracted, > 3000ft/AGL, < ASEL ALT	
	changes to CRZ		at programmed CRZ ALT for 90sec and SPD is around pre-selected SPD	
	changes to GA		inflight when LDG gear is extended. **Highest thrust available AEO** Limited to **5**min (OAW: **10**min **OEI**)	
	changes to CON		ENG fail during T/O and 3000ft/AGL or ENG fail inflight	
	TO-1/2/3		Highest thrust AEO. Limited to **5**min (OAW: **10**min **OEI**)	
	Take-off		No mode changes up to 400ft/AGL, except: RSV	
	ATTCS	On GND	Select via MCDU	
		Inflight	Automatically armed when mode is GA	
			Controlled by FADEC, activates **RSV thrust** if: TL in TO/GA, ΔN1 > 15%, ENG fail during T/O / G/A / neg windshear Manual activation: TL to MAX **Flex** T/O possible with ATTCS on or off. Defaults on. No ATTCS in TO-1 Limited to **5**min (OAW: **10**min **OEI**)	
Indications	N1	Red tick	Max N1 limit. "N1 red line"	
		Green tick	Max allowed for current mode/conditions, MAX	
		Hollow sector	Δ between actual N1 and requested N1	
		Cyan tick	Minimum N1. During icing conditions, gear down or **flaps** extended (< **1200**ft)	
	ITT	Red tick	ITT red line	
			Amber tick (after T/O) ITT limit; maximum continuous	
	Oil		PRESS in psi, LVL in quarts (0.95l) (MFD status page),	
	VIB		For N1 (LP) and N2 (HP). Caution range: 4..5	
	EICAS	ENG 1/2 CONTROL FAULT MC	Thrust modulation disabled	
		ENG 1/2 TLA FAIL MC	Dual failure in TLA sensor	
		ENG EXCEEDANCE MC	ENG limit exceeded	
		ENG NO TAKEOFF DATA MC	No T/O data or discrepancy betw FMS or T/O data not accepted if **delta between measured OAT and entered TO TEMP** exceeds 12°C (E1) / 5°C (E2) Enter matching TEMP, re-calculate performance	

			ENG THR RATING DISAG MC	Discrepancy betw max thrust ratings	
			ENG 1/2 FUEL SW FAIL advisory	Fuel PRESS sensed with all pumps off	
			ENG TDS REF A-I ALL status msg	REF A-I ALL selected in T/O dataset	
			ENG TDS REF A-I ENG status	AUTO mode, REF A-I ENG in dataset	
Limitations	N1			100%	
	N2			**59.3** .. **100**%	
	ITT	**E1**	GND start	**740**°C	
			inflight start	**875**°C	
			max T/O / G/A	**983**°C	max **5**min
			max continuous	**960**°C	
		E2	Start, T/O, G/A	**1054**°C	
			Max CONT	**1006**°C	
			New ENG 1/2 LIMIT CL if limitation exceeded		
	Oil	**E1**	min TEMP for ENG start	**-40**°C	
			max continuous TEMP	**155**°C	
			min PRESS	**25**psi (5psi for **2**min if oil < -22°C during start)	
		E2	Min TEMP T/O	**24**°C (otherwise: MC)	
	Start	**E1**	Starting #1 - #2	**90**sec (GND) / **120**sec (inflight) - **10**sec	
			#3 - #5	90sec (GND) / 120sec (inflight) - **5**min	
			Dry motor #1	**90**sec - **5**min	
			#2 - #5	**30**sec - **5**min, then **15**min cool-down	
			(max combined starter time: 90sec)		
			Inflight	ENG **airstart envelope** acc QRH NAP1-19	
		E2	**4**min starter limit, max. 3 attempts, thereafter **30**min cool-down		
	Warm-up	**E1**	**Idle for 2min** for thermal stabilization **before selecting higher thrust**		
			Wait **30**sec after N2 stabilization before shutting down APU / GPU		
			GND maneuvering: ~**30**% N1		
		E2	ENG WARM UP	No T/O thrust allowed (otherwise: OIL LO TEMP MC)	
	APU inop		ENG **2**	GND pneumatic start	NP12-1
			Disconnect pneumatic unit		
			ENG **1**	XBLD start	NP11-1 **not** during pushpack
			Min recommended **bleed duct PRESS** prior start:		
			40 - 0.5psi each 1000ft		
			(with temperature correction: AOM 3-70 5)		
	Reversers		**MAX REV** should only be used over **wet/slippery/contaminated** RWY		
	Cool-down	**E1**	**2**min at/near idle before shutdown		
		E2	**3**min after nosewheel TD before shutdown (recommended: 5min)		
	E2 single ENG taxi		ENG 1 does not require HYD 1 ELEC pump to run (↔ E1)		
			Do not shut down ENG 2 while APU starting		

14-07 FIRE PROTECTION

General	Bottles	Halon 1301, PRESS w/nitrogen 2 discharge outlets (APU bottle: only 1), 2 cartridges, TEMP compensated PRESS switch, safety PRESS relief valve; rupture disc, ELEC activation
	E2	FWD/CTR/AFT EBAY smoke CL replacing RECIRC SMOKE CL Smoke detection: **3** (E195-E2: **4**) in fwd CGO and **4** in aft CGO Halotron instead of Halon Only two OXY masks
	Test	Press for **2**sec: 10 lights / 5 msg (E2: EBAY SMOKE MC additionally); fwd fan deactivates, fwd CGO shutoff valve if bleed air avail On GND, if pressed > 10sec, APU shuts down
Engines	Detection	Loops A/B per ENG, each with 2x4 pneum fire detectors in ENG core ENG 1 loop A / ENG 2 loop B, connected to MAU 1, **DC ESS** bus 1 ENG 1 loop B / ENG 2 loop A, connected to MAU 3, **DC ESS** bus 2
	Bottles	A / B (on **HOT BATT bus** 1 / 2), RH side of rear wing-to-fuselage fairing Cross-connected
	Fire handles	Closes **fuel** / **HYD** / **bleed air** shutoff valves
	Indication	Fire handle illuminated, MW, aural warning, ENG FIRE MW on EICAS, FIRE warning on EICAS ITT indicator Fire conditions still persists if handle illumination is off but CAS message still active
APU	Detection	Loops A/B, connected to MAU 1/3, **DC ESS bus 2**
	Pressing	APU FIRE EXTINGUISHER: Discharge APU fire bottle, shut down APU via APUT FADEC, closes APU fuel shutoff valve, displayds EICAS advisory
	Bottle	Forward of **APU compartment**. On **DC ESS bus 2** (in contrast to ENG)
	APU EMER STOP	Closes APU **fuel** shutoff valve, APU is **shut down** immediately, **bottle is armed**, white **stripe** appears in switch
	APU FIRE EXT	Closes APU **fuel** shutoff valve, APU is **shut down** through APU FADEC, **bottle** discharged, EICAS advisory is displayed
	Indications	Striped bar in APU EMER STOP btn, MW, aural warning, APU FIRE MW After 1min if APU EMER STOP not pressed, APU fire extinguisher button illuminates red and bottle is armed **On GND**, **automatic APU shutdown** 10sec after fire detected, if APU EMER STOP **not pressed**
Cargo	Smoke detection	Fan-type photoelectric smoke detectors in ceiling **2** detectors must trigger before a MW is generated **4** in **fwd** CGO (MAU 1), **3** (E295: **4**) in **aft** CGO (MAU 3); **independent** 2 on **DC ESS bus** 2, 2/1 on **DC ESS bus** 1/3
	Bottles	2 (1 **high-rate**, followed by 1 **low-rate**, **75**min) in **center** ELEC bay Dischargeable into **either CGO** compartment

Operation

		High-rate	Low-rate
With MW	Inflight	Push 1x	**Auto** after **1**min **or push**
	GND	Push 1x	Push 1x (**no auto**)
No MW	Inflight	Push 2x*	**Auto** after **1**min **or push**
	GND	Push 2x*	Push 1x (**no auto**)

*within 2min; auto reset after 2min

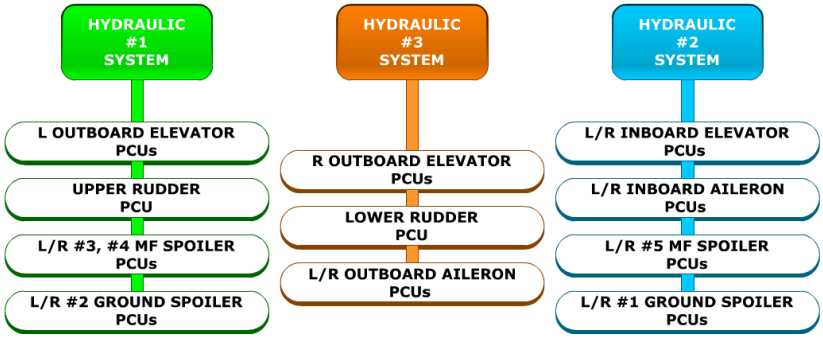
	Indications	FWD/AFT **button** illuminates, CRG FWD/AFT SMOKE **MW**, high-rate bottle is armed. If in fwd CGO: Vent fan is disabled, CGO shutoff valve closes	
		FWD/AFT FIRE SYS FAIL MC	If all smoke detectors failed, PRESS in any bottle low and firing cartridges intact, any firing cartridges circuits open
		IFE RACK SMOKE MC	IFE rack near cockpit
Cabin	Portable	1+2+2 halon fire extinguishers	
	Lavatory	SMK detection	On ceiling. Ionized air between electrodes Powered by DC ESS bus 1/2 LAV SMOKE MW Use deploy tool to silence the horn
		Waste extinguish	Waste container fire extinguisher PRESS gauge (E1 only), 2 discharge tubes on TEMP No cockpit indications
	Test in cabin	LAV SMOKE MW for 7sec	

Flight Controls

Primary: Ailerons, elevators, rudder, MFS (3 OB panels) as **roll** spoilers

Secondary: Slats, ground spoilers (IB), MFS (OB) as speed brakes or as GND spoilers, flaps, horizontal stabilizer

PCUs: HYD actuators (servos)



HYD SYS 1 Middle/IB MFS panels; OB GND spoilers

HYD SYS 2 OB MFS panels; IB GND spoilers

SYS Inputs: Inputs: ADS 5, AFCS, LDG gear, FADECs

E1 Fly-by-Wire System

Controls PCUs **except ailerons** (these have conventional cable SYS)

Flight ctrl electronics: **4 FCM**, **3 P-ACE** / **3 S-ACE** / **2 SF-ACE** / **1 HS-ACE**

Operate electro-hydraulic or electro-mechanical actuators

Power: Normally via **DC bus 1**, in EMG via **DC ESS bus 2**

FBW backup BATT (when **no normal and no EMG ELEC pwr**; lead acid, charged by **DC ESS bus 3**, **15**min for **ELEV** and **rudder**, no switches, no EICAS messages, cannot power other buses)

PBIT: ELEC and HYD; latent faults in **flight control SYS**: FCM, **P**-ACE, **SF**-ACE FLT CTRL TEST IN PROG **status** message

Valid for **50**h (FLT CTRL BIT EXPIRED MC **after LDG** otherwise)

ELEC Done when **AC** is **available**. Takes **3**min. Tests **FCM**, **P-ACE**, **SF-ACE**

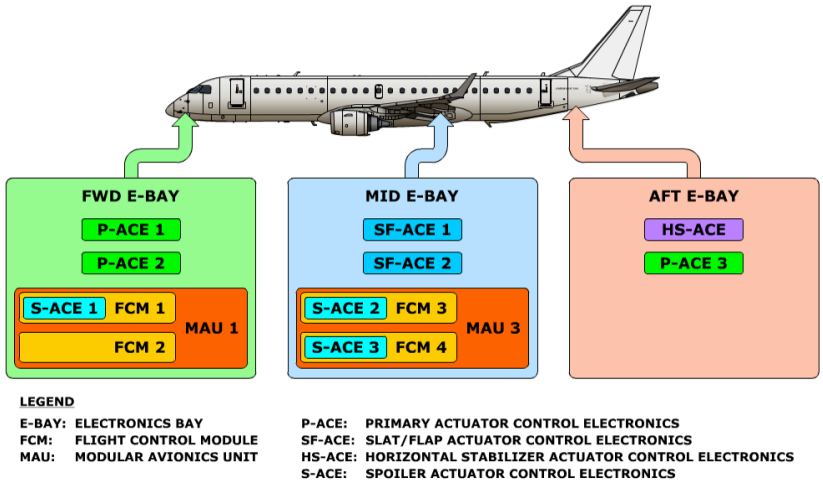
Interrupted if **ELEC HYD pump** on, **AC PWR** off or **FCP** switches cycled

HYD On GND, if **all 3 HYD** are PRESS, HYD TEMP > **10**°C. Takes **1**min

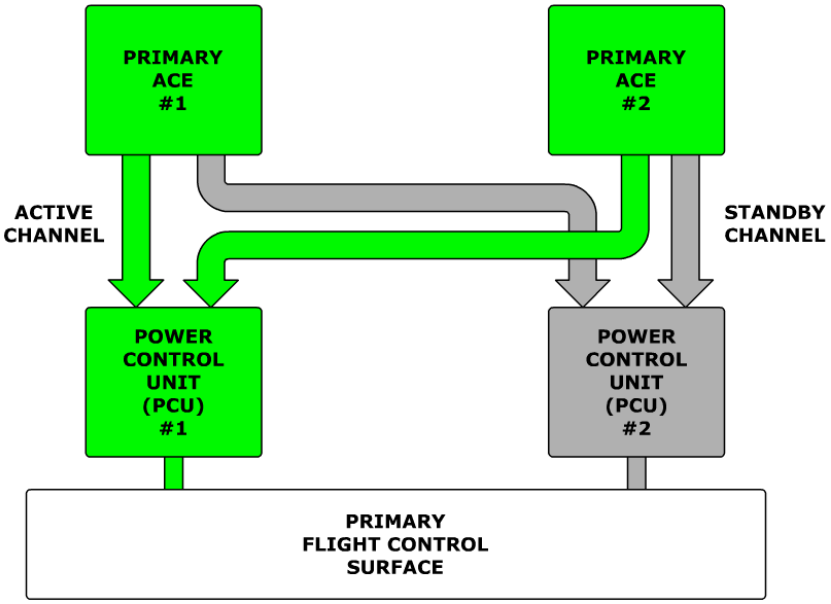
Interrupted if ctrls **moved** (do not touch; FLT CTRL NO DISP MC else)

Yoke: via LVDT to P-ACE

ACE: **9 ACE** (each w/active and standby **analog** channel), connecting the control column **electronically** to the respective control surface, providing direct **analog** control of the surface via **PCU**



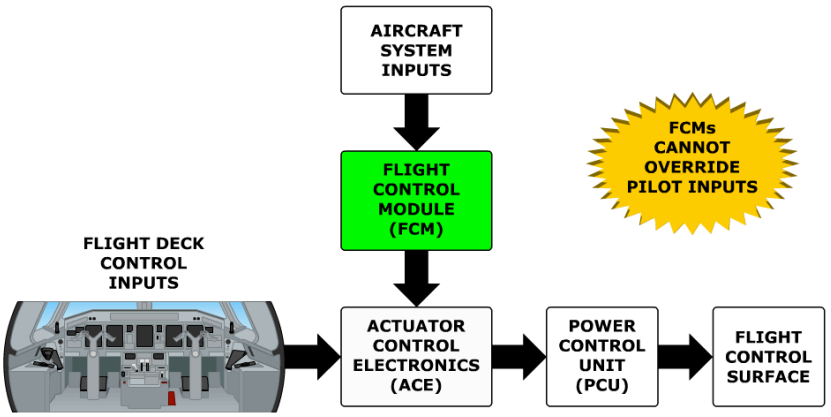
4 units	SF-ACE **1/2**	**Slats**, **flaps**. **ELEC**. One ch for **flaps**, one for **slats**
	HS-ACE (**1**)	**Horizontal stabilizer**. **ELEC**. One active + one stby ch
	S-ACE **1/2/3**	MFS (OB/IB/mid). Integrated in **FCM**
	P-ACE 1/2/3	**Rudder**, **elevators**. Connected to two PCU



Rudder, elevator, stabilizer channel **switch** roles after first **power-up** on GND a day (odd-even-day-engage). Standby channel monitors active channel, takes over if active channel failed

FCM

4 FCM. Interconnected via **ASCB**
Augment pilot inputs (account for SPD, ELEV scheduling, thrust compensation, AOA limiting); SW-based assistance for the **P-ACE** (connected via **CAN** bus). FCM cannot override pilot inputs



Normal mode

FCM provide gain schedules and control limits to the P-ACE units
FCM enhance the signal for the P-ACE
ELEV scheduling based in A/S, auto-thrust compensation using ELEV, AOA limiting using ELEV, rudder scheduling/limiting based on A/S, YD and turn coordination using AFCS, roll spoiler scheduling based on A/S and SPD BRK deployment, pitch compensation during configuration changes

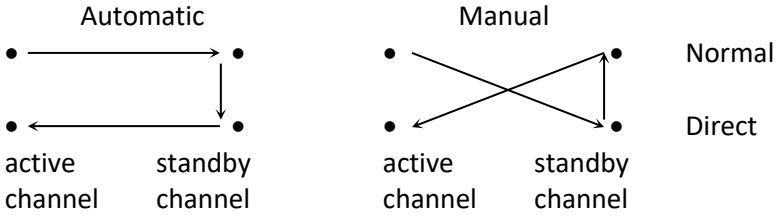
Direct mode

Controls → CCPS → ACE → PCU; **bypassing FCM**
FCM inputs removed, control limits based on P-ACE units defaults
e.g. due to loss of data from all FCM or due to multiple ACE unit failures (channel failure: **automatic**) or **selectable** via FLIGHT CONTROLS MODE
Inputs from cockpit controls are sent directly to flight control surfaces

Switching modes — Sequence when pushing button on flight controls panel:

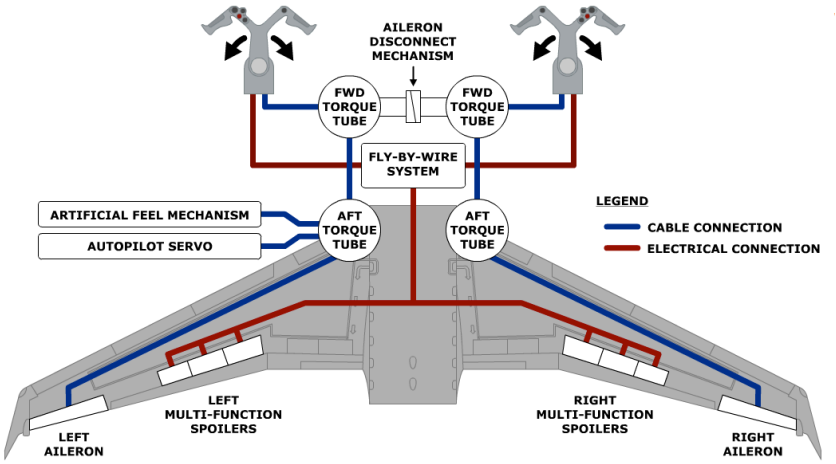
Automatic — 1. Normal active 2. Normal standby 3. Direct standby 4. Direct active

Manual — 1. Normal active 2. Direct standby 3. Normal standby 4. Direct active

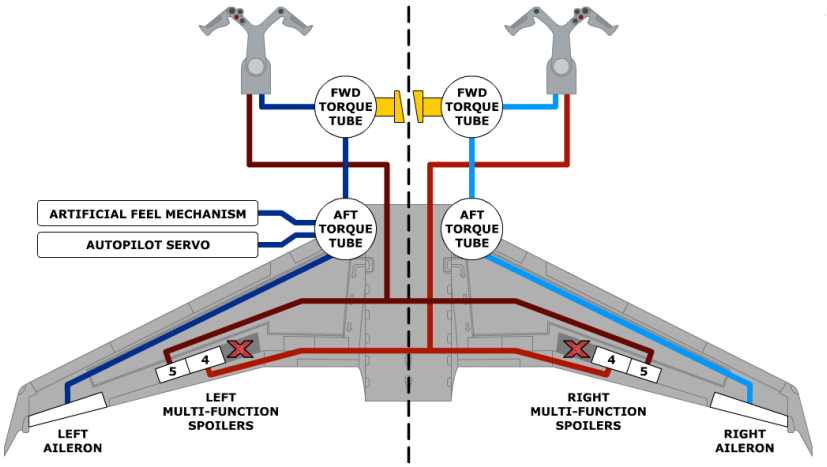


Roll Control

Aileron and MFS as roll spoilers
HYD SYS **2** for **IB** aileron **PCU**, HYD SYS **3** for **OB** aileron **PCU**
Ailerons: Conventional cable assembly. **Artificial feel** MECH on **LH** side



Disconnect handle only re-connectable on GND only by maintenance
Only 1 spoiler panel avail. Artificial feel only available if RH side jammed



1 **PCU failed** — Aileron **force authority halved** (**AILERON LH/RH FAIL** adv from FCM)
HYD failed — Associated PCU acts as damper. Aileron inoperable if both HYD failed
Roll trim — Adjusts the neutral feel POS. 3sec cutout. Quick DISC button
Requires **constant force**

Pitch Control Systems

ELEV (HYD) and horizontal STAB (ELEC)
ELEV: Controlled by FBW and by AFCS
Powered by **4** PCU (via **4** P-ACE channels)
ELEC disconnect via torque tube; re-connectable on GND only by maint

AFU
2 artificial feel units, center **spring**
Reduced by half if ELEV disconnected or if one feel unit failed

FCM
Gain scheduling based on A/S, ELEV thrust comp, TSA, AOA limiting

Gain scheduling
ELEV movement reduced as A/S increases

ETC
Applies ELEV inputs (±**5**°) to reduce pitch moment due to thrust chng
Calculated by FCM, based on **N1**, **M**, **PRESS ALT**
Not available if sensor failed (ELEV THR COMP FAIL MC)
Parameters adapted in steep APP mode

TSA
Estimates height above RWY for T/O and **calculates** it **on LDG**
Uses **V/S** (on T/O) or **2 RA** (on LDG / G/A)
No full protection; pitch should be < 10°
T/O < **20**ft, max pitch down ELEV deflection **8**°. If pitch rate negative, max pitch up ELEV deflection 0°
Tail strike protected only if normal rotation (3°/sec)
LDG < **70**ft, F5 or Ffull. Max pitch down ELEV deflection **8**°
G/A **T/O** limits used. Change when TLA > **70**° and positive **CLB**
LDG / G/A w/flaps 5: TSA can only be engaged 5min after T/O
Authority depends on A/C configuration (T/O, LDG)
No cockpit **indication** if activated

AOA protection
Stall protection by limiting AOA. Gradually reduces column authority in nose up direction. Activated when AFCS activates the stick shaker
Has **PRIO over TSA** function. Input: **AOA** data, control **column** POS
No stick pusher

Direct mode
if A/S information is lost
ETC, TSA, AOA limiting function are lost (**stick shaker** is still available)
ELEV is controlled directly by pilot
A/P is lost

Pitch trim
HSA, **ELEC** driven by one of two DC motors (active, standby)
Repositioning the horizontal stabilizer
Pitch trim on control wheel (**3**sec / **5**sec on GND **cutout** if both halves are actuated; **7**sec switch **deactivation**
if one half is actuated; requires maintenance action) **or** pitch **backup** switch (on backup channel; disconnects A/P). In addition, the FCM send autopilot trim commands to the horizontal stabilizer
Autopilot trim function is enabled when A/P is engaged, configuration trim function is available, and manual ELEC trim is not active
A/P disengages if the horizontal stabilizer **trim** SYS or A/P **trim** fails
PRIO of trim inputs: Backup trim, LH trim, RH trim, A/P trim command
Horizontal stabilizer ACE will not respond when stick shaker active (stick shaker is a function of AFCS)
ELEC EMG or **loss of A/S data**: Only HS-ACE **channel 2** enabled, trim only at **half** the normal **rate** for either manual or A/P trim
Autoland: Trims up

Mach trim
In AFCS. As M increases, aerodynamic center moves backwards, nose goes down (Mach tuck). Mach trim via FCM to ACE; activated if A/P **not** engage, A/S > M 0.7, horizontal stabilizer not trimmed manually, A/P disconnect switch not pressed, no other trim command active

Pitch trim ind
11° / 7.25° / 3.5° nose up, 0.25° / 4° nose down

Yaw Control Systems

Single rudder, **2 PCU** (active/standby), both can provide full control
Standby PCU as HYD damper (flutter protection)
LH pilot pedals control **upper** PCU (HYD SYS **1**)
RH pilot pedals control **lower** PCU (HYD SYS **3**)
PCU jam at rudder: rudder is HYD locked
Loss of A/S data: ACE reverts to **direct mode**. **Two fixed schedules** to control rudder authority (low SPD fixed gain when **flaps/slats** are extended, high SPD fixed gain)

FCM
YD, **turn coordination**, rudder authority variation based on A/S
Rudder authority reduced as A/S increases
YD and turn coordination still possible when pedals are jammed

Rudder trim
3sec cutout. Moves neutral point

Parallel rudder
Refer to 14-03 Automatic Flight - Autoland, SOPM 3-35-05 p. 5ff
A/P on, A/L engagement

Spoilers

5 panels per wing
1/2 (IB)
3/**4**/**5** (OB) Called **MFS**
Roll control, speed brakes, GND spoilers, steep APP mode
A/P requires ≥ **2 panels** per side (=HYD SYS 1)
If FCM fails, its spoiler turns to **direct** mode, other splr remains **normal**
SF-ACE switches off if differential panel deflection exceeds limits

Roll spoilers
Roll augmentation. Belongs to PRI flight controls
Initially, only the aileron moves. As wheel angle increases, spoilers deflect (angle depends on A/S, ~4°; in direct mode: fixed gain. SPOILER FAULT MC)

SPD BRK
Max deflection **30**°. SPD BRK lever signals FCM 1/3/4
Auto-retract when **flap ≥ 2** or **TL > 70°** during G/A or **< 180kts**
(SPDBRK LEVER DISAG MC)
SPD BRK and roll spoiler commands will be mixed
Not available in direct mode

GND spoilers
During LDG. Together with the 2 IB panels
Deployed when A/C **WOW**, TLA < **26**°, wheel SPD > **45**kts or A/S > **60**kts
1/2: **60**°, 3/4/5: **40**° deflection
Auto-retract when wheel SPD < 45kts for **5**sec or TLA > **35**° after LDG
Not available in direct mode

Steep APP mode
Only 2 OB panels L4/L5/R4/R5. ELEV fixed; pitch control via spoilers

Control column:	-4°	0°	+4°
Spoiler deflection:	18°	10°	0°

High Lift System — Dual channel SF-ACE. Skew sensor protecting from asymmetric cond

Leading edge slats — PDU with 2 **ELEC** DC motors. **4 slat panels per wing**, 2 actuators each

Trailing edge flaps — PDU with 2 **ELEC** DC motors. **2 flap panels per wing**, double fowler slot (main flap panel / rear panel), 2 actuators each

Operation		E1/E2	E1/E2		
	0	slat 0°/0°	flap 0°/0°	v_A **210**kts	detent/stop
	1	slat 15°/11°	flap 7°/7°	v_A **180**kts	detent
	2	slat 15°/17°	flap 10°/13°	v_A **160**kts	detent
	3	slat 15°/20°	flap 20°/20°	v_A **150**kts	detent
T/O	**4**	slat 25°/25°	flap 20°/25°	v_A **140**kts	gated/stop (G/A)
LDG	**5**	slat 25°/25°	flap 20°/25°	v_A **140**kts	detent
	Full	slat 25°/25°	flap 37°/35°	v_A **130**kts	detent/stop

Slats extend first, **then the flaps**. Flaps retract first, then the slats ("flaps are under the slats")
F5 / **Ffull** only when **gear down** and locked
Slat/flap interlock is disabled on GND, allowing any slat/flap selection
If lever remains between detents, slats/flaps remain in last POS
If one ACE or one motor fails or in **ELEC EMG**, slat/flap operate at **half rate** (FLAP LO RATE or SLAT LO RATE advisory message)
Both failed: FLAP FAIL MC or SLAT FAIL MC (the other part still works, while certain slats/flaps combination are prevented inflight only)
ELEC EMG: No selection beyond position 3 possible (A/S for RAT req)

Skew protection — Protection against **asymmetric** extensions; SYS is shut down

Strike protection — SYS **removes ELEC power** in case of excessive loads. **Retraction** still possible. FLAP FAIL or SLAT FAIL MC, SLAT-FLAP LEVER DISAG MC
"Cycle" up to three times, then the ACE units remove all power

Indications — Two cyan pointers — Selected POS of flaps and slats
Tick marks on scale — Up and max down POS

E2 Fly-by-Wire System — Full fly-by-wire (all axes). No control movements if A/P is engaged
Leave controls at zero-point, only **minor corrections**
Hardly any inputs required for **flare**
3 FCC instead of P-ACE/FCM
1 additional pair of **MFS** (**4 pairs** / 8 in total; 3/4/5/6)
1 additional (5th) pair of **slat panels**
Neutral spiral stability (maintains bank)
Autopilot is integrated into FCC; control columns do not move
Autopilot **not** available in direct mode
Actuators are always ON (normal mode; **active/active**)

FCC — Command computation, pitch/yaw damper, SPD brakes, roll, GND spoilers, turn coordination, autopilot, normal/limit flight envelope (autopilot, normal/limit flight envelope: n/a in direct mode)
Trim inputs as well via FCCs

Normal flight env — **Max bank 33°, AOA shaker, v_{MO}/M_{MO}, pitch -15°..+30°**

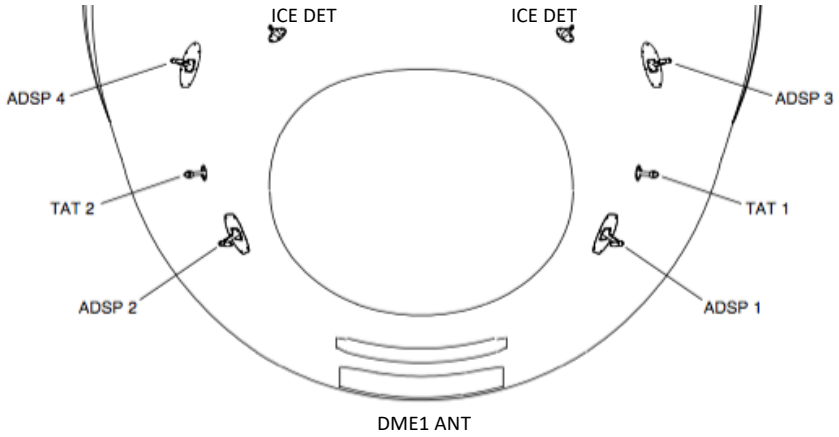
Limit flight env — **Max load factor, max AOA, TSA, max sideslip angle, max dive SPD v_d, bank max 33° above v_{MO}/M_{MO}**

		Normal mode	Direct mode
	Pitch control	GND control law (e.g. elevator down deflection), **rotation** and **de-rotation** (after main wheel TD) function, normal flight envelope, trim via SPD target, TSA, high SPD protection, MLA (to reduce loads), **stall protection**, pitch protection	**No stall/envelope protection**, direct function of column position, stability augmentation
	Roll control	GND control laws, neutral spiral stability, turn coordination, bank protection	direct function of control wheel displacement, lift compensation and bank limit angle protection
	Yaw control	On GND direct rudder control, **50**kts YD engagement, sideslip demand inflight, thrust asymmetry compensation, **best beta** function	Direct control with pedals, limited by A/S and flaps position
	Trim inputs	Primarily via elevator, horizontal stabilizer movement only secondary (to reduce elevator load), so **no pitch trim** runaway risk anymore On GND: Trim directly controls horizontal stabilizer position	
	Quick disc button	Only for A/P	
	Best beta function	Automatic rudder (app 75% of required rudder input) / target side slip (turns **cyan**) for best CLB performance, if - ENG failure - TLA > 57 - Flaps < **5** - gear **not locked down** Yaw trim disabled	
	Flare behaviour	Different than on E1 (less input required)	
Limitations	Flight ctrl check	A full green box indication on the synoptic page is *not* required	
	Max ALT	**20'000**ft for flap extended	
	Max SPD	**230**KIAS $v_{FE,Flaps\ 1}$ **215**KIAS $v_{FE,Flaps\ 2}$ **200**KIAS $v_{FE,Flaps\ 3}$ **180**KIAS $v_{FE,Flaps\ 4, 5}$ **165**KIAS $v_{FE,Flaps\ Full}$	
	AFM 2-10	Allow **10kts margin** to v_{FE}. Step-by-step extension, except F4	
	SOPM 3-35-01	Target: Extend **before green dot SPD** (E1: +10kts in icing conditions)	

Electronic Display System		EDS
	Components	5 DU, 2 CCD, EICAS FULL panel, 2 MCDU, 2 reversionary panels DU 2/3 must be operative
	PFD	"Aviate" / "navigate/communicate" section
	MFD	Map/plan, synoptic, status, maintenance CCD (swipe along borders of track pad) **Reversion** priorities: PFD, EICAS, MFD
	Operation	Use WX and terrain. Select WPT center

Flight Instruments 5 ADS, attitude indicators, PRESS altimeters, RA, clock, A/S / M / V/S / SPD indicators, standby instruments

ADS For A/S, static air and total air TEMP, V/S, side slip, IESS, flight controls
4 **ADSP** (w/**ADC**, 1 total and 2 alpha [for AOA] PRESS and 2 drain holes, PRESS sensor in ADC), 2 TAT probes → 3 **ADA** (in MAU), correcting values



ADS **1**: uses	ADSP 1/2	ADA 1	TAT 1	→ **LH PFD**
ADS **2**: uses	ADSP 3/4	ADA 2	TAT 2	→ **RH PFD**
ADS **3**: uses	ADSP 3/4	ADA 3	TAT 1	
ADS **4**: uses	ADSP 3/4	IESS		→ **IESS**

ADS **5**: sends ADS 1/2 information to the **flight control SYS**

Static port blockage ADSP 3/4 → affects all ADS 2 / ADS 3 / IESS

Pitot port blockage ADSP 4 → affects only ADS 2 / ADS 3 (only affects pri smart probe)

If ADS fails or SENSORS ADS pressed, affected PFD **reverts** to other SRC:

LH PFD:	ADS **1**, ADS **3**, ADS 2	(first reversion
RH PFD:	ADS 2, ADS **3**, ADS 1	automatically)

PFD	A/S	"Rolling digits", only if > 30kts. Barber pole (v_{MO}, M_{MO})	
		Top of red section	**v_S**
		Top of amber section	**1.13**v_S (stick shaker may activate. (may be less if > M 0.45)
		Trend vector	**10**sec
		REF SPD bugs	If > 40kts. v_1 (magenta), v_{FS}/v_{APP} (cyan), v_R (cyan), v_2 (white)
		M number	if > M 0.45; remains until < M 0.40
		Green dot	Driftdown SPD when slat/flap up and ideal slat/flap extension SPD for current mass. Full bank protected **Not** accounting for SPD BRK ≥ 1.3v_{SS}
		CAS	Difference between PFDs
	ALT	Range	±550ft
		Trend vector	**6**sec
		Selected ALT	Cyan when set by crew Amber when within 1'000..200ft
	V/S	Needle	Non-linear. Parked if > 4'000FPM, removed if > 9'999FPM
		Digital readout	If > 550FPM. Resolution: 50ft
	ATT	Chevron	Acceleration/deceleration ptr
		Speed error tape	Δbetween actual and selected SPD (both should be on **opposite side**) (both not displayed in TO/GA)
	Miscompare trigger values		RA ≠ set value, roll ≥ 6°, pitch ≥ 5°, IAS ≥ 5KIAS, ALT ≥ 200ft, FPA ≥ 2°, HDG ≥ 6°, G/S 2/3 dot, LOC 1/2 dot
RA	**-20**..**2500**ft/AGL. For low ALT awareness, min ALT annunciation, RA indication 2 RA control units Cyan selected RA value. White if a minimum RA ALT Green actual RA ALT. Amber if one RA failed. White MIN if at/near MIN Amber RA on ADI when Δ > 10ft		
IESS	Standby SRC of PRI flight information. Not for RVSM **Own air data computer**, **own IRS** (nr. 3) Attitude, baro PRESS, IAS, M, ALT (ft/m), V/S, v_{MO}/M_{MO}, slip/skip, **LOC** / **G/S** (via "ILS" button; LOC is rather sensitive) Powered when **BATT 1 ON** and **BATT 2 AUTO** **90**sec alignment phase (INIT 90 s flag - do not move; inflight ATT errors) CAGE: press for ≥ 2sec		
Stby Magnetic Compass			
Clock	UTC time, elapsed time, date, chronometer. Powered by DC ESS bus 1 CHR or wheel btn to start/stop the chrono; RST to reset (only if stop) GPS: Sync time/date with GPS. INT: Internal (if no GPS received); SET to set ET: AUTO: Starts at T/O and ends on GND. RST to reset (GND only)		

Communications

Radio COMM SYS
VDR 1/2/3, HF, optional SATCOM
VDR 1/2 in MRCs 1/2, VDR 3 in MMRC
VDR 1/2 used for voice COMM only; audio/MIC bus
VDR **3** normally for **data** COMM by ACARS (via MAU 1); also usable for voice COMM (via MRC 2)
All 3 connected to MCDU/PFD through ASCB
Tuning (COM/NAV):
1. MCDU - RADIO (via scratchpad or tuning knob)
   Abbreviated frequencies may be entered
   Change squelch by pressing twice on STBY freq
2. CCD: Select PFD, move to COMM/NAV window
3. MCDU 2 backup MENU-RDO page
   (COM 1/NAV 1/XPDR 1 only)

ACP
3 digital **ACP**. Audio warnings from ALT alert SYS, GPWS, TCAS, windshear alert SYS. Through cockpit SPR and HDPH; **cannot be silenced**
Outputs: Radio, NAV aid, INPH, PA
Automatic transmit time-out SYS
OXY AUTO: Switch to mask MIC when mask is taken out
SPKR are automatically activated
To **reset**: **Close** mask box, press **TEST/RESET**
ID Filter out voice part of NAV aid broadcast
SELCAL Four-letter code for VHF or HF. Button flashes on call
If pressed; the SELCAL code is displayed
VOL Most recently selected audio, if BKUP NORM
BKUP If ACP PWR loss or both digital audio buses fail
LH pilot: VHF 1, RH pilot: VHF 2

INPH SYS
Cockpit to cabin (incl LAV) and to GND (w/horn)
2 INPH stations in cabin (FWD, aft)
ACP: CAB (single high/low chime; green light on rainbow, pick up handset, press CAB again, and again to terminate), EMER (triple high/low chime; red light on rainbow), RAMP (horn sound; 3 headset stations outside A/C)

PA SYS
Pilots' and F/A's (from both stations) announcements to PAX and pre-recorded announcements and music. PA button on center pedestal
PRIO: **Cockpit**, F/A, pre-recorded announcements, music

DVDR SYS
Audio and flight data information (CVR and FDR)
2 Units (FWD/aft ELEC bay)
Can be accessed for maintenance via MCDU
2h audio of cockpit, **25**h flight data, **2**h digital COMM
OVHP: TEST to test both units. CVR ERASE on GND only

CMF
ACARS With thermal printer. **Flight times**: Door closed, PKG BRK
CPDLC Not activated

Navigation

Display
On PFD (lower part) and MFD
MFD: Full compass, arc, map. WND as single arrow or in H/XWND comp

Radio-based
VOR, NDB (1), DME, ILS, XPDR. Located in MRC
No NDB/VOR tracking possible; use HDG mode
RA (≤ 2500ft)

GPS
2. POS, SPD, time
GPS 1 in MAU 1 in fwd avionics bay
GPS 2 in MAU 3 in center avionics bay
NAV - POS SENSORS
RAIM (5 SAT req; ABAS), FOM (uncertainty in NM); HDOP, VDOP (SAT geometry, the lower the better, normally < 10), mode (navigation, self-test, initialization, acquisition, differential, altitude aiding, velocity aiding, failed) - required at ETA ±15min (OM-A 8.1)

GPS RAIM ABOVE LIMITS (depending on phase of flight), RAIM WILL EXCEED LIMIT, GPS RAIM UNAVAIL, ALMANAC EXPIRED (> 3.5 days)
MCDU - GPS STATUS page - PREDICTIVE RAIM page
PRIO: FMS 1: GPS 1, then GPS 2. FMS 2: GPS 2, then GPS 1.

IRS
Attitude, ground speed, HDG, PO. 3 laser gyroscopes, 3 accelerometers
Delivers MCDU, PFD, reversionary panel (**not automatic**), FMS, WX rdr
2 IRS: Each IRU, ADC, GPS
IRU outputs: Pitch, roll, mag HDG, true HDG, linear acceleration, angular rate, inertial velocity, POS, WND SPD, WND direction
Automatically powered up and aligned when on GND
Initial POS manually from MCDU or automatically from GPS
Do not move during align. Can take up to **17**min (IRS STATUS page)
No "quick align". Alignment possible **inflight with GPS**

FMS General
Load 27.2. Auto POS INIT, auto VNAV capture, VAP is target SPD when LDG flaps is selected, G/A auto LNAV (200ft) / VNAV
Editable fields — No space to LSK
Boxes: Required values. Dashes: Optional values
Provides set of NAV functions using **GPS** (PRI) and IRS, also radio NAV
RNP LVL 0.3. For remote/oceanic areas
Update NAV DB on a 28 day cycle
Push FMS to display on PFD, push a second time for cross-side FMS
MFD, vertical flight plan profile: Selected ALT (dashed cyan), selected horizontal range (white vertical lines)
Displays next WPT ALT constraints (bars above and/or below identifier)
Amber **XTRACK** / amber FMS vertical track line when A/C significantly deviates from planned **horizontal track**
If in FMS SRC mode, switch to VOR/LOC via **V/L** (E1) / **NAV** (E2) button, or preview via **PREV** (off → on-side → cross-side → off)
VTA issued 60sec before FMS commands CLB/DESC or 1000ft before LVL off at a constraint
Auto-tune: PROG, DEL, 6L/R LSK

T/O
VNAV CAP AFE — FLCH, SPD limit
DEP SPD AFE LIMIT — Acceleration → v_{FE}-10 → 250

OEI T/O
LNAV and BANK engage at 200ft/AFE; FMS SPD allowed. A/C would follow SID, so select HDG (which disengages BANK automatically) at 400ft/AFE to follow EO routing
VNAV engages at VNAV CAP EO ALT acc DEP LIMIT page (set according ePerf level-off height). Once engaged, A/C accelerates to v_{FS}

APP SPD
Fixed SPD schedule: FMS commands SPD according flaps setting
Green dot SPD can be used as APP SPD (may be < than scheduled SPD)
< **30**NM — **ACT APP SPEEDS** prompt appears
Manual SPD intervention via LSK 1R

RNP
DEGRAD if **EPU** > RNP value, or if FMS position integriy > alarm limit

G/A
TOGA — LNAV/VNAV will be armed
FMS SPD — CLB with **v_{REF}+20**, VNAV engages at VNAV CAP AFE, commands programmed SPD LIMIT, at AFE LIMIT ALT acceleration to CLB SPD (acc PERF INIT; v_{FE}-10 then **250**) for clean-up
Man SPD — Stick to "Gear up, SPD up".

OEI G/A
TOGA — LNAV/VNAV/EO AUTO will be armed, speed **v_{AC}**
LNAV engages at 200ft/AFE, BANK will engage
A/C follows missed APP route
VNAV engages at VNAV CAP EO ALT acc G/A LIMIT page (set according ePerf level-off height). Once engaged, A/C accelerates to **v_{FS}**

DD
engages when ENG OUT is confirmed on EO range page (green dot)

Misc	MENU - MCDU MAINT - RESET	Reset MCDU
	MENU - MISC - SETUP	WND as vector or components
	MENU - MISC - TEST - NEXT	**RA test**
	PROG 3/3	**EPU**, Spot WND, track, HDG
	DLK - SYS MENU - DLK MGR - VHF FREQ SEL - ACARS FREQ 131.725	
	DLK - SYS MENU - DLK MGR - AOA VHF DISABLE/ENABLE - VDL MODE A	
		For FPL download on GND
	DLK - FLT TIMES	Flight times
	PERF - LANDING	**LDG mass**
		(actual mass: MFD - status page)
	NAV - CROSS PTS - EQ TIME PT	Equal time point
	NAV - FLT SUM	Flight summary, **fuel used**
	NAV - NEXT - CONV	Conversions
	NAV - NEXT - POS SENSORS - GPS STATUS - GPS ALT, PRED **RAIM**	
	NAV - NEXT - POS SENSORS - VOR/DME - NOTAM	De-activate VORs
	NAV - WPT LIST	Store GPS POS as WPT, NAV DB
	NAV - DATALINK - FLT PLAN	**FPL ID** from updated FPL in IFS ("D…")
	NAV - DATALINK - WINDS	REQ, ACCEPT to update ENR WND
	PERF - NEXT - FUEL MGT	Fuel, GND SPD, specific RNG, flow
	PERF - PERF DATA	Performance data, ETE, ETA, **fuel**, **masses** at DEST/ALTN, WND
	PERF - LANDING	LDG mass only after 15min flight time (before: LDG mass for return to DEP A/P)
	PROG - NEXT - VNAV DATA	TOD / BOD
		TWND: Adjust PERF INIT angle
	PROG - DEL, or RADIO - 2x4L/R	**Autotune**
	RTE	**Offset** (**SLOP**). E.g. insert "R5"
		SLOP not possible on SID

WX Radar

Primus P-880, WU-880 antenna
E2: with RDR-4000 3D volumetric radar
WX, turbulence, GND mapping. Can be displayed on PFD and MFD

WX intensities	Black, green, amber, red, magenta
	Rain rate x3..4 per step
GND mapping	Coastlines, hills, mountains. Black, cyan, amber, magenta

RTA unit (antenna stabilized by inputs from IRS)
Controlled by CCD

Modes	WX, GMAP, STBY/FSBY (FSBY on GND), OFF, SLAVE (one radar OFF). OFF/STBY/FSBY: Antenna stowed
FSBY	Exit by **FSBY OVRD** (both MFDs), or **4 x STAB OFF** < **3sec** (one side)

White WAIT: RTA unit warms up

On PFD

HSI - WX - HSI (range: last selected range)

Functions

GMAP for hilly mountains
Consider variable gain

SECT Sector scan
±30°/24 sweeps/min instead of normal ±60°/12 sweeps

STAB Antenna stabilization
White STAB: STAB OFF selected; amber STAB: Function disabled

GAIN Receiver gain
VAR or calibrated (preset; adjusts receiver sensitivity)

TGT Target alert
Beyond selected range and HDG ±**7.5**°; red/magenta levels beyond selected range; only < **200**NM
Amber TGT if echo detected

RCT REACT to identify severe TS
Auto gain adjust to compensate for loss of signal energy when passing through targets
Cyan field: No further compensation possible

ACT **ALT compensated tilt**
±15°. Function of ALT and range
CCD inner knob to adjust tilt offset by up to 2°

LX Lightning clear test. Radius 200NM
Detect presence of lightning
Rate 1 (single strike): ⚡ white icon, no arrow
Rate 2 (3 strikes): ⚡ white icon, lower arrow
Rate 3 (6+ strikes): ⚡ white icon, both arrows
Intense lightning: magenta icon
Clear lightning symbols via CLR TST

TURB Turbulence detection
Soft white areas, in WX mode only, range ≤ **50**NM

Test — MCDU avionics test page. SYS radiates power during test if not in FSBY

E2

Screen settings — OM-B 2.0.2.9. **PFD in ¾th layout**, **PF** defines position of EICAS

Power-up		DU1: Status / EICAS	DU4: EICAS / Status
Default		DU2: Flt controls / EICAS	DU3: Status / Map
Flt prep		DU2: ELEC / Flt controls	DU3: EICAS / Status
Flight	PF LSP	DU2: Map	DU3: EICAS / Map
	PF RSP	DU2: Map / EICAS	DU3: Map
Shut-down		DU2: ELEC / Flt controls	DU3: EICAS / Status

SVS — OM-B 2.0.2.10
FMS: MENU - DISP SETUP - SVS
Must **not be used as primary NAV source**
Shall be **on below MSA**
Wider pitch scale compared to E1
White terrain range lines (distances; 10/20NM)
RWY is track oriented; ZPRL HDG bug (⚲)
Bottom of surrounding box is abeam TDZ
Extended centerline of RWY (not of APP)

Traffic — ▶◀ Closure rate

SA terrain — Max elevation Within circle (not on entire display)
40° (±20° based on TRK) / 40NM arc
TRACK on VNAV Terrain displayed based on TRK

WX radar — Hazard: Lightnings (⚡) and hail (☌, red areas)

AUTO	Primary/secondary WX
ALT	WX for selected ALT/FL
AZM	WX for selected track
SEC WXR	Secondary WX (transparent/striped)

3D volumetric

Use of **INAV** — OM-B 2.0.2.11
Topography shall be selected **on below MSA**
TRAFFIC shall always be on
E195-E2: **Graphical flight planning** (Direct To, Aircraft - PPOS Hold)

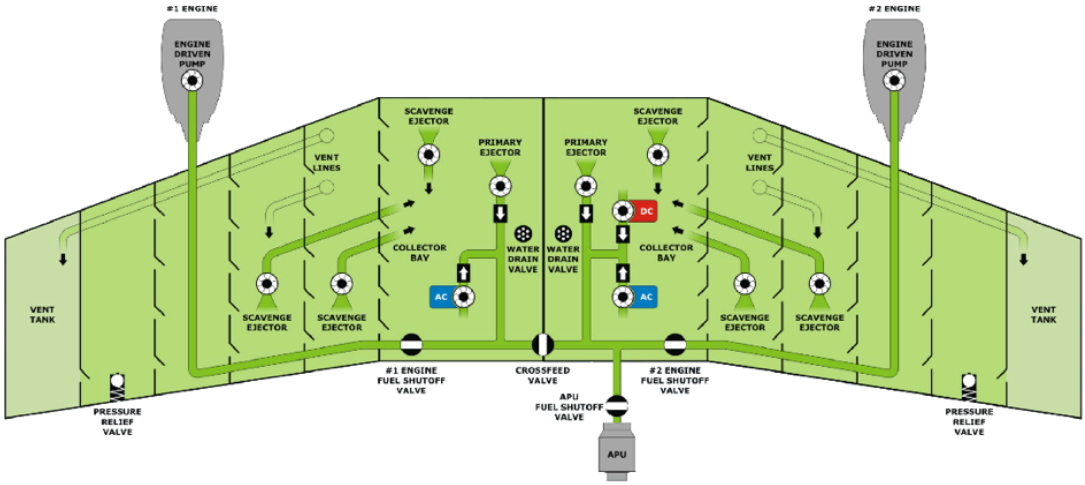
Call-outs — OM-B 2.0.2.19

Predictive WS — OM-B 3.13.4
Up to 5NM ahead (**10-60sec** warning time)
Auto < **1800**ft/AGL, alerts ≤ **1200**ft/AGL
MW: HSI reverts to 90° arc / 2.5NM range

Advanced RAAS — OM-B 8.3.29.1.3f
"RAAS checked", consider G/A
Unstable aural warnings (flaps, too high, too fast, unstable): **G/A**

ALT	Enter, then confirm (**push**) QNH **VNAV** display: Calculated for idle descent, 40kts TWND, w/SPD reductions
ET	To reset: CCD top left, then side button
EDS	**4 DU**, **2 CCD** (with **6 hot spots** [double tap]; LH CCD for DU 1-3, RH CCD for DU 2-4), 2 display controllers Power up / ELEC EMG: **DU 1 and 4**. Power up: MFD/EICAS Automatic reversion (prio: PFD-EICAS-MFD)
Controls	**NAV** iso V/L (green SRC), LNAV iso NAV, **no YD button** (**auto** engagement at **50**kts), MIN/BARO swapped; BARO: Push to enter No FPR available in V/S mode
DU	AUTO reversion: 1 PFD/side when airborne (most ob), 1 EICAS ib, 1 MFD
Brightness	MENU - DISP SETUP - BRT: 2x85

E1 Fuel System Storage (2 vented integral type tanks), distribution, indication



Each wing **Surge** tank (= vent tank; outward; NACA air inlet, flame arrestor, surge relief valve) - **main** tank - **collector bay** (inward, with **low level sensor**, **independent** from fuel quantity sensing probes)
Dry bay (near ENG pylon, to prevent rupture if rotor bursts)
Wing ribs with baffle and flapper check valves (one way)
Pressure relief valve, 2 water drain valves at wing root

Collector bay To keep the fuel pumps **submerged** (**continuous fuel feed**)
If collector box is not full (e.g. due to **ENG failure**, loss of **motive flow**, failure/blockage of scavenge pumps):
Collector bay flows out, fuel is leveled with other part of the tank, FUEL LO LEVEL MW may come on if < 2800kg. ENG could flame out if |pitch| > 15° / during uncoordinated maneuvers / negative g. Monitor fuel quantity on EICAS/MFD

Vent system **2 independent lines** into surge tank, to keep **PRESS difference** within limits, to **prevent fuel spillage**
Main vent line with float actuated drain valve, ob vent line with float vent valve, wing stub line with float actuated drain valve)

Pumps All pumps in collector bay

Ejector 1 per tank, **ENG driven**. **PRI** mean. No moving parts, **no ELEC**, venturi eject, **motive flow** from
Displayed on MFD

AC ELEC **Backup** (for ejector pump)/boost for **ENG start**, automatically
AC bus 1 (LH) / AC ESS bus (RH)
For **onside ENG start**, on **during XFEED** on cross-side ENG, **APU** when ENG not running
If ENG 1/2 FUEL LO PRESS MC
If **not in AUTO**, XFEED command is overridden

3 scavenge per tank. To **fill the collector bay**, for constant flow
Driven by **motive flow**

DC ELEC **RH collector bay only**. **DC ESS bus 2**
For **APU** if ENG not running, no AC power, or no AC pump

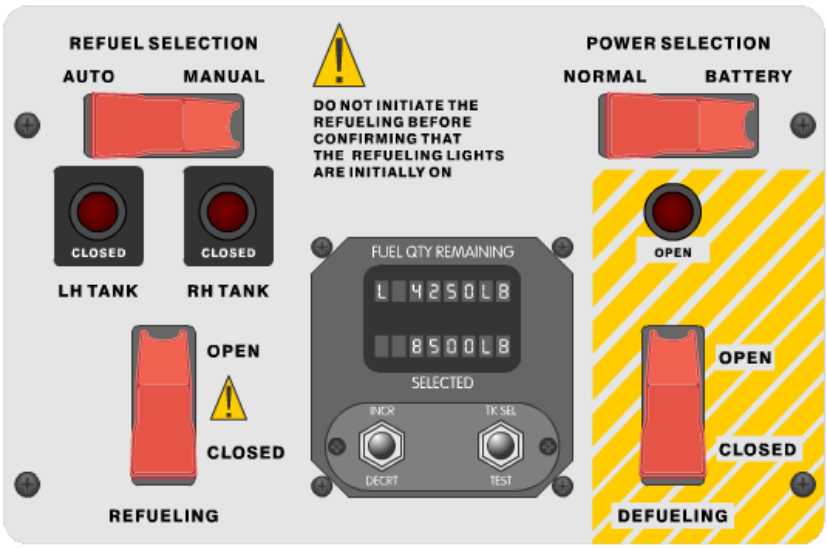
Valves ENG, APU, XFEED (on DC ESS bus 3; both ENG fed from same tank)

E2 Fuel System

Components		2 wing tanks, 1 center tank, **2 collector** tanks, **2 surge** tanks (outer end) **2 AC** pumps in center tank, **1 AC** pump per wing tank, **1 DC** pump in RH wing tank (for **APU** start), 1 transfer valve On-board **inert gas generation** (**OBIGGS**; enriching air with N to minimize flammability)
E1 Way of fuel		Scavenge pump - collector bay - ejector pump - shutoff valve - ENG **Low PRESS** pump - heat exchanger - **high PRESS** pump - fuel filter - fuel metering unit - fuel injectors, and after high PRESS pump via motive flow to fuel tank again. (EDP: 2 pumps; low/high PRESS) **Fuel shutoff valve**: Normally open; to close: ENG cmd off, or fire handle
E2 Way of fuel		Center tank (1 SOV, 2 AC pumps / one automatic, ensuring **2100..2200kg per wing tank**, feeding both wing tanks simultaneously) - wing tank - scavenge pump - collector tank - primary ejector pump (motive flow) - shutoff valve - LP part of ENG; one part via FCOC-HP, another part to FMU
Measuring		ELEC/MECH fuel quantity, **TEMP** (**LH** tank collector bay only, ≤ -37°C), low fuel level sensor **13 AC capacitance-type** ELEC probes, 1 compensator unit per tank MECH: 3 magnetic level indicators under each wing
AUTO operation	**AC** pump	On if low PRESS in ENG inlet (ejector fail) or in **XFEED** Controlled by SPDA. Required for **ENG start**
	DC pump	On if APU switch on START if no other pumps running AC/DC pumps to AUTO for APU start required
Indications	Amber X on pump	Pump failed on (green) / off (white)
	Amber total fuel indication	if ≤ **1600**kg total
	Amber tank fuel indication	if ≤ **800**kg in respective tank
	FUEL LO LEVEL MW	if < **400**kg in wing tank (800kg total/**30**min)
	FUEL IMBALANCE MC	Imbalance ≥ **360**kg, disappears if ≤ 45kg
	FUEL EQUAL-XFEED OPEN adv	Imbalance < **45**kg, close XFEED
	FUEL TANK LO TEMP MC	if ≤ **-37**°C in left tank
XFEED		No XFEED during T/O and LDG

Fuel Panel

Single refuel/defueling point, fwd bottom RH wing, ob of ENG
Additionally, two gravity refuel ports on top of each wing



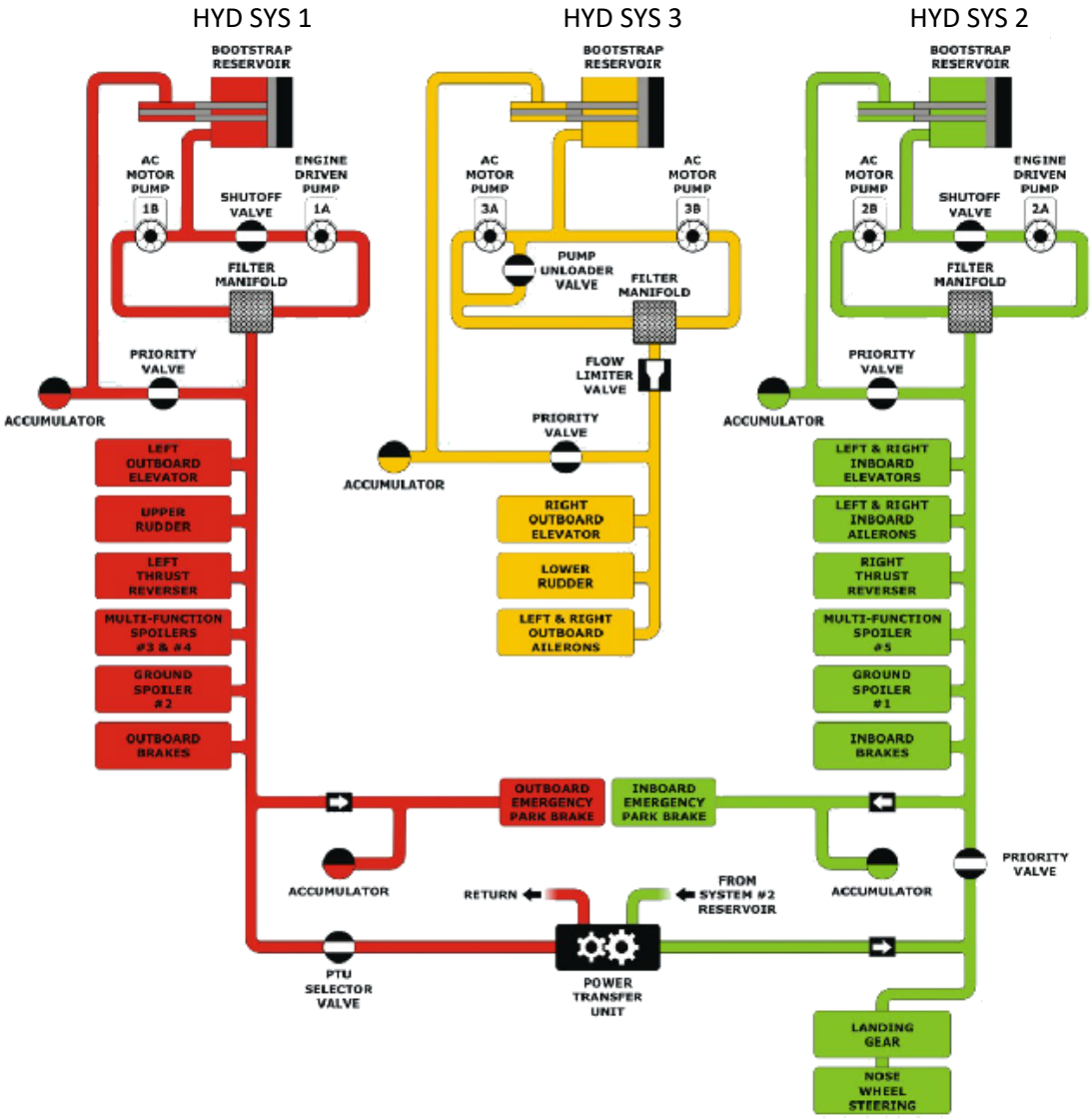
DC bus 1/2 or HOT BATT bus 2 (select via POWER SELECTION switch)
AUTO (FCU) or MANUAL
Automatic SYS check once refuel line is plugged in. Successful if two

			CLOSED lights illuminate Start via REFUELING to OPEN
	Fail-safe MECH		Refueling shutoff valve when quantity in tank exceeds certain value STOP L/R OVER message
	Defueling		AOM 13-25 4f Using PRESS or suction, via defuel valve GND A/C, connect to nozzle, AC pumps on (if PRESS), XFEED
E2	**Trapped fuel**		PERF - NEXT - FUEL MGMT, enter amount of fuel in center tank Only **range** value on PERF - CRUISE page is adjusted (but not on progress page)
	Cold soaked		Allowable **cold soaked fuel frost area** on upper wing, if no precipitation, no vis moist, TEMP > 0°C, frost only inside marked area
Limitations	Capacity	**E1**	Max usable **13'100**kg (2 x **6'550**kg), 2 x **46**kg unusable
		E2	Max usable **13'690**kg (2 x **2'190**kg in wings + **9'310**kg in center tank)
	Low level MW		< **400**kg per tank (if < **1200**kg on T/D: Write report)
	Max imbalance		**360**kg
	Fuel Jet A-1		Min **-44**°C < **-10**°C: Fuel ice inhibitor additive use recommended

14-11 HYDRAULIC

Hydraulic System **3000**psig nominal
Safe operation even with two failed SYS
Fluid **cannot be transferred** between the SYS

Pumps	SYS **1/2**	**1 ENG** pump	**EDP**	1A/2A	**PRI** SRC
		1 ELEC pump	**ACMP**	1B/2B	**AC bus 2 / 1**
	SYS **3**	**2 ELEC** pumps	**ACMP**	3A	**AC ESS bus**
			ACMP	3B backup	**AC bus 2**



HYD PUMP 1 on if **taxi on ENG 2** only
(otherwise: BRK FAULT)

NWS on HYD SYS 2

Location Center section of fuselage, aft of MLG

Components **3** HYD **reservoirs**, 3 MECH pistons, **2 ENG driven pumps** (main SRC, with shutoff valves - only valve can be closed; pump cannot be stopped / AGB cannot be disconnected), **4 ELEC** HYD pumps (T/O, LDG, and as backup), **accumulator** (**constant/residual PRESS** to avoid cavitation; but not feeding HYD SYS in case of HYD leak), **thermal bypass** valve for fluid from the pumps (**not in SYS 3**), **PTU**, quantity/TEMP sensors (**closing** EDP shutoff valve [SYS 1/2] or switch **ELEC pumps off** [SYS 3] if > **125**°C)

Priority valve Isolates **LDG gear/NWS** if PRESS low (priority to flight controls)

PTU Transferring **PRESS** from SYS **1 to** SYS **2** during T/O/LDG for **LDG gear/NWS** when ENG 2 driven pump failed
Not for flight controls. **No fluid transfer**

Unloader valves	Pump unloader valves, controlled by FADEC during windmilling	
Consumers	PRI/SEC flight controls/spoilers, LDG gear, BRK, NWS, thrust REV **SYS 3 accumulator**: Also for flight controls from start of RAT deploy until AC ESS bus is powering again pump 3A	
HYD PBIT	Functional test of flight control actuators, every time on GND **when all 3 SYS are powered**. **10**°C HYD reservoir TEMP minimum. Valid for **50**h Force HYD PBIT: Via HYD warm-up procedure (QRH NP16)	
SYS 3 valves	During **ELEC EMG**: Pump unloader valve (**during RAT deployment**) and flow limiter valve (**during RAT operation**), to avoid RAT overload SYS 3 provides power for flight controls during RAT deployment SYS 3 overheating protection (and MC/MW) inhibited during ELEC EMG	
SYS **1/2 AUTO**	Inflight	EDP or ENG fail, or **flaps** > 0. Off if **F0** or 1min after T/D
SYS **1 AUTO**	GND	**Flaps** > 0; and T/O **thrust** or > **50**kts. Off if **F0**
SYS **2 AUTO**	GND	additionally, ENG 1 running, PKG BRK released ENG 1 start (when N2 40%) if PKG BRK has been applied within last 6min (for **flight controls check**) → **Start ENG 1 then ENG 2**
SYS 3 AUTO	On when pump 3A failed	
PTU AUTO	T/O / LDG	Active when ENG 2 or EDP 2 fail Active when flaps extended, EDP 1 operating, HYD 2 quantity > 12%

Operation	Prior ENG start:	PTU, ELEC PUMP 1/2/3B to AUTO
	After ENG start:	ELEC PUMP 3A ON (OAW: when S/U received)
	ENG 1 only taxi:	ELEC PUMP 2 goes auto on (NWS, IB BRK)
	HYD SYS warm-up	**<u>If reservoir TEMP ≤ -18°C</u>**, prior ENG start (referenced in QRH NP16-1) 4 ACMP on, engage NWS, check flight ctrls, when SYS 1-3 > -10°C: ELEC PUMP 2 off, PTU ON, 30sec, all AUTO, ELEC PUMP 3A OFF
E1	Loss of HYD 1 or 2	**A/P** still functional (if HYD3 is available)

Indications	Cyan quantity	Needs to be refilled
	Dashed amber	Position/status/PRESS undeterminable
	Amber cross	Component failed
	HYD OVERHEAT **MW**	At **145**°C Respective pump goes off at **125**°C (shutoff valve)
	HYD HI TEMP **MC**	At **100**°C
	HYD LO PRESS MC	
	HYD PTU FAIL MC	PTU is not supplying PWR / compromised
	HYD 1/2 EDP NOT D-PRESS MC	
	HYD 3 VLV FAIL MC	One or both valves failed

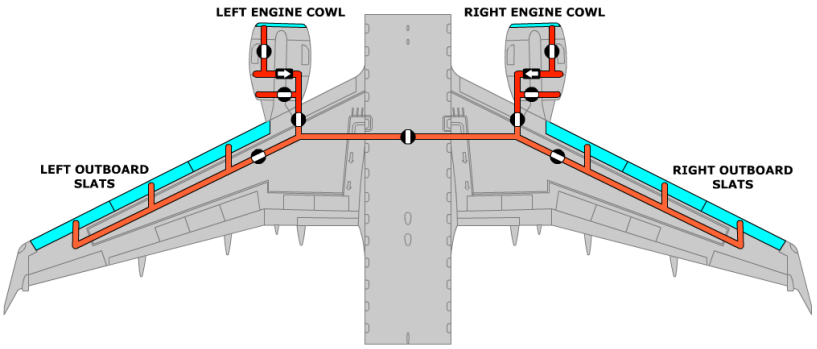
14-12 ICE AND RAIN PROTECTION

Ice Detection

2 ice detector probes, LH/RH of nose section, connected to MAU
ICE CONDITION advisory; probe is heated for few seconds
Dual ice detector failure: Use A/I SYS in **manual** mode

ENG / Wing A/I

Pneumatic bleed air for A/I heating for ENG cowls, 2x3 OB **slats** (**not** for IB)
No A/I for horizontal stabilizer (in contrast to EMB145)



SRC

APU bleed cannot be used for A/I. If REF A/I is ENG or ALL for T/O or ice is detected during T/O with APU bleed, the APU bleed valve will close and PACKS will switch off

ENG cowl

Bleed air from **5th stage compressor**, piccolo tube around cowl
ENG A/I valve powered by DC bus 1/2, ELEC controlled by AMS, pneumatically operated. ELEC PWR required to maintain closed POS
A-I ENG 1/2 FAIL MC if valve is closed but cmd open, or duct fail

Wing

A/I valve located in wing pylon, telescoping duct, piccolo tubes in slats
2x3 slat skin TEMP sens (1 on slat 2, 2 on slat 4, 1 for calc of heat req)
PRESS sensor downstream, overheat detector (leak detection)
AMS calculates the required skin TEMP
Cross bleed valve will **open** automatically if bleed source is lost

Test

TEST ENG/WING by maintenance only

Self-test

BIT, takes **60**sec; **10**min after T/O / **10'000**ft/AGL (whichever is first):
A-I WING VLV OPEN status message, MFD A/I synoptic page is displ
E2: 10'000ft/AGL and at least 2min after liftoff

MODE **AUTO**

Wing A/I comes on if ALT < 22'000ft, OAT within certain limits, V/S < ±200FPM, A/S 150..320KIAS for 2min, until 2min thereafter
ENG and **wing** A/I auto **on** if ice detected,
<u>until 5min with no ice any more</u>
E2: **<u>2</u>**<u>min</u>

MCDU ENG/ALL ON

On when wheel speed > **40**kts (E2: 30kts) until **1700**ft/**2**min, then AUTO
ENG on if ENG **running**, **wing** on if A/C **airborne**, A-I MODE NOT AUTO advisory

On GND / T/O

Select via MCDU (TRS)
≤ **10**°C and moisture (can cause ice accumulation)

> **10**°C	MODE AUTO/ON	REF A/I **OFF**
5..10°C, **moisture**	MODE AUTO/ON	REF A/I **ENG**
< **5**°C, moisture	MODE AUTO/ON	REF A/I **ALL**

(ENG REF A/I DISAG otherwise)

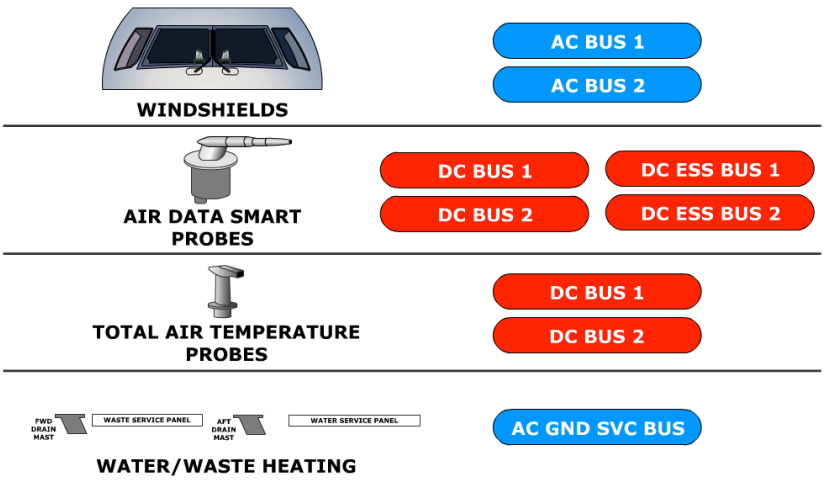
Failures

One ice detector failed: **System** (including automatic activation) **still works, but CL requests manual mode**
If both ice detector failed and OAT ≤ 10°C: MODE to ON, until 2min after leaving icing conditions

TO DATASET MENU	MODE SELECTOR KNOB	ICE CONDITION	ENGINE A/I ACTIVATION	WING A/I ACTIVATION	EICAS CAUTION MESSAGE
OFF	AUTO	NOT DETECTED	-	-	-
		DETECTED	1700 ft AGL or 2 min after liftoff	1700 ft AGL or 2 min after liftoff	-
	ON	NOT DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
		DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
ENG	AUTO	NOT DETECTED	ENGINE RUNNING	-	-
		DETECTED	ENGINE RUNNING	1700 ft AGL or 2 min after liftoff	-
	ON	NOT DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
		DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
ALL	AUTO	NOT DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
		DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
	ON	NOT DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
		DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-

Windshield, Sensor, Water, Waste Heating, Wipers

AC ELEC PWR for A/I heating for windshields, **4** ADSP, **2** TAT probes, water and waste SYS



Windshield heat

To prevent fogging and icing. Not available in ELEC EMG
LH/RH WHCU inf FWD ELEC compartment
Anti-static film, heater film, laminated glass. 200VAC
3 heat sensors per side: 1 control sensor, 1 overheat detector, 1 spare
Self-test (gradual warm-up, several min - **120**sec with single AC pwr)

On GND with only one AC PWR SRC	Windshield heat is inhibited
Inflight with only **one AC PWR SRC**	**LH** windshield heated only If failed, RH windshield is heated
WINDSHIELD 1/2 HTR FAIL MC	Failed or overheated

Windshield wiper

To remove rain. Not available in ELEC EMG. 28VDC
Auto-shutdown if **dry** windshield and motor stalled (to reset: OFF)
LOW (80 cycles per minute), HIGH (125 cycles), TIMER (every 8sec)
RH wiper synchronized to LH wiper

Limitation Max **253**KIAS (E2: Max 14'000ft). Required for **CAT II** APP

	Sensor heating	Sensors LH/RH of nose section Fully automated; heated if an **ENG is running** or **A/C is inflight** (and button is pushed in) Heating controlled by ADCs. Heat SYS is continuously monitored Controlled by ADS PROBES HEATER **button**, manually ON (in; striped bar) **ADSP 3 heated** only if on **BATT** only	
	Water and waste	Water drain masts	Fwd, aft; heated
		Fill/drain nipple	On water service panel; with cuff heater
		Water lines	Routed through pressurized part, no A/I protect
		Rinse nipple, waste drain valve (waste service panel): Gasket type heaters	
	Indications	MFD A/I synoptic page: amber lines: Overheat detected APU icon only displayed when A/C is on GND	
E2	**Icing speeds**	OM-B 2.5.1.1. STALL PROT ICE SPEED message **Resettable** if **no icing** conditions detected, **no ice accretion** and **SAT** ≥ **5**°C May be performed by heart	

14-13 LANDING GEAR AND BRAKES

E1 Landing Gear

Tricycle, ELEC controlled/monitored, HYD SYS 2 operated
Extend and retract HYD lines, MECH locking stay to hold gear down
Indication: Amber cross-hatched boxes while gear is in transit

MLG
Door MECH connected, open if down, wheels uncovered if up
2 actuators (retraction, assist extension; center downlock disengage)

NLG
2 aft doors MECH connected, open if down
2 fwd doors, HYD actuated, only open during transition
2 actuators (retraction, assist extension; center locking stay disengage)

PSS
2 PSEM (redundant) in MAU 1/3, LDG selector valve (3 POS, 4 way), uplocks, actuators, each PSEM monitors **6 WOW** proximity sensors (**2** per leg), **uplock**/**downlock sensors** (**2**/**2** per leg)

Air/GND
Sensing via compression of LDG gear shock absorbers, input for APU/CGO fire protection, spoilers, window heat, PRESS, ENG idle SPD and IGN, thrust REV operation, BRK, nose wheel steer, LDG gear
If **shock absorber** does not fully extend, the PSEM signals A/C on **GND**

Downlock release
Mechanically bypassing system protection logic

Extension			
1	Normal	ELEC signal to HYD SYS to release uplocks DN LOCK REL, override lever locking MECH (if WOW sensor failed)
2	ELEC OVRD	Switch to GEAR DOWN, **bypassing PSEM**
3	Free fall lever	LDG lever to DN, pull. Releases HYD uplocks MECH controlled / gravity powered If **HYD or ELEC failed**. Once activated, **leave in up** POS; no retraction possible, call maint

Warnings

LDG GEAR aural (E2: + flashing amber box)	F0-4 1 TLA < **38**°(AEO)/**57**°(OEI), RA < **700**ft (E2: 45°AEO/60°OEI) (**LG WRN INHIB** only if 2 **RAs failed**) F5-Ffull Always. **Not silenceable** Nosewheel steering not available anymore
TOO LOW GEAR	GPWS; < 190KIAS and below threshold ALT
LG LEVER DISAG MW	**Disagreement 20**sec after lever movement
LG NO DISPATCH MC	Failure
LG NOSE DOOR OPEN MC	One of the four proximity sensors
LG WOW SYS FAIL MC	Failure in WOW SYS

E2 Landing Gear

Trailing arm-typed main wheels with gear doors fully covering the wheels
No ELEC OVRD switch, no numerical BRK TEMP indication
After ALTN gear extension, STEER still operative (if **HYD2** is available)
Flashing amber box together with **LDG GEAR aural** warning

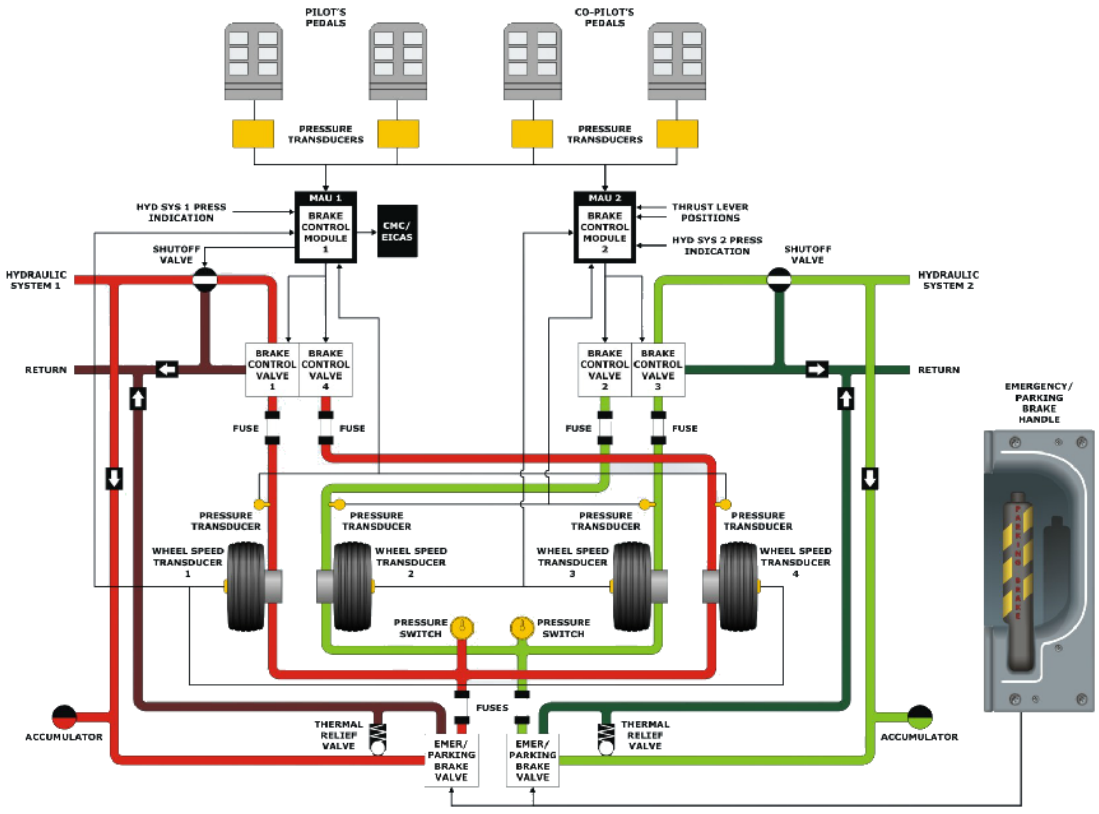
LG DOOR OPEN	Leave LDG gear down, do **not retract**

Nosewheel Steer

System	NWSCM, controlling steering manifold, located in LDG gear bay	
	Electronically controlled, HYD operated, powered by HYD SYS **2** and DC bus2. WOW indicates on GND required, **disabled if inflight**	
	Centering cams when shock absorber is extended	
Steering range	With pedals	±**7**°
	With hand wheel	±**76**° ≤ 10kts, ±20° at 26kts, ±**7**° > **100**kts
		Angle is **not proportional**
Engage	**Push** on hand wheel to engage hand wheel or pedals NWS	
Disengage	On pilot's control wheel and left fwd fuselage (at AC GND PWR)	
	Free castor mode if disengaged or faulty or angle beyond 76°; use **differential/asymmetric** braking / **rudder**. Range ±170°	
Indications	Nose gear panel	Green TOWING light if PKG brake not set or brakes not applied
	STEER OFF	Status message
	STEER FAIL MC	Failure in steering system
	STEER FAULT advisory	Degradation in steering system

Brake System

Brake **by wire**; ELEC commanded, HYD actuated



Sources	HYD SYS **1**	**OB** brakes (HYD SYS 3 not involved)
	HYD SYS **2**	**IB** brakes
Fusible plug	Attached to wheels, melting to relieve tire PRESS in case of tire **overheat**	
BCM functions	Antiskid protection, automatic wheel braking, locked wheel protection, T/D protection. - No braking while inflight	
Antiskid protect	Minimize tire wear, optimize braking distance, prevent skidding	
	Releases HYD PRESS if wheel speed falls below avg wheel speed	
	Disabled if < **10**kts (for pivoting on a wheel) and for **EMG/PKG brake**	
Locked wheel prot	Wheel pairs to compare **wheel speeds**: IB-IB, OB-OB	
	Cmds **zero HYD PRESS** on slower wheel if speed **33**% less than other	
	Disabled when fastest wheel speed is < **30**kts	

T/D protection		**No braking** during wheels spin-up to **50**kts or < **3**sec after LDG	
		If deactivated, shutoff valves energized	
		Shutoff valves de-energized closed 10sec after wheel speed 0 (T/O)	
ABM		Aims at a predefined deceleration rate	
		1, housed in MAU 2, powered by DC bus 2, connected to BCM	
		Automatic braking during LDG / rejected T/O / gear retraction	
		Antiskid, T/D and locked wheel protection still available	
		During automatic braking, a different rate may be selected	
	RTO	Arm RTO	WOW indicates on GND, average wheel speed < 60kts, no fails. Can only be selected on GND
		Activated	Average wheel speed > 60kts, both TL at idle or reverse
		To disarm	Select OFF/LOW/MED/HI, any brake pedal > 60kts, 1TL above idle, failures
	LDG	To arm	WOW indicates inflight, average wheel speed < 60kts, brake pedals not pressed, no brake control system fault
		Activated	WOW indicates **on GND for > 2sec**, average wheel speed > **60**kts, both TL at idle or reverse
		To disarm	Select OFF or RTO, any brake pedal, 1 TL above idle
		Fault	Knob returns automatically to OFF
BCM		2, powered by respective DC ESS bus	
		Pedals position transducers, commands the 4 brake control valves (each with a dual, two-stage pressure control servo-valves; in case of failure shut off), PSEM, wheel speed transducers	
BTMS		4, indication on MFD status page, via MAU 3	
Brake control valve outlets		Volumetric HYD fuses to prevent loss of fluid if leaking	
Gear retraction	Main wheels	Automatic braking	
	Nose wheels	Snubbers to stop the spinning	
EMG PKG brake		Mechanically controlled, HYD actuated (SYS 1/2), independent of BCMs	
		PRESS through the dual EMG/PKG brake valve	
		Handle deflection increases with decreasing SPD	
		2 separate **accumulators**: **6** full applications / **12**h PKG BRK usage	
		ON Indication if ≥ 140psi. **No antiskid**	
		Nose gear panel: red **NO TOWING** light if set if PKG BRK set	
Brake wear **pins**		**2**, front and rear on each wheel	
		Within limits until pin is flush with plate	
Indications	Aural AUTOBRAKE	When armed cond changes to disarmed	
	EMER BRK FAIL MC	Accumulator PRESS low and HYD SYS PRESS 1/2 low	
	BRK LH/RH FAIL MC	Both ib/ob brakes failed on one side	
	BRK OVERHEAT MC	If TEMP above normal range (> 420°C) (green indication range: < 232°C)	
	BRK CONTROL FAULT advisory	PRESS transducer failed; degraded	
	BRK LH/RH FAULT advisory	One wheel brake failed on that side	
	BRK PEDL LH/RH SEAT FAIL adv	Brake pedal failed	
	EMERG BRK FAULT advisory	PRESS in one accumulator low or disagreement in ib/ob PRESS	
	LG TEMP EXCEEDANCE advisory	A/C **cannot be dispatched**, brake ovht (> 739°C)	

Limitations

		E1		**E2**
Gear retraction	v_{LOR}	**235**KIAS		**220**KIAS
Gear extension	v_{LOE}	**265**KIAS		**250**KIAS
Gear extended	v_{LE}	**265**KIAS		**265**KIAS
Tire speed	$v_{maxTire}$	**195**KIAS		
Recommended taxi SPD		**30**kts	straight	dry
		10kts	straight	wet/contaminated
		10kts	turn	dry
		5kts	turn	wet/contaminated

14-14 OXYGEN

General		OM-A 8.8.1.2 OXY required ≥ FL130 or after 30min ≥ FL100 Cross-references: 14-02 AMS, OM-A 8.8		
Cockpit		OXY bottle with **77**ft^3, **1'850**psi nominal pressure @ 21°C, rechargeable Fwd CGO compatment OXY service panel with PRESS gauge For 22min (FL410 - FL100, level-off at FL250), then 98min (NORM) at FL100 Discharge indicator on RH fuselage (**green**=ok; discharge at 2700psi/21°C, 2450psi/71°C)		
	Min dispatch	Green	1150psi	3 crew members in cockpit
		Cyan	842psi	2 crew members in cockpit
		Amber		No dispatch
	Indications	CREW OXY LO PRESS MC		12min for two pilots
		OBSERVER OXY LO PRESS advisory		Below limit for 3 crews
	Masks	Donned **within 5sec**. Automatically: **OXY flow**, SPKR, mask MIC **NORM** (**diluted**), **100%** (default pos), **EMER** (positive PRESS); purge valve Reset to **headset MIC** Close mask box doors and pull reset knob		
	Test	100%; flow indicator (yellow star, then **disappearing** again) Door closed, TEST/RESET MIC deactivated, OXY flow stops		
PAX		**Chemical** generators in PSU (3 each); **LAV**, F/A **J/S**, **fwd galley** (2 each) Activated if pulled. Gets very hot. No protection from smoke (diluter type) Doors are ELEC actuated (DC bus 1/2) **AUTO**: Above 14'000..14’750ft **automatically**, controlled by SPDA 1 (energized for 6sec; ALT switch in fwd ELEC bay, near CPCS), or **manually** (**OVRD**) **NO SMKG** / **FSTN BELTS** come on automatically, ON caption Line flow indicator in the hose		
	Duration	E190-E1	E190-E2	E195-E2
		22min	**12**min. No retainer	**22**min
Portable OXY		**2**l/min (walking in cabin; left = low), **4**l/min (first aid) Discharge 2700..3000psi		
	Min dispatch	**1200**psi (30min)		
	E190-E1	**4** bottles, **11**ft^3, **1800**psi (0.3m^3 OXY), 2 continuous flow masks		
	E190-E2	**2**. Stowage unit, LH doghouse		
	E195-E2	**3**. Stowage unit, LH bin, LH doghouse		
E2 Lavatory OXY		Not chemically generated but stored in a bottle		
PBE		5 PBEs (EROS). **15**min OXY. Protects against smoke and toxic gases Usable up to **25'000**ft Check green indicator		

14-15 WARNING SYSTEM

EICAS

EICAS MSG
- **Priorities**: MW, MC, advisory, status; **grouped**; **last** message **on top**
- Root cause: Marked with a pointer (>)
- "FAULT": One channel / component failed
- "FAILURE": Both channels failed / whole SYS failed

EICAS **de-clutter**: **30sec after gear retraction**: Oil PRESS/TEMP, VIB, slat, flap, spoiler, LDG gear, pitch trim green band, APU
Disabled if gear extended or flaps/slats ≠ 0 or by EICAS FULL button

Inhibition: 80kts to 400ft (AOM 14-15-10, K3)

CAS MSG: EICAS msg miscomparison (→ QRH)

T/O Configuration

On GND, thrust applied / T/O CONFIG pressed and any of:
- **Flaps** not in T/O pos or not in agreement with flaps selected on FMS
- **PKG BRK** applied
- Pitch **trim** out of green range
- Any **spoiler** panel deployed

RAAS

To improve SA / prevent RWY incursions;
taxi, T/O, final APP, LDG, roll-out
RAAS INHIBIT button to deactivate functionality

Routine advisory	Analyze silently; call-out only if CA required
Non-routine advisory	"**RAAS checked**", CA

Stall Protection System

Warning when approaching stall speed
Provided by AFCS by activating stick shaker
FCM provides stall protection by means of AOA limiting function (reducing control column authority in nose up direction gradually, **limiting AOA**)

EGPWS

GND or obstacles, windshear. Uses POS, configuration and terrain DB (all concrete RWY > **1067**m/3500ft; GND PROX TERRAIN INHIB)
Inputs: FMS, GPS, IRS, ADS, RA, slat and flap control SYS (GND PROX FLAP OVRD)
Forward looking terrain awareness, TCF, GND proximity warning, terrain awareness

Modes

Mode 1	Excessive descent rate (parameters adapted in **steep** APP mode)	"sink rate", "pull up"
Mode 2	Excessive terrain closure	"terrain", "pull up"
Mode 3	ALT loss after T/O or G/A	"don't sink"
Mode 4	Unsafe terrain clearance	"too low" "terrain" / "gear" / "flap"
Mode 5	Excessive low G/S deviation	"glideslope"
Mode 6	10°/30ft, 40°/150ft, 60° above	"Bank angle" if < 2500ft

RA calls: 2500, 1000, 500, 200, 100, 50, 40, 30, 20, 10, MIN

Mode 7: **WS** alerts "Caution windshear" MC or 3x"windshear" MW **10** .. **1500**ft, if EGPWS and RA are working
Windshear escape guidance mode activated manually when windshear detected and **TO/GA button pressed**
Automatically activated when windshear detected, TL at TO/GA detent or FD in **TO** or **GA** mode
A/P disengages, FADEC commands G/A thrust

Can provide terrain mapping on MFD (MFD Map soft key)
If automatically: Range goes to 10NM, WX radar display disabled
Change range with rotary knob on CCD

WS test: On MCDU test page

	Colors	Solid red	30sec to impact
		Solid yellow	60sec to impact
		Bright red dots	> 2000ft above A/C
		Bright yellow dots	1000..2000ft above A/C
		Dark yellow dots	-500..-+1000ft (-250ft if gear down)
		Solid **green**	±500ft of A/C (±250ft if gear down)
		Bright green dots	-1000..-500ft
		Dark green dots	-2000..-1000ft
		Dark **cyan** dots	Terrain is at 0ft/AMSL
	Test	Via MCDU test page. WINDSHEAR FAIL MC, red WSHEAR, 3 x aural	

TCAS

To reduce mid-air-collision incidences. Select via MFD soft key menu
Interrogates mode A/C/S XPDRs

Cues

◊	Other traffic	(> **6.5**NM, within ±**2700**ft; above/below/expanded: **9900**ft)
♦	Proximate traffic	(≤ **6.5**NM, within ±**1200**ft)
●	TA **35**..**45**sec	2 x "Traffic"
■	RA **20**..**30**sec	Preventive or corrective Trapezoids on PFD Initiate maneuver within **2.5**sec

Max range **120**NM
Arrow indicated if > **550**FPM
Other traffic display is inhibited during TA or RA
No increase DESC cmd < 1450ft during DESC / < 1650ft during CLB
No DESC commands < 1000ft during DESC / < 1200ft during CLB
TA ONLY when < **900**ft during DESC / < **1100**ft during CLB
No TA when < **380**ft
No TCAS aural advisories when < 400ft during DESC / < 600ft during CLB
No CLB commands ≥ **34'000**ft (E1) / **40'000**ft (E2)

Modes: STBY, TA/RA, TA, ALT-ON, ALT-OFF (MCDU - RADIO), shown on MFD
ABS: Absolute ALT indications

2. OPERATIONAL

FLIGHT PLANNING AND MANAGEMENT

WX Planning

SWC		WND speeds ≥ 120kts: ALT of WND is being indicated 80kts isotachs (from LVL / to LVL)
NOSIG		Trend appended to a METAR/SPECI overrides TAF for that period (**2h**) If both VIS+RVR is given with a NOSIG, then - **RVR** overrules VIS for **current situation** - **VIS** however is **valid for 2h**
PROB30/40 alone		**Mandatory** if **deterioration**
PROBxx TEMPO		Not mandatory (but consider) Also refer to table in OM-A 8.1.6.3 Application of AD Forecast (e.g. gusts)
CEIL		BKN or OVC; VV/// is no legal CEIL
VIS / RVR		If variable — Use lower value
LOW VIS		If RVR < 550m
WND		If direction fluctuating — Use mean direction, or most conservative
Icing conditions		OAT/TAT ≤ 10°C and visible moisture (e.g. VIS < 1.5km)
	Light	Occasional deicing required — Consider exiting
	Moderate	Frequent deicing required — Consider exiting
	Severe	Insufficient deicing — Immediately exit
T/O	**No T/O**	if **moderate or heavy freezing rain** (FZRA) / **drizzle** (OM-A 8.2.4.23)
	If no lights	MIN RVR **500**m (OM-A 8.1.3.3)
	LVTO	OM-A 8.4.4: If RVR < **550**m (MIN **125**m, 90m visually [slant range]) Must be performed by **CMD**. **Static** T/O. **LVP** must be in force **Start T/O roll at threshold** (taxi forward if displaced threshold) OM-A 8.1.3.3 / 8.4.4.1/2 T/O MIN depending on **RWY facilities** RVR < 150m: High intensity runway center line lights spaced 15m or less apart and high intensity edge lights spaced 60m or less apart; 90m visual segment that is available from the flight crew compartment at the start of the take-off run; required RVR value is achieved for all of the relevant RVR reportings. No VIS to RVR conversion allowed
	T/O ALTN	If DEP A/P is **below OEI MIN** (RVR < 175m CAT III / acc MEL) or performance restricted OM-A 8.1.5.3.3: T/O ALTN has to fulfill OEI MIN OM-A 8.1.2.2.5: Max 1h M0.8/310KIAS OEI CRZ SPD @ ETA ±1h @ TOM OM-A 8.1.10: New OFP required
ENR	Min ALT	1'000ft over radius of 5NM (MEA; 2'000ft if terrain > 5'000ft/AMSL)
	ENR ALTN	**Max distance** to adequate A/D: **380**NM (E190-E1/2) / **355**NM (E195-E2) (1h OEI CRZ SPD; OM-A 8.1.2.2.4)
	FZRA/FZDZ	OM-A 8.3.8.3.2, OM-B 2.1.16.1.2: Shall be **avoided**
LDG DEST		OM-A 8.1.5.3.4 Environmental and RWY conditions have to be met at **ETA ±1h** **VIS** (not RVR) required at **ETA ±1h**; plus **CEIL for non-prec**
	CAT III	**RVR** TDZ/MID
	CAT II	**RVR** TDZ
	CAT I, VNAV MIN for APV BARO-VNAV	**RVR**/**CMV**
	NPA/RNAV/RNP APCH (LNAV)	**RVR**/**CMV** and **CEIL**
	APV BARO-VNAV (LNAV/VNAV)	RVR/CMV: VNAV MIN

	CMV		OM-A 8.1.5.4. **Planning** only
		CMV :=	f(VIS) acc **conversion table**: HIALS/RWY lights x 1.5 (day) / x 2 (night), other lights x 1.5 (night), no lights / day: x 1
			For CAT I/**NPA** (n/a for CAT II/III, T/O, RVR MIN < **800**m, when RVR is given)
	NPA		OM-A 8.1.3.5 Planning MIN
	APV		RVR ≥ **600**m DH ≥ **250**ft (OM-A 8.1.3.5.2)
	Circling		VIS **2400**m MDH **600**ft (**Cat C** A/C, OM-A 8.1.3.1/4)
	VIS APP		VIS **5000**m CEIL **3000**ft (OM-A 8.3.2.36)
			LDG threshold always in sight; day only unless flat terrain, APP aid available as backup, TCAS operational
	NIT		RWY edge/threshold/end lights must be operational
	Dispatch		**Dispatch LDG performance assessment**. OM-A 8.1.3.10.3
			Not req if no **CAT II/III** conditions, no **malfunction** affecting LDG PERF, TWND ≤ **10**kts, A/P ELEV ≤ **3000**ft, RWY ≥ **2200**m, RWY not **contamin**
LDG ALTN			OM-A 8.1.5.3.4f
			Type A (≥250ft) +**400**ft / +**1500**m
			Type B (<250ft) +**200**ft / +**800**m
			Not both DEST and ALTN A/D must solely rely on GNSS APP
WX Inflight			Req **VIS** at ETA (no ±1h margin), CEIL/VV not required
			ALTN must be open (no lower APP cat required as during planning)
	APP ban		OM-A 8.4.5.7; **not only for low VIS**
			APP may be started irrespective of RVR when there is a reasonable chance for a success. Continue < **1000**ft only if latest **RVR/VIS ≥ MIN and** if **RCAM** indicates that a safe LDG can be assured; G/A otherwise
		NPA	No APP ban for ceilings
	MIN	CAT **I**	Required RVR is **550**m/125m/75m
		CAT **II**	Required RVR is **300**m/125m/75m, only **TDZ** RVR req
		CAT **III**	Required RVR is **175**m/**125**m/75m, only **TDZ**/**MID** RVR req (down to safe taxi SPD, **1000**m; OM-A 8.4.1.15)
		CAT II/III	AEO **and** OEI possible
			OM-A 8.4.1.17.1/2, OM-A 8.4.6.1.3/4
			Troubleshooting / downgrading: Until **1000**ft (OM-A 8.4.7)
	DA/H		ALT/height at which the decision to land / G/A has to be taken
	MDA		MDA must not be undershoot (OM-A 8.3.2.33.1)
			For all NPA: **DA = MDA + 50ft (E1) / 100ft (E2)**
			(LNAV, LOC, VOR, NDB, SRA; **not** for LNAV/VNAV, LPV, circling MIN)
			Jeppesen does not add increment to DA/DH (operator responsibility)
Wind			OM-A 8.1.6.2.1/2 (dry RWY), OM-A 8.3.2.16, OM-A 8.3.2.40, AOM 2-10
General (planning)		DEP/DEST	**50**kts OM-B - **10**kts OM-B - **5**kts
		ALTN	**40**kts OM-B - **10**kts OM-B - **5**kts
Specific	E1	**X**WND	**38**kts (dry), **31**kts (wet), **20**kts (compacted snow), **18**kts (water/slush/wet/dry snow), **12**kts ([wet] ice)
			Static T/O **not** recommended with XWND > **30**kts
		TWND	**15**kts (T/O, LDG, CAT II/III)
		CAT II	**H**WND 37kts **X**WND **16**kts
		CAT III	**H**WND 25kts **X**WND **10**kts
			(Ops Note 2021-21. E1: **15**kts)
	E2	OM-B 1.3.4.1	
		XWND	**36**kts T/O dry/wet (limited by ENG, incl. gusts)
			35kts LDG (incl gusts) (limited by ENG, incl. gusts)
		TWND	15kts If ≥ 13kts: **N1 max 60% below 20kts GSPD**

	Planning	**Mean WND (w/o gusts)** must be within limits, but **XWND gusts must not exceed XWND limits plus 5kts**		
	Inflight	50kts; XWND/TWND acc OM-B **XWND/TWND gusts** must be considered		
	ePerf T/O	**Gusts** shall be considered, but **do not need to be calculated** **WS**: **No flex**		
	LDG	**Gusts** need to be calculated		
Fuel		OM-A 8.1.10		
	Expressions	**Planning**	Pre-flight before moving under own power	
		Fuel management	Inflight before DEST or ALTN	
		Replanning	Inflight if significant previous factors have changed OM-A 8.3.7.4: Remaining trip, contingency, (ALTN), final, additional	
	Fuel planning	**Shortest SID**, **longest STAR**, **ALTN** only **PT-to-PT**		
		Fuel density	Standard **0.796** kg/l if no density given	
		Taxi, APU	200kg	(OM-A 8.1.7.3.1)
		Contingency fuel	5% of trip, or 3% with ERA	(OM-A 8.1.7.3.3)
			Must be on board until T/O, except: **RCF** (on board until DP)	(OM-A 8.1.7.7)
		Additional fuel	ADDE, ADDNAR, ADDISO	(OM-A 8.1.7.3.6)
		Diversion fuel	Dest ALTN fuel + company fuel + final res = fuel from MAP to dest ALTN + final res	
		Discretionary fuel	**4**min per **100**kg	
		Final reserve	**800**kg (**30**min holding at 1500ft; OM-A 8.1.7.3.5)	
		SWIFAT	FL380+ not possible if heavy → Update FL in SWIFAT	
		ADDNAR	**No DEST ALTN** required if flight time ≤ **6**h, **two separate RWYs**, CEIL ≥ **2000**ft / circling height + 500ft (whichever is higher) at ETA ±1h, VIS ≥ **5**km, **no adverse WX** (TS, SS, BC FG, **gusts**, WSHR), BA ≥ **medium** Add **15**min at 1500ft / **400**kg for 2nd APP instead of ALTN fuel OM-A 8.1.5.5.2. Possible via IFS Contact OCC if ALTN required after ADDNAR has been selected	
		Closed DEST	2nd open ALTN required Calculate with the higher ALTN fuel OM-A 8.1.5.5.3, OM-A 8.1.7.6	
		RCF	Select optional refuel destination, decision point along the route OM-A 8.1.5.5.4, OM-A 8.1.7.7. Plan via OPS	
		PDP	Large distance between DEST and ALTN / no suitable ALTN OM-A 8.1.5.5.5/6, OM-A 8.1.7.8/9. Plan via OPS	
		Tankering	Through-tankage if **GAIN is higher than sum of LOSS** (-) / **GAIN** (+) on following flights	
	Fuel mgmt	**Checks** GND	E1 OM-B 2.1.19.1 **Uplift Δ** max **2**% of indicated + **110**kg	
			E2 OM-B 2.11.5.1 **Uplift Δ** max **2**% of indicated + **140**kg	
			ATL entry acc OM-B	
		Flight	OM-A 8.3.7.1: After **TOC**, then at least **once an hour**, before **TOD**	
		ALTN fuel	may be used when **committed to land** or: **Inflight change to ADDNAR** if WX permits	

Mass and Balance

OM-A 8.1.8.7, OM-A 8.1.14 (NOTOC), OM-A 8.1.8.2 (signed by both pilots)

Envelopes: OM-B 6.1.15. 3 envelopes: AFM (least restrictive), DCS (seatrow trim, cargo sections), manual loadsheet (section trim; most restrictive)

DOM/DOI tables: OM-0 9 17

Manual loadsheet: E1: OM-B 6.4.2, E2: OM-B 6.6.2; OM-B 2 Appendix 1 (QRH) (M&B tables)

- Form: APM - APM 4 Forms - Ground Operations - Manual LS
- Do not mistake **T/O fuel** with **block fuel** on manual loadsheet

E2

- OM-B 6, 7: E2: Smaller tail; CG is more aft
- OM-B 6.6.2.3.5.1: Special Index/MAC diagram for **ferry flights**
- **No ALTN CG** for perf calculation
- Ballast fuel: OM-B 6.2.4. Max 2000kg
  Enter as trapped fuel. Must not be consumed
  Paper loadsheet, call OCC

Preliminary data: Use rounded (up) values (100kg). Use if within LMC limits

LMC: E1: OM-B 6.1.6, E2: OM-B 6.6.3

Up to **300**kg (E1) / **350**kg (E2); CG ±**2**% (max 5 PAX, 1 crew member)
Record on loadsheet, check limitations
Fuel discrepancies ≤ 100kg may be accepted

Rough estimate: TOM = **28t** + 100kg x #PAX
43t MLM + trip fuel - ZFM - 200kg reserve

Crew complement: 2 cabin crew

Max **100** PAX (OM-A 8.2.2.1.1f, while parking)

PAX: **Infants** on a separate seat: 35kg
#PRM ≤ # able bodied persons (OM-A 8.2.2.3.2)

- WCH**R**: Can walk stairs
- WCH**S**: Cannot walk stairs
- WCH**C**: Completely immobile

CGO

- Loading: OM-B 7.10. Load FWD CGO first, unload AFT CGO first
- Tie-downs: OM-A 8.2.2.8
- Special loads: OM-A 8.2.2.9
- **Live animals**: OM-A 8.2.2.9.4, OM-B 7.13, AOM 8-80
  PRESS, TEMP, ventilation, lighting
  Fwd hold only; observe min TEMP vs flight time
  Separate from HUM by ≥ **1**m

Performance

ePerf: Not all A/C **WND limitations** are flagged by the app

- **Gusts**: Consider T/O-1 or T/O-2
- T/O: **LEVEL OFF ALT** Earliest OEI ACC ALT

E1

- MACTOW CG: ≥ **17**%: **ALTN CG** (aft CG), < 17%: STD CG

Balanced T/O: T/O dist to 35ft (w/ENG failure at v_1) = ASD (dry RWY)
(by adjusting v_1 within v_{MCG} .. v_R to obtain max TOM)
- Wet RWY: v_1 is reduced to compensate for longer ASD; screen height reduced from 35ft to 15ft, usage of reversers is allowed for ASD
- Reduced acc (deposits, uphill, density ALT, OAT, ... → increase v_1) and reduced stopping capability (e.g. slippery, downhill, ... → reduced v_1, 15ft margin only). No v_1 correction if RWY covered with roll-resisting deposits
- Contaminated RWY: v_R/v_2 are increased for better climb

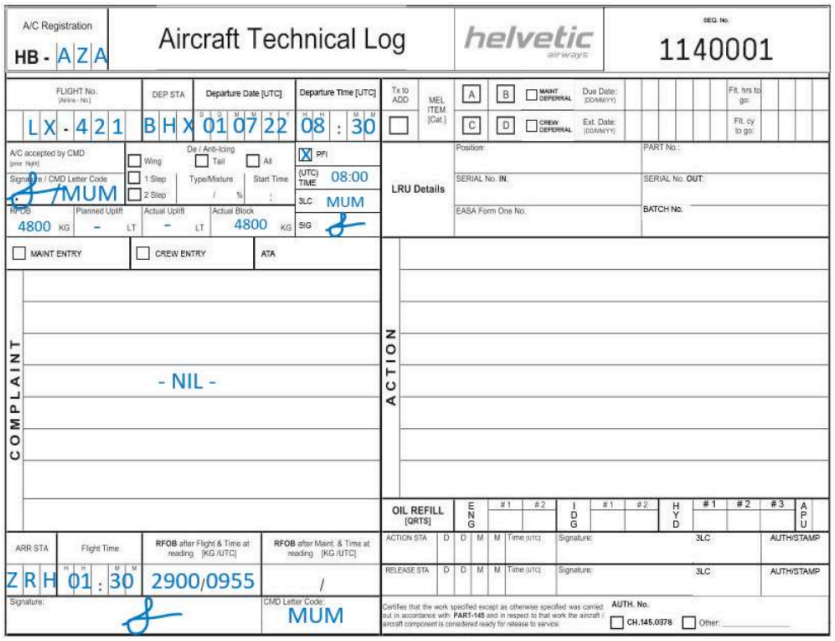
Unbalanced T/O: Only if **not RWY limited**, contaminated RWY (gap between v_1 and v_R)

ASD: AOM 5.20 57ff; roughly **1800**..**2000**m

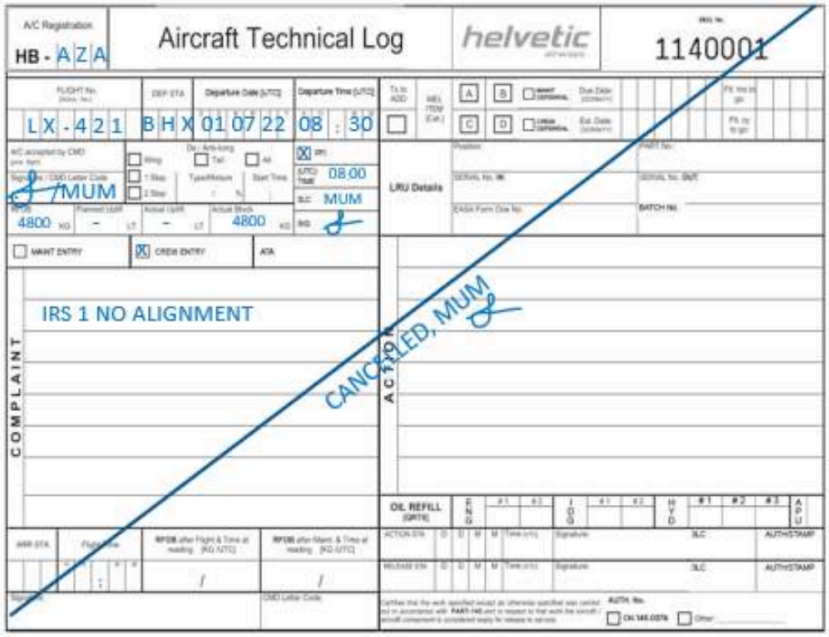
Ground roll: v_1 - v_R - v_{LOF}

	CLB segments	1st segment CLB	Gear in transit, 35ft at v_2	
		2nd segment CLB	Up to acceleration ALT (400ft)	
		3rd / acceleration	Flaps up	
		4th / final segm CLB	v_{FS} or 1.25v_S, max continuous power, to 1500ft	
	Climb gradients	**T/O climb** gradient **AEO**	AOM 5-20 85ff If **restricting**: Select VNAV at a higher ALT	
		APP climb gradient **OEI**	AOM 5-30 7ff, **OM-B 4.1.1.6** (E1) / **4.1.6.3** (E2) Calculate average over whole MAP trajectory ePerf (up to ACC ALT / MAP ALT; reference only)	
		Charts	Indicated on APP chart only if gradient > **2.5%** (brief OEI MAP) (SID: 3.3%)	
		Conversions	OM-C - Abbreviations and Conversions - Conversion Factors, or **% x GS ≈ FPM**	
	Max perf LDG	OM-B 2.6.1.6	Ffull, max REV, MAN BRK after main gear T/D Not for A/L	
		v_{APP}	Increment max 10kts	using MAN SPD
		50ft	**v_{REF}**	using **FMS** SPD
	E2 TOLD	OM-B 2.2.2.4 (T/O), 2.4.2.1 (LDG) Not yet available on E195 As well setup TOLD (LDG IDENT) PF enters flaps settings and T/O SPDs, PM cross-checks Pitch trim Master: ePerf; tolerance **±0.5** (checked by both pilots) LDG SPDs Tolerance **±1kts**. If beyond: use ePerf SPDs		
Airports	Categories	OM-A 8.1.2.4		
		Class B	Self-briefing airport	OM-0 6
		Class C	SAAA airport	OM-0 6
	Adequate A/D	"Usable" A/D regarding infrastructure/services		OM-A 8.1.2.1.2
	Suitable A/D	:= adequate A/D + MET conditions		
	Sources	**OM-C** Aerodrome Competence **OM-0** 1 Airport Briefing & Station Information + **EManual/CFP/LX ICB** **OPS Note** "**List of Category B+C Aerodromes**" OPS Note "List of Approved RNP AR Approaches" OPS Note "OEI Procedure LSZB Runway 32"		
	Fire fighting	Cat **6** (OM-A 8.1.2.3)	4 for TNG (OM-A 8.1.2.3.1)	
Runways		MIN **length/width**	**1500**m (E295: **1800**m) / **30**m	OM-A 8.1.2.2.9
		LDA	for dispatch min **220**0m	OM-A 8.1.3.10
		LDA < 2000m	**CMD** shall be PF	OM-A 8.3.2.40
		Slope	**-2** .. **+2**% paved	
		Contamination	**25.4**mm WED for T/O	
		Unfact LDG dist	QRH PD35. Roughly **<u>1000</u>**m	
		Factored LDG dist	= required LDG distance (= certified/demonstrated)	
			DEST unfactored x **1.67** for dry RWY unfactored x **1.92** for wet RWY (+15%)	
			ALTN unfactored x **1.67** for both dry and wet RWY	
			With **malfunctions**: calculate with the **highest factor**	
		Dispatch LDG dist	Required acc OM-A 8.1.3.10 (e.g. **<u>< 2200m</u>** or **contaminated**) **No REV**, max manual braking (but use full REV if req) Resulting in MLM (considering depth of contamin) Save screenshot in IFS Cont RWY: **<u>Inflight LDG performance may be lower</u>**	

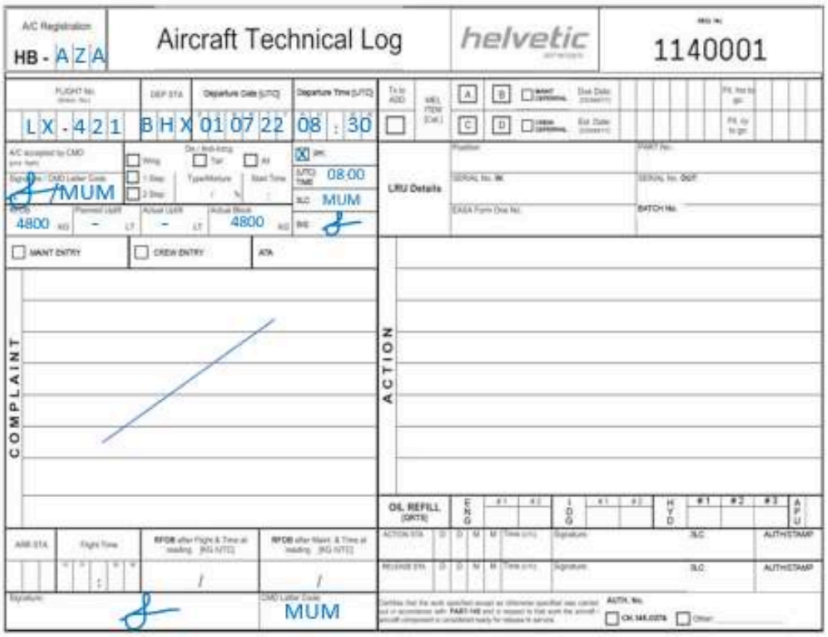
		Operational LDG dist (**inflight**) = based on **RCC** (1-6; Snowtam/ATIS/ATS) OM-B 2A1.7, 4.2.11.1: RCAM **Max REV**, selected braking option
		WED	0.85 (slush), 0.40 (wet snow), 0.20 (dry snow)
		Damp RWY	Not dry, not shiny
		Wet RWY	Visible moisture within required length **Grooved** wet RWY may be considered **dry**
		Contaminated	WED **> 3mm** (but < 13mm) on ≥ **25%** Plan at least with **wet** **No flex T/O** allowed; consider **ATTCS off** (for EO) LDG: Use **autobrake** and **full REV**
		BA	**BA unreliable** does not imply a poor BA
	GRF	Perf section	RWYCC, percentage coverage, contaminant depth, condition descriptor, width of RWY Use RCAM/ePerf (RWYCC 0-6 for each third of RWY) (E1: OM-B 2A1.6, E2: OM-B 2A1.7) RWYCC of the lower RWY designator is published
		SA section	E.g. reduced RWY length, snowbanks, TWY, ...
OFP	**Recalc by OCC**		Change/add **T/O ALTN**, **A/C** change, **ΔZFM** > **2**t, on CMD request (OM-A 8.1.10, Ops Note 2022-10)
Dispatch	Blue doc folder		OM-A 8.1.12.1
	Flowchart		OM-B 2A1.4: Tech malfunction handling flowchart
	ATL, **ACL**		OM-A 8.1.11 ATL entries with safety-relevance: Write iQSMS report as well Overspeed events: OM-B 3.24 **Crew deferral** acc MEL; must be **covered by MEL**, no (M) procedure (otherwise: AOG; exception: CAMP) OM-A 8.1.11.8 (e.g. after GND reset by crew) **Cross out previous log entry**, entry on next slip, sign both slips Sign entry in "Complaint" section Error entries shall be marked with "**canceled**" and signed off
	NIL		Technically uneventful flight

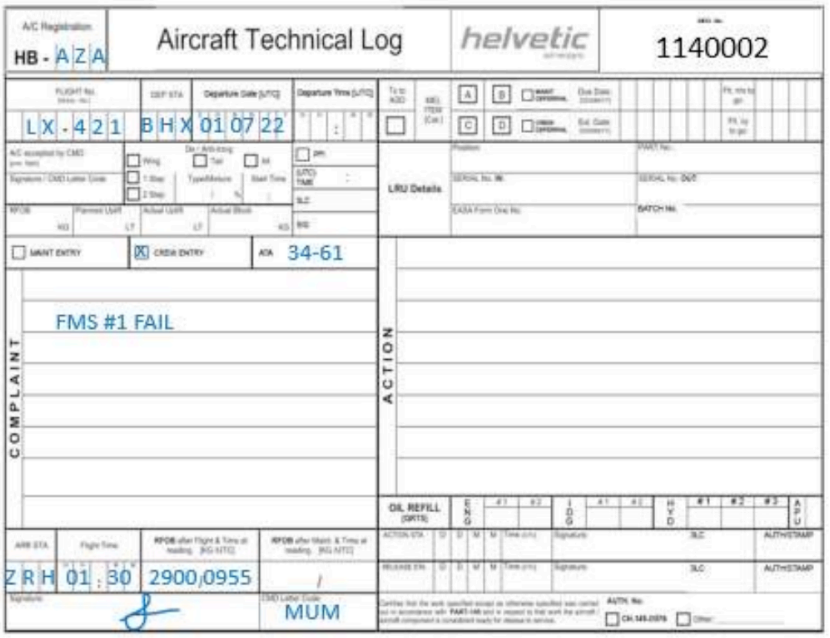


Cancelled Invalid entry after a mistake



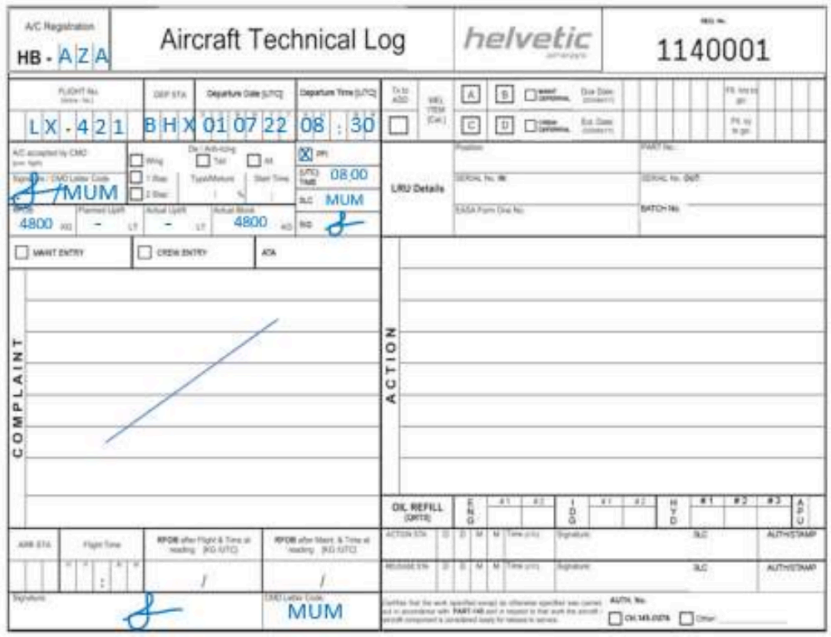
Defect requiring maintenance action, non-deferrable. Report to MCC

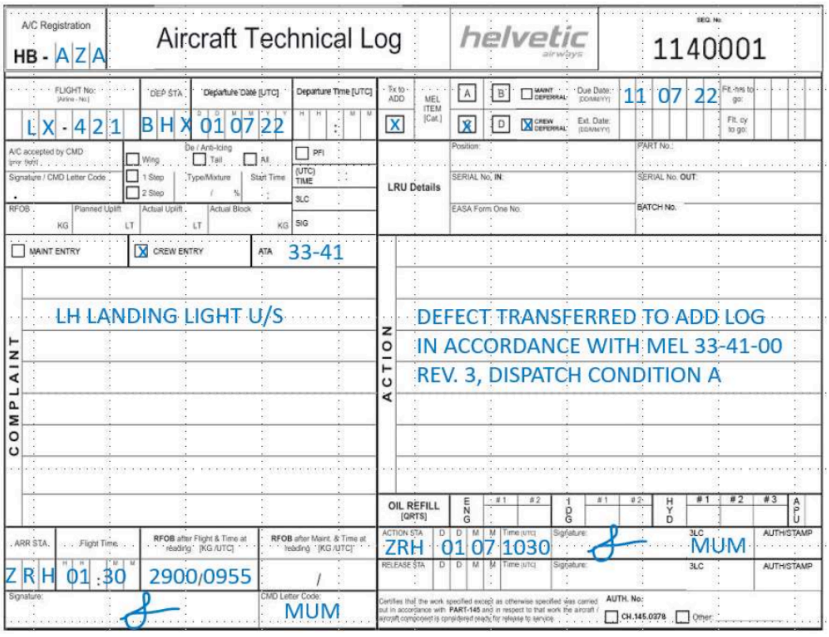




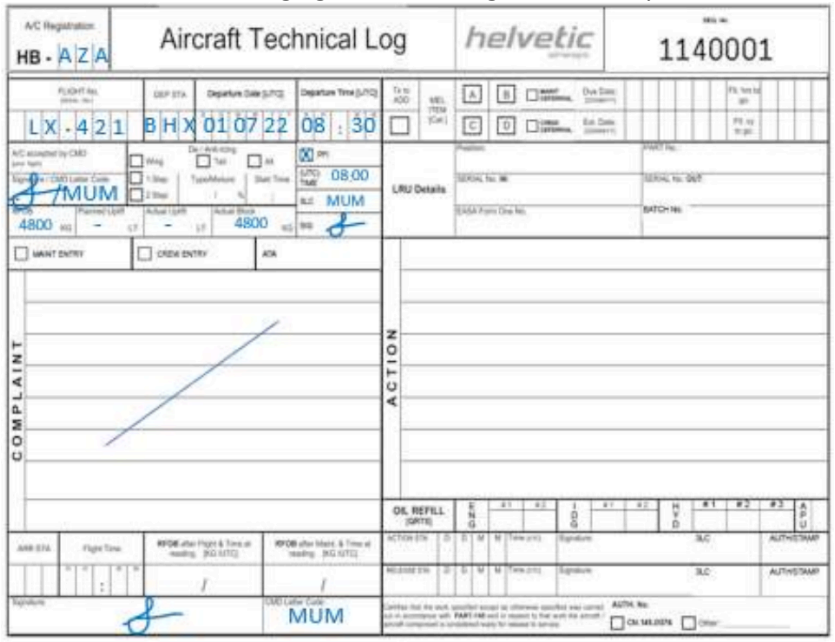
Deferral

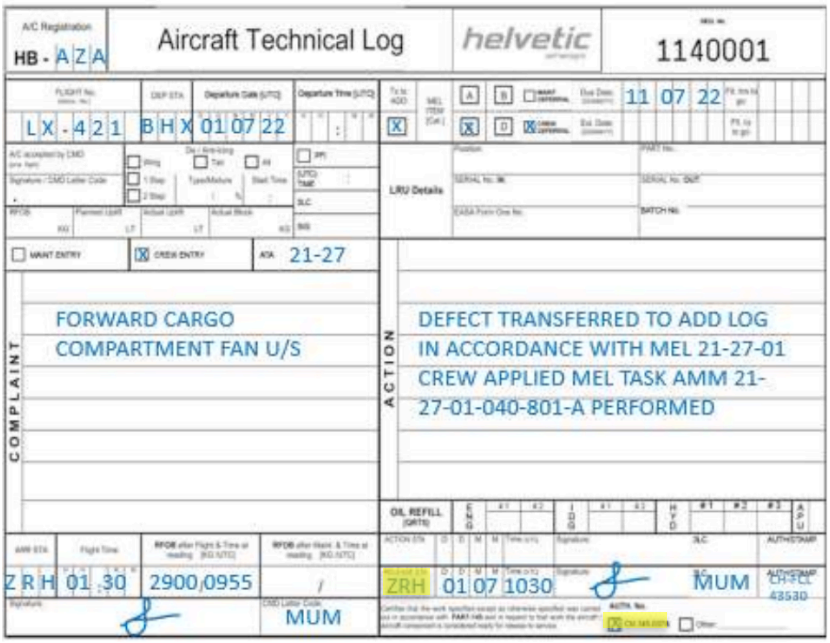
No "M" procedure required prior dispatch
Report to MCC. OM-A 8.1.11.8
Remove green ADD slip; deferral instructions in ATL

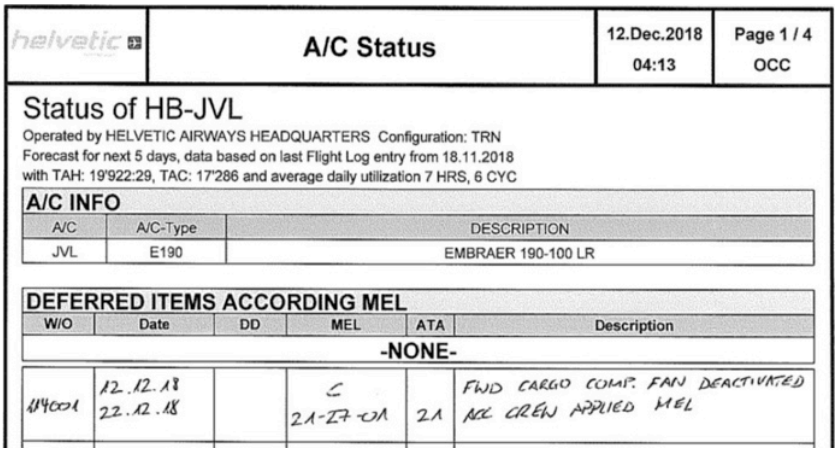




CAMP MEL deferral ("M" procedure). MEL Appendix 2, 4.3, 4.3.3
Authorization for (M) procedures, valid for 12 months
Items acc MEL / FLT CTRL no dispatch/return to service
Call LMC/MCC on duty before performing a CAMP
ATL: Crew entry, ATA, defect details; MEL category, crew deferred, due date, "defects deferred acc MEL ..., ...", limited pilot authorization
Send picture of ATL slip to LMC. Use new slip if station copy already handed over to handling agent. Remove green ADD slip






helvetic

A/C Status | 12.Dec.2018 04:13 | Page 1 / 4 OCC

Status of HB-JVL

Operated by HELVETIC AIRWAYS HEADQUARTERS Configuration: TRN
Forecast for next 5 days, data based on last Flight Log entry from 18.11.2018
with TAH: 19'922:29, TAC: 17'286 and average daily utilization 7 HRS, 6 CYC

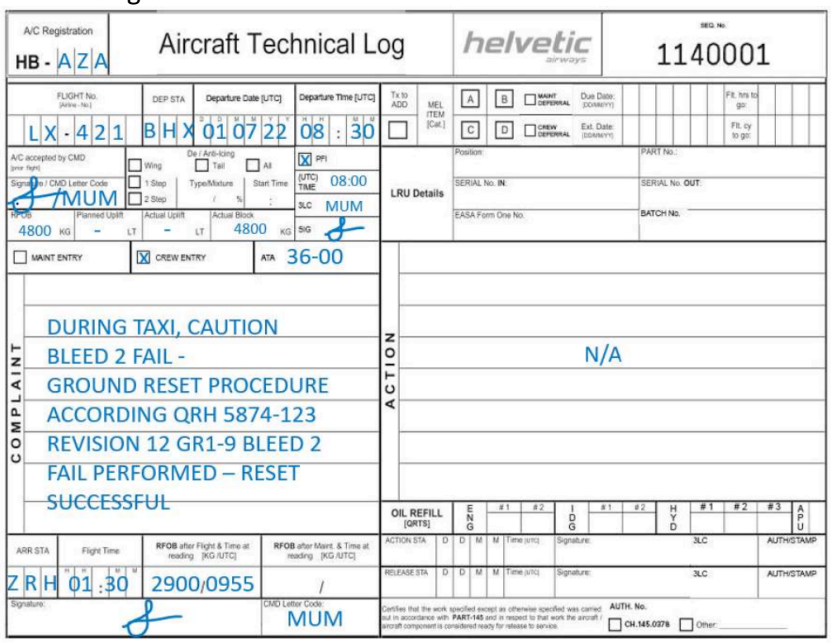
A/C INFO

A/C	A/C-Type	DESCRIPTION
JVL	E190	EMBRAER 190-100 LR

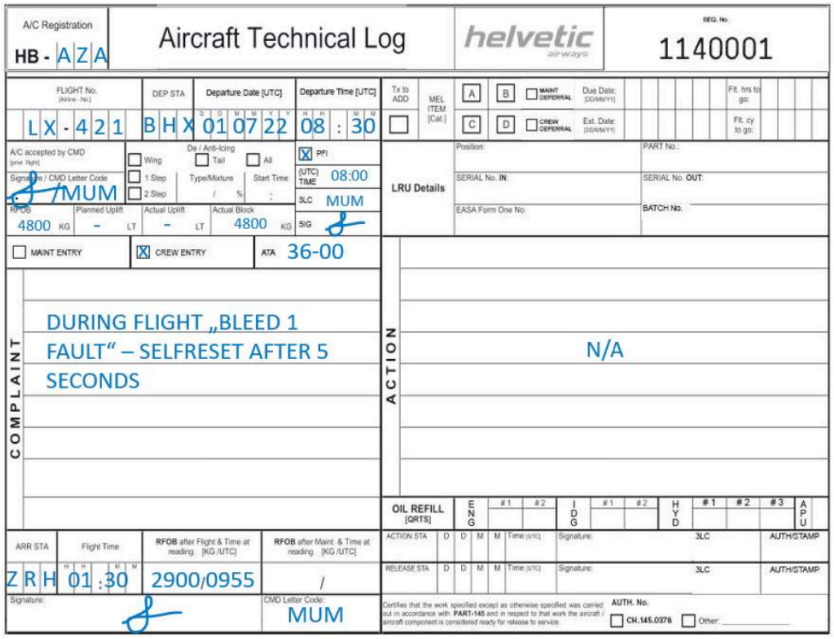
DEFERRED ITEMS ACCORDING MEL

W/O	Date	DD	MEL	ATA	Description
-NONE-					
114001	12.12.18 22.12.18		C 21-27-01	21	FWD CARGO COMP. FAN DEACTIVATED ACC CREW APPLIED MEL

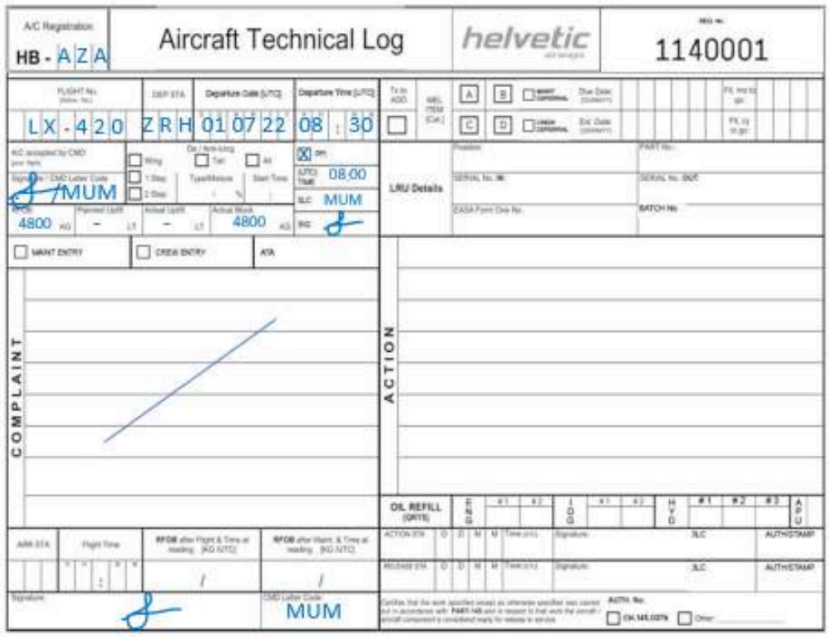
GND reset acc QRH successful. OM-A 8.1.11.7.1
For tracking reasons

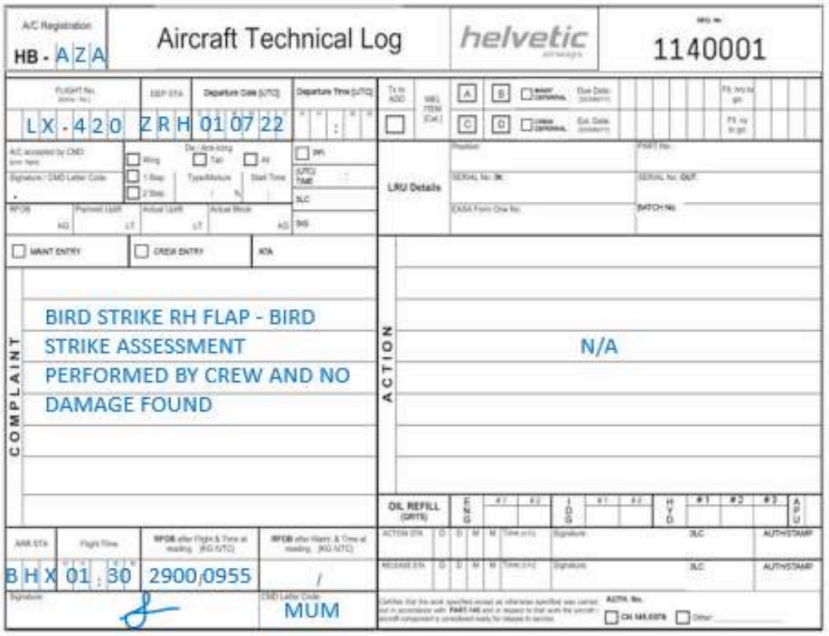


Self reset For tracking reasons

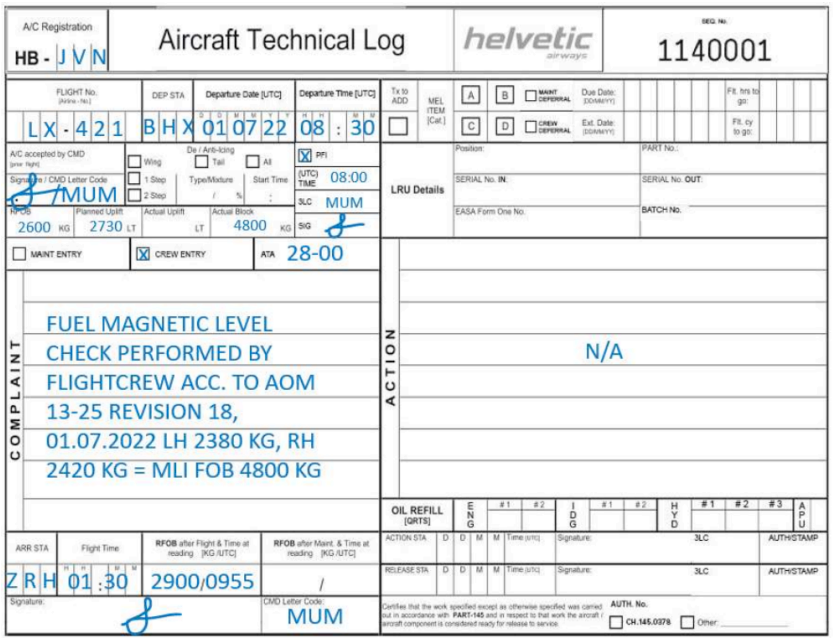


Bird strike assessment. Contact MCC. OM-A 8.1 App 1





Dipstick E1 only. If no fuel slip, incorrect uplift report, technical reasons. AOM 13-25



MEL OM-A 8.6
On GND as long as A/C is not operating under own power
If a system is not listed, then it has to be working

MEL Cat A	Rectified within specified time interval
MEL Cat B/C/D	Rectified within 3/10/120 days, excl day of discovery
*	Must be placarded
(M)	Maintenance procedure
(O)	Specific operational procedure
Appendix 1	**EICAS messages list** (dispatchability), MEL entries, non-essential EQ and furnishings list (cabin, galley, lavatory, cockpit, screws, door latches)

AFM The only certified manual
QRH After off-blocks: **QRH** is applicable, not MEL any more
CDL Configuration Deviation List. No time frame given for rectification
HIL Maintenance has to transfer tech log entries to HIL (or pilot with assistance of maintenance, if pilot is trained)

RVSM OM-A 12.2: FL**290** to FL**410** (both inclusive)
Operator, crew and aircraft must be approved
Check blue documents folder and ATC FPLN (10/equip 'W')

MEL	2 independent primary ALT, 1 A/P w/**ALT** hold (±65ft), 1 ASEL (**alerting** deviations > 300ft), 1 XPDR w/ALT enc
ΔALT	GND max **75**ft (in between and compared to known ALT) Inflight max **200**ft betw **primary** ALT, check every **60**min Height keeping performance monitored by GMU or HMU
ALT changes	Do not over-/undershoot by more than **150**ft, Reduce to max 1500FPM the last 1000ft

AP may be disengaged under exceptional circumstances (re-trim, turbulences, …)
"**Affirm**/negative RVSM" / "**Unable** RVSM **due EQ / turb**" / "Ready to resume RVSM"

Non-RVSM

odd	FL290 FL330 FL370
even	FL310 FL350

Performance Based Navigation Based on World Geodetic System 1984 (WGS 84)
FMS, IRS/IRU, based on GNSS or DME/DME
PBN specifies RNAV/RNP system performance requirements:
Availability, accuracy, integrity, continuity, functionality
Flexibility↑, A/S capacity↑, more economic routings

APP	Type **A**	MIN ≥ **250**ft	2D, MDA/H, non-precision
	Type **B**	MIN < **250**ft	3D, DA/H
		Cat I ≥ 200ft	
		Cat II ≥ 100ft	
		Cat III < 100ft	

Angular type NDB, VOR, LOC, ILS, **LP**, **LPV** (n/a for OAW E190-E1), GLS (GBAS)
Linear type RNP APCH (LNAV), RNP APCH (LNAV/VNAV), RNP AR APCH
CDI scale transition 5NM - 1NM (TERM) - 0.3NM (APPR)
1 dot deflection equals ALT Δ of ±75ft

2D No vertical guidance; vertical advisory information from chart
NDB (DME), VOR (DME), **LOC** / LOC BC (DME), RNP APCH LNAV MIN, RNP APCH LP (SBAS;WAAS/EGNOS) MIN, circling (with prescribed flight track)

3D Barometric or SBAS vertical guidance
ILS, GLS (GBAS), SLS/LPV (SBAS/WAAS), RNP APCH LNAV/VNAV MIN (APV), RNP AR APCH
APPR / **magenta GP** appears **2NM before FAF**. Set ASEL to FAF ALT

TEMP effect	4% per 10° deviation from ISA; raise if below ISA **Low TEMP** (ISA **-15°C** or if outside promulgated TEMP): G/S capture earlier, V/S lower → use **TEMP correction** if terrain limited (OM-A 8.3.3.9.1)	
TEMP comp	If outside promulgated TEMP on chart, not under radar control (OM-A 8.3.3.9.2.2) Only from FAF to RWY (approach segment; not for MAP). **Inform ATC** Enter **MIN** on last TEMP COMP page, then adjust selected MIN Step-down ALT: Use TEMP compensated values NAV - NEXT - MAINT - NEXT - SETUP - FLT CONFIG - NEXT	
Path terminators	Initial fix IF, CRS to ALT CA, Fix to ALT FA, CRS to fix CF, track to fix TF, direct to fix DF, radius to fix RF	
Total system error	Path definition error PDE + flight tech error FTE + NAV SYS error NSE FMS PROG 3/3: **EPU**	
RNAV specification	RNP RNP 4 (oceanic, remote), RNP 2 / RNP 1 / RNP AR APCH, RNP ... RNAV RNP 10 (oceanic, remote), RNAV 5 / RNAV 2 (ENR, terminal)	
RNP	Includes **onboard performance monitoring and alerting** (the term "RNAV" will disappear by Dec 2022)	
	ENR	RNP 2
	STAR/SID	RNP 1 (30NM)
	Intermediate APP	RNP 0.5
	Final APP	RNP 0.3
	RNP APCH	2D **LNAV**, LP
		3D **LNAV/VNAV**, LPV
	Missed APP	RNP 1
SAT	**5** SAT required (also for RAIM) Msg on MCDU scratchpad if GPS failed Confirm **GPS-D** on **PROG** page	
APV	APP procedure with vertical guidance Baro-VNAV to LNAV or LP MDA/H (Type A) TEMP comp / RAIM SBAS-VNAV to LPV DA/H (Type B) Still a non-precision APP, but with a DA/DH	
GNSS	GPS, GALILEO, GLONASS, Beidou	
SBAS	EGNOS, WAAS, GAGAN, MSAS	
ABAS	RAIM	
LPV	SBAS. No temperature compensation required NPA based on FMS as primary NAV source **n/a** on OAW E190-E1. Currently not allowed on OAW E190-E2 Angular type of APP; gets linear when approaching the RWY threshold	
Vectoring	**No direct to FAF** (stabilization required 2NM before FAF)	
Overlays	Use conventional NAV overlay. G/A if beyond tolerances	

Flight modes	MIN	Lateral	Vertical	Sensor
NPA	LOC, LNAV CFDA	LOC/LNAV	FPA	2D VOR/DME/NDB LOC
	LP	LNAV	FPA	2D GPS+SBAS
APV	LNAV/VNAV	LNAV	GP	3D GPS+BARO
	LPV (n/a)	*LNAV*	*GP*	*3D GPS+SBAS*
PA	ILS	LOC	GS	3D ILS/MLS
	GLS	LNAV	GP	3D GPS+GBAS

CPDLC	Only on E2. OM-B 2.4.1.12, E2 AOM 14-09-15, E2 AFM Supplement 7, ICAO Doc 10037, Honeywell FMS Guide for Embraer E190-E2 ch 13 Supplementary two-way datalink system for non-urgent (non-time-critical) strategic msg	
Compulsory	Maastricht	
Coverage	Jeppesen iPad app: High IFR - Pubs - Europe - Airway Manual - CPDLC, or via bullet numbers at FIR boundaries along blue flight route ATC FPLN: 10 "J"; 18 "DAT/", "CODE/", "COM/CPDLC"	

	Logon	On **GND** or inflight, **10..15**min prior entering CPDLC airspace DLK - ATC LOGON/STATUS or NAV - ATC LOGON TO: CPDLC address code (e.g. LSAZ) - LOGON SEND
	Messages	Apply - Accept - Activate "ATC" on PFD and in aux window Answer time limit **60**sec (or: "Standby") Only expect CPDLC msg > FL150..200 Replies on multi-element msg are valid for all elements Voice COM to correct CPDLC msg: "Disregard CPDLC ... message, break, ..." "CPDLC failure". Do **not** re-send after an error
	Revised route	NEXT - ATC CLNC - NEXT. ATC UPLINK - APPLY, DLK - ACCEPT - SEND Once accepted: ACTIVATE
	Callouts	PM: Calls out msg content (for CLB e.g.: "Able or unable?") PF: "Checked", "(un)able" PM: "Confirm?" PF: "Confirmed" PM: ACCEPT or REJECT. "Activate Direct?" PF: "Activate"
	Clearances	Only valid once **ACCEPTED** is displayed after pushing **APPLY**
	Logoff	Automatically of manually. Ensure 15min after exiting CPDLC area
Flight Data Monitoring FDM		OM-0 9 16: GPWS, TCAS RA, WS (**negative warnings** shall be reported), **stabilized APP**, stall warning, **ROD** (> **5000**FPM > FL**100**, > **3000**FPM < FL**100**, > **2000**FPM < **4000**ft/AGL, > **1000**FPM < **1000**ft/AGL), **SPD** < FL100, **long LDG**, rough taxi, low fuel, flight envelope exceedance, rejected T/O) OM-A 8.3.2.20: > 250kts < FL100 can only be accepted above 5000ft
Miscellaneous	Ops permissions	OMM 1.4.2. Noise certificate: ICAO annex 16 volume I chapter **3**
	SMS	OMM 4
	Security	ACSP, OM-A 10, APM 4 Forms - Security
	Weapons	ACSP 10.2-5, 10.6
Ops Notes	includes current	COVID-19 risk mitigations summary, E1/E2 FOL, list of category B+C aerodromes, RNP AR APP
	2021-33	OM-C / African region
	2022-08	Ops on different A/C variants

4P

OM-A 2.0.1: Philosophies - Policies - Procedures - Practices
(e.g. Policies: If no procedures are defined for a certain situation, e.g. "clean aircraft concept" with regard to de-icing)
OM-A 2.0.3: **Safety** - **Economy** - **Reliability** - **Environment**al Protection
(e.g. delay vs high SPD)

CRM

OM-A 1.4.1 — Authority, duties, responsibility of the CMD

PAX boarding — At least one crew member must be present

Threats — OM-A 8.0.1.7.1.1

- env — Adverse WX, A/P conditions, terrain, other traffic, ATC req/errors
- ops — Pressure, A/C malfunctions, MX errors, GND handling errors, cabin events, crew scheduling errors
- latent — systematic/organisational deficiencies, HW design, TNG deficiencies, ATC systematic deficiencies
- other — Stress, fatigue, distractions

Crew briefings — OM-A 8.3.15.2, OM-A 8.3.0.1 (**TEM**), OM-A 8.0.1.7.2.4 (**TWO-P**), OM-A 8.3.2.14.1 (FMS)

- topics — Crew presence, fit to fly, qualified, crew composition, planned flights, A/C type/registration, flight times, WX, cabin and EMQ EQ deficiencies, special PAX/load, chain of command

DEP / T/O briefing — OM-A 8.3.2.14/15
Shall be bilateral, interactive

1. **TWO-P** — Non-standard items
   E.g. descent planning w/TWND and icing; discont APP, ...
   Operational: **A/C** variant, limitations, procedures
   Awareness briefing: OM-A 8.3.2.3.2

Flight-Phase	Terrain	Weather	Operational	Pilot
Departure	vertical and lateral situation	departure and take-off alternate	aircraft technical status, aerodrome specials	fatigue, stress, operational pressure
Cruise	AEO and OEI performance, decompression and engine out routing	adequate aerodrome and enroute	adequate aerodrome: fuel status, ATC, landing mass, runway condition	
Approach	vertical and lateral situation including missed approach climb gradient	destination and alternate	aircraft technical status, aerodrome specials	

2. **What-if**
3. **Charts**, **procedures** (FMS: Prefer pilots checking FMS individually)

APP briefing — OM-A 8.3.2.26

Manual flng — OM-A 8.3.18.2: Must be briefed

Low VIS — OM-A 8.4.5.4: WX DEST/ALTN, A/C, A/P, RWY status, task sharing, APP, MIN, G/A, malfunctions < 1000ft, downgradings

Call-outs

- "set" — Setting of values
- "select" — Selection of modes
- "engage" — Engagement of automation
- "insert" — Entering of FMS data. "... inserted", "confirmed", "activated"

Deviations — OM-A 8.4.6.5

IAS	+10, -5	"speed"
ROD	-1000	"sink rate"
Pitch	10° ANU, 2.5° AND	"pitch"
Bank	7°	"bank"
LOC	Exc deviation / ¼ dot	"localizer"
GS	Exc deviation / ½ dot	"glideslope"

	FMS	One head up all the time **FMS insertions below FL100** should be ordered (OM-A 8.3.2.4)
	RWY operations	OM-A 8.3.2.10.1, OM-A 8.3.2.10.4, 8.3.2.16: Confirm with other pilot: **Crossing** / **backtrack** / **line-up approved**, **clrd for T/O**, **clrd to land**
	ALT	**Confirm any ASEL setting**, call-out has to match curr ALT setting (ALT/FL) X-CHK **ATIS QNH** with **TWR QNH**
	FAP/FAF check	OM-A 8.3.2.29: **QNH**, **FMS WPT**, **DIST vs. ALT**
	Admission to FD	OM-A 8.3.12: Personally known, LH/LSZH staff (with ID)
	Controlled rest	OM-A 4.1.2.1, 8.3.10.3
	Fatigue	OM-A 7.3 Physiological state of reduced mental/physical capability IQSMS - hazard identification report - human limitations - fatigue
COMM with Cabin		OM-A 8.3 Appendix 1 Communication Wording, CSPM 2 Appendix 1 OM-B 2.1.1 (E1) / 2.0.2.1 (E2)
	On GND	**RSP** communicates with cabin (when FD door is closed)
	Inflight	**PM** communicates with cabin
	Fueling w/PAX ob	OM-A 8.2.1.5. FSTN BELTS off, NO SMKG on Coordinate with red cap (local procedures), inform cabin "Cabin crew prepare for fueling with PAX onboard" - "Fueling completed"
	Cockpit door	Closed/locked as soon as all doors are closed.
	PAX announce	Omit below FL100 Hints: OM-0 9 18 PiComm First PAX announcement by CMD
	FL100, BELTS on	"Cabin crew released"
	Turbulence	"Cabin crew **seat belt sign is on**" (light turbulences) "Cabin crew **take your seats**" (moderate turb)
	Incident call	"Cabin crew **at stations**" (e.g. **rejected T/O**)
	Emergency call	"**Senior cabin attendant report to flight deck**" (e.g. post decompr) + Pilot **EMG button**
	EMG descent	"Emergency descent"
	Brace order	"Brace, brace" or flash FSTN BELTS or NO SMKG **1**min prior T/D CSPM 2 App 1, 1.6.6 → "Cabin crew **normal operation**" (all prev canceled) → "Cabin crew **at stations**" (**stay alert**) → "Cabin crew and PAX **keep your seats**" (**no evac**) → "Cabin crew **rapid disembarkation**" (bomb threat, near fire) Jetty: **Disarm slides** first → "**Emergency**, **open seat-belts**, **evacuate**" CSPM 4.2.3.3: Any crew member can may initiate evac if A/C is on GND and severe structural damage / explosive fire / after ditching QRH CL: Read and do
	Debriefing	OM-A 8.3.15.13. E.g. for abnormal/EMG, irregularities, disputes, ...

Time Hacks OM-A 2.4.6.7, OM-0 9 17 LIFASI

STD - 63min	Flight documents
STD - 60min	Flight crew briefing
STD - **55**min	**Cabin crew briefing**
STD - 45min	Entering crew bus
STD - 15min	Crew at Stations CL completed
STD - 8min	Boarding completed, LS finished
STD - 7min	ENG start (outside stand)
Ground crew	Insist on absolute time hacks ("bus should arrive at ..." instead of "... in ...")
Delay codes	Coordinate with red cap
Turnaround time	OM-A 8.2.2.20 MIN declared GND time **35**min; delay code 93 if less time available Code 02 (DEP procedure after S/U): Only possible if doors closed at STD-3
CTOT	-5/+10min
Slot extension	Available only once within 20min prior IOBT (10min extension) Otherwise: DLA message

A-CDM AMS, ARN, BCN, BRU, CDG, CGN, CPH, DUS, FCO, FRA, GVA, HAM, HEL, LGW, LHR, LIN, LYS, MAD, MUC, MXP, NAP, ORY, OSL, PMI, PRG, STR, SXF, VCE, ZRH

mobile.ehamcdm.nl. Adjust TOBT (by handling agent); influences CTOT

ATC FPLN	OCC
TOBT	Handling agent (A/C ready for push and start) Report ready ±5min Req D/I latest at TOBT -15min
TSAT	ATC
CTOT	Eurocontrol/OCC

Radiotelephony OM-A 12
"Delivery, C/S, E190, stand, information, request clearance"
"..., call you when ready" - "fully ready" - "request taxi"
Conditional clearances: Read back **condition first**
RWY crossing is not a clearance (only T/O and LDG)
"Leaving ALT / FL ..." calls not req any more

EFB OM-A 8.3.25, OM-B 2 Appendix 3 (EFB handling guidelines)
WiFi hotspot from A/C on GND (*later*)

Hotspots	iPhone	Settings - Personal Hotspot
	Android	Swipe upwards, then downwards,
	Pocket Hotspot	Press and hold button. Auto-standby
Jeppesen app	**Search function**	Go to (any) **area chart**, then select magnifying glass

Ground Servicing AOM section 13 External connections, towing, mooring, (**de**-)**fuel**, oil, tire PRESS, OXY, water, waste, GND resets

Pitot tubes **covers**	OM-B 2A1.7
Leaving A/C unatt	OM-B 2 appendix 1.7 / "OAW QRH" / E2: OM-B 2A1.6 Chocks, covers (if > 12h, outside Europe, sandstorm/volcanic ash), check for leaks, check condition, all off, drain potable water tank (freezing conditions only), seals (if required)
E2 Towbar	Certification issue. Request **open stand** (as well in case of diversion) (exceptions: ZRH / two blue certified towbars; destinations according list on flight crew briefing)

Cold WX Operation QRH **NP16**, SOPM 2-75, 3-10 (1, 15f), 3-20 5, 3-40 7f, 3-75, AOM 13-70, E2: OM-B 2.8.3.2, 2.11.13.4.5.8

Limitations	**E1**		**E2**	OM-B
Depth of deposit	25.4mm	AOM 2-10 9/10	15 .. 95.25mm	1.3.7.1
Taxi SPD	10kts/5kts (turns)	SOPM 3-10	10kts/5kts (turns)	2.3.1.2
BATT MIN TEMP	-20°C	AOM 3-02 8/26	-20°C	2.8.3.2
Oil reservoir	≥ -18°C	AOM 3-02 8/26	≥ -18°C	2.8.3.2
Wing frost	if > **3420**kg/tank	AOM 3-75 4/34	if > **850**kg/tank	2.8.3.2.2
HOLD SPD	≥ 210kts/green dot	AOM 3-75 12/34	Green dot	2.8.3.2.12/16.11

De-icing OM-A 8.2.4, OM-0. Pre-flight contamination check: OM-A 8.2.4.12
3mm frost layer on underwing acceptable
E2 Frost due to cold fuel allowed on upper surfaces, but only in marked areas, no precipitation/visible moisture, > 0°C
CL Power-up Read and do
Before start Do and verify, "+" items as read and do (until T/O)
E1 OM-B 2.1.16.1.1, E2: OM-B 2.0.1.4
QRH NP16 "Icing conditions, cold weather and cold soak operations"
De-ice, **TC** (1min), **after start CL**, **flight controls check**, **finish QRH CL**
HOT tables (OM-0-9 1.2) do not cover heavy precipitation
One-step D/I E.g. with frost
Two-step A/I fluid after D/I. **HOT starts when step 2 begins**
Type I: orange (no thickener); II: white, III: yellow, IV: green

Ice shedding taxi ENG run-up if OAT ≤ **3°C**, visible **moisture**, GND idle time ≥ **30**min:
E1 **54**% N1 for **30**sec or VIB normal → for **30**min ok
AOM 3-75 10/34
E2 **60**% N1 for **10**sec or VIB normal → for **30**min ok
OM-B 1.4.7.3, 2.3.2.1/2.8.3.2.9

T/O prohibited **Deposits on critical A/C parts, heavy snowfall, FRZ RA/DZ, BA poor**
A/I on T/O MIN 60% N1, check ENG parameters, then release BRK
Ice shedding inflight QRH non-annunciated procedure for ENGINE ABNORMAL VIBRATION
Contamin RWY **No flex** for T/O. Use **autobrake** and **full REV** for LDG. Positive TD
After LDG Retract **flaps** only when free of ice/snow/slush
Freezing overnight Release **PKG BRK**
Consider Cold WX suppl CL (E1) / OM-B 2.8.3.2.16.13 (E2)

XWND Control wheel displacement > **4°** result in drag (**spoilers** deployment)
On GND **No aileron** inputs. Observe **skypointer**
Airborne Small inputs only
LDG Stay on upwind centerline side
Sideslip Crossed controls until TD
Upwind wheels touch down first
Crab TD with crab. If RWY is slippery (e.g. wet)
De-crab Crab, then downwind rudder and upwind ailerons shortly before TD
Crab+sideslip Crab until TD, then slip when first wheels touch down. For strong WWND

Take-off **Flex T/O** **Not** allowed if **WS** forecasted (prefer **F1**), or if RWY **contaminated**
Low VIS RVR < **550**m (OAW: MIN **125**m; **6** consec lights for visual segm of **90**m)
By LSP, **static** T/O, start at RWY threshold
TWND > 10kts SOPM 3-15-05 5f: **AT off**, BRK, **60% N1**, release BRK, **AT on**
80kts call Pilot incapacitation check, A/S xchk, transition to high energy SPD

NADP	AOM	NADP-1	ICAO A	NADP-2	ICAO B
	VNAV (CLB thrust)	800ft	**1500**ft	800ft	**1000**ft
	Acceleration	3000ft	3000ft	800ft	1000ft

OM-B, OM-A 8.3.2.17: Prefer NADP-2 unless airport regulations stipulate NADP-1. Min acc ALT 1000ft

Maintain positive rate during acceleration

NADP-1 Noise protection for areas **close** to the A/P (ICAO A)
VNAV/AP at **1500**ft (VNAV CAP AFE)
v_2+10 until 3000ft (acceleration ALT; AFE LIMIT), then maintain pos rate

NADP-2 Noise protection for areas **distant** to the A/P (ICAO B)
VNAV/AP at **1000**ft (VNAV CAP AFE)
v_{FS}+10 from 1500ft / thrust reduction ALT, climb sequence,
3000ft (AFE LIMIT): **250**kts

Climb — SPD — **$v_X \approx v_{FS}$**
$v_Y \approx v_{FS}$ + 50
Climb gradient — e.g. 383FPM: Multiply by [GS]

Climb / Descent — **Rates** — OM-A 8.3.2.21.2/3
max. **1500**FPM when within **2000**ft
max. **1000**FPM when within **1000**ft if potentially conflicting traffic
ROD [FPM] < height above MSA [ft]

Call-outs — OM-A 8.3.4.2.4: 2000ft before: "**Approaching** FL/ALT" if > 1500FPM

Eco descent — Use FLC, adjust rate with SPD (initiate descent with V/S)
Idle descent tables: **QRH PD30-1f**
CDA table AOM 6-20 6ff, enter ° in FMS const FP angle

Intercept G/S — **from above** should use VS/FPA
(more stable; SOPM 3-35-01 27, OM-B E2 2.5.3.2)
OM-A 8.3.2.28 ASEL may be set to **MIN 1000ft/AAE** to avoid level offs

Thunderstorms / Cells — OM-A 8.3.8.2 (table), SOPM 2-80 1, 3-25 7f (turbulences)
Circumnavigate on luv side 5..**20**NM / **10'000**ft; do not fly below

WX radar — T/O 5°, CRZ 0..0.2°, APP 4..5°. AOM E1 14-09-20

ALTITUDE (ft)	RANGE SCALE (NM)									LINE OF SIGHT (NM)
	0.5	1.0	2.5	5	10	25	50	100	200	
40000	(TILT LIMITED REGION)						-6	-3	-2	246
35000							-5	-2	(LINE OF SIGHT LIMITED REGION)	230
30000							-4	-2		213
25000						-8	-3	-1		195
20000						-6	-2	-1		174
15000						-4	-1	0		151
10000					-8	-2	0	0		123
5000				-8	-3	0	+1			87
4000				-6	-2	0	+1			78
3000			-9	-4	-1	+1	+1			67
2000			-6	-2	0	+1				55
1000		-7	-2	0	+1	+1				39
500	-7	-3	0	+1	+1					27

Near CBs — Anticipate **F**lame-out, **U**pset, **S**tructural damage, **E**xtreme turbulences

Lightnings — QRH NP17-1f, SOPM 2-77
Mainly during climb/descent/in clouds, 5..10kft

Configuration
Lower flaps before going below **green dot** SPD
Retract flaps if > **F_{bug}** SPD
Allow flap operating SPD margin of **10kts** to v_{FE}

13NM	F**1**	**210**kts
10NM	F**2**	**180**kts
7NM	**Gear** down, F**3**	**160**kts
5NM	F**5/full**	**v_{APP}** **Ffull**: Directly from F3, or via intermediate F4

APP Modes

PREV Arms green mode (if within **30**NM / 150NM post-mod load 27.1)
Arm APP only if HDG within 90° of final track (*n/a* for RNAV)

LOC **HDG** - **V/L** (E1) / **NAV** (E2) - **NAV** (E1) / **LNAV** (E2)
Disarm ASEL prior DESC

Other **NPA** Via FMS
Not possible to track VOR or NDB

RNAV Display **PROG** page (for **EPU**)
APPR (no DGRAD) must be displayed **2NM before FAF**
Perform **predictive RAIM** (n/r for LPV). **QRH NP 27** / NP50
Set ASEL to intermediate ALT
DGRAD: Perform G/A

ASEL **GS**/**GP** vertical modes do **not** LVL off at ASEL ALT

APPROACH TYPE	INITIAL MODE	PRIMARY SOURCE	PREVIEW	ARMING	FINAL FMA INDICATION	
					LATERAL	VERTICAL
ILS	LNAV	FMS	YES(6)	APPR(4)	LOC	GS
	HDG	FMS	YES(6)	APPR(4)	LOC	GS
	HDG	NAV	NO	APPR	LOC	GS
LOC	HDG	NAV	NO	LNAV	LOC	FPA(3) V/S
BC	LNAV	FMS	YES(6)	APPR	BC	FPA(3) V/S
	HDG	NAV	NO	LNAV	BC	FPA(3) V/S
VOR	LNAV	FMS	YES(1)	APPR	LNAV	GP(2) FPA V/S
	HDG	FMS	YES(1)	LNAV / APPR(7)	LNAV	GP(2) FPA V/S
NDB	LNAV	FMS	NO	APPR	LNAV	GP(2) FPA V/S
	HDG	FMS	NO	LNAV / APPR	LNAV	GP(2) FPA V/S
RNAV (GNSS)	LNAV	FMS	NO	APPR	LNAV	GP(5) FPA
	HDG	FMS	NO	LNAV / APPR(9)	LNAV	GP(5) FPA
	HDG	FMS	NO	LNAV	LNAV	FPA(3) V/S
RNAV (RNP)	LNAV	FMS	NO	APPR	LNAV	GP
	HDG	FMS	NO	LNAV / APPR(9)	LNAV	GP
RNAV (LPV)(8)	LNAV	FMS	NO	APPR(4)	LNAV	GP
	HDG	FMS	NO	LNAV / APPR(9)	LNAV	GP

No GP

E2 only

(1) Use **PREVIEW** to monitor the VOR course bar while on FMS SRC. The VOR mode cannot be captured.
(2) Prefer **VNAV GP**.
(3) Prefer **FPA**.
(4) To intercept final: Use **LNAV**, or alternatively display VOR/LOC and arm it by pressing **NAV**.
(5) Prefer **VNAV GP**.
(6) Depending on certain conditions of LOC interception, such as interception angle and speed, the FMS may inhibit LOC capture.
(7) When PREVIEW is active, pressing APPR does not arm LNAV. Use **LNAV** to arm.
(8) Optional type of approach.
(9) To intercept final: Use **LNAV** to arm LNAV.

Split APP

OM-A 8.3.2.35 ("should")
If **ΔVIS** < **1500**m / **ΔCEIL** < **200**ft (between act and req), except CAT II/III
LSP Briefing
RSP PF
LSP takes over "**my controls**" / "continue for VIS circling", or
RSP flies **G/A**

Low Visibility

System: The system starts to engage highest mode at 1500ft; **freeze at 800ft**

Briefing LSP: Special call-outs, G/A, no troubleshooting < 1000ft, downgradings
+ refer to CRM - APP briefing
CAT II / **A/L**: Perform **QRH NP CL**

Troubleshooting
1000ft: **Troubleshooting** must be completed
500ft: **Downgradings** allowed, e.g. CAT III → CAT II (higher MIN)
RA fail: **RA test** req
below: Only **A/T fail**; mention in **APP briefing**

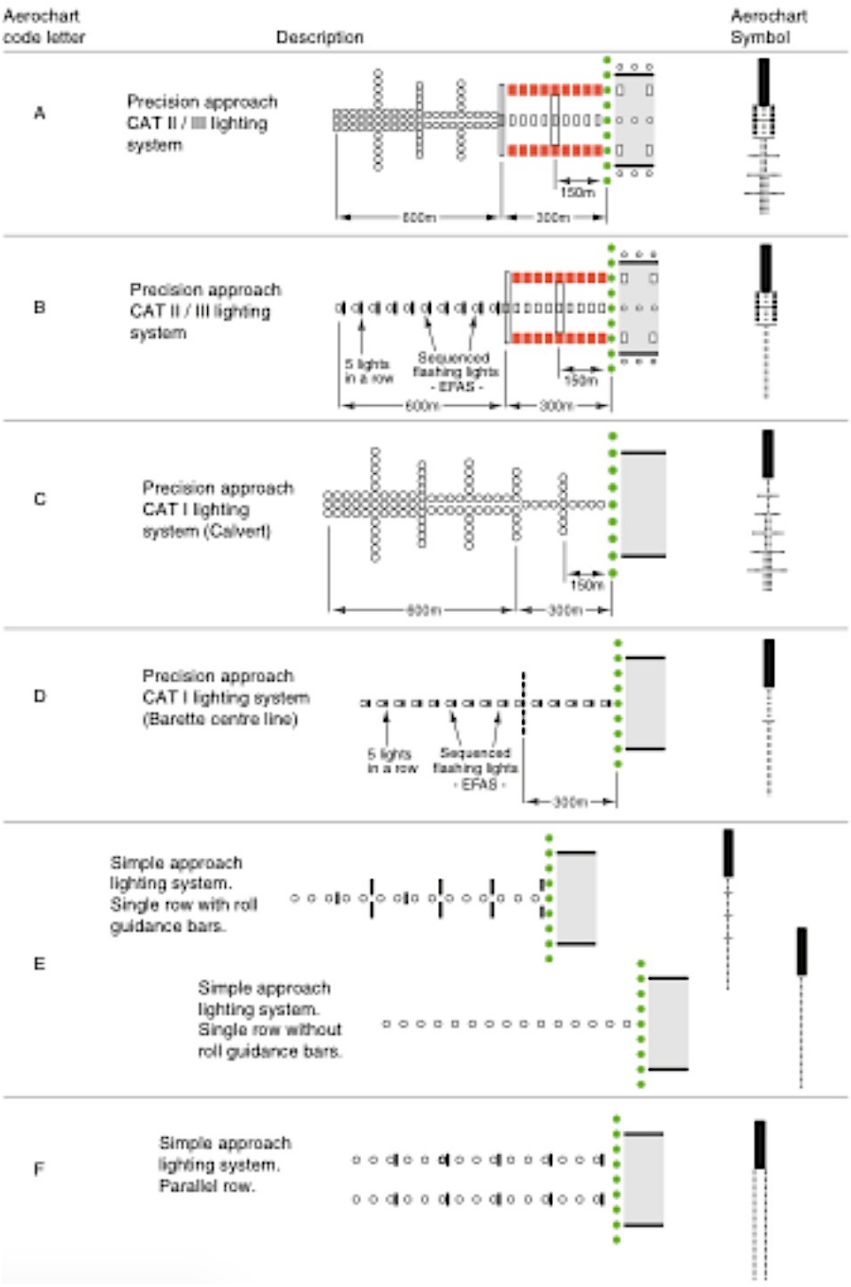
APP: EGPWS "APP MIN" call-out 80ft above DH: Scan to outside visual cues
CTC if at least **3 consec lights** in sight (one of which with a central row)
CAT II/III: Must include a **lateral element** (APP lighting crossbar, LDG threshold or barrette of the TDZ lighting)
(OM-A 8.4.6.1.3/4)

	CAT III	CAT II
Mode	**A/L**	**APPR 2** or **A/L**
MIN	50ft ≤ .. < 100ft Set RA < **80**ft	100ft ≤ .. < 200ft Set RA < **1500**ft
RVR req	TDZ/MID	TDZ
Cues	3 consecutive lights	3 consecutive lights + lateral element
EQ	**2 RA** req, A/T **not** req	**1 RA** req
PF	LSP	LSP
Conf	**F5**	**F5**
Automation	**A/L**	**A/P** or **A/L** or **FD** A/P MUH **50**ft (E1) / **80**ft (E2) **No manual CAT II** (FD only) (OM-B 2.5.3.2.1)

Autoland: OM-A 8.4.6.6
(A/L 2 complements A/L 1 with roll-out guidance down to safe taxi SPD)
Fail-passive; no out-of-trim; stable. Auto trim-up at 800ft
(refer to 14-03)

MIN	Max **H**WND / **T**WND / **X**WND	**25**kts / **15**kts / **10**kts
	Min DH	50ft
	Min EQ (QRH NAP50-4)	Aural warning SYS, A/P, EGPWS, 1 FD Ch, 2 ILS NAV, 2 IRS, 2 PFD, 2 RA, W/S wipers
	Loss of HYD SYS 1+2 or 2+3	No A/L
	Flight control SYS failures	No A/L
	A/T fail	**Manual** thrust (mention in APP briefing)
RA test	MCDU MENU - MISC - TEST - NEXT	
ePerf	Calculate with **A/L SPDs**	
	v_{AP}	depends on AT engaged / not engaged
	v_{AP} =	v_{REF} + ½ steady HWND + gust increment
	$v_{AP,min}$ =	v_{REF} + 5kts / v_{REFnew} + 5kts v_{REFnew} = v_{REF} + 5kts if LM < **40**t
	$v_{AP,max}$ =	v_{REF} + 20kts

	Setup	MCDU - MENU - MISC - OPERATOR CONFIG - AUTOLAND Usage of **autobrake recommended** (OM-A 8.4.6.3)	
	Operation	QRH NP22-1	
	Inhibited	TCS, SRC, NAV, APP, BANK, HDG, VNAV, FLC, ALT, FPA, V/S	
	Config	F5	
	A/L wording	"APPR | **A/L 1 armed**"	"Checked"
		"APPR | **A/L 1 engaged**"	"Checked" (800ft latest)
	to CAT I MIN	MIN to **RA**; **revert to BARO MIN** (for Cat I) only **after A/L engaged**	
	A/L **OEI**	**Neutral rudder trim** prior parallel rudder engagement, then **no rudder inputs** any more	
	G/A	**No manual rudder inputs**, AP RUDDER SERVO FAIL advisory otherwise, disallowing a further A/L (E1 only)	
	Malfuncts	Before FAF	Re-engage A/P If A/P disengages again: G/A
		After FAF	G/A
		Excessive deviation	G/A
		Hardover, slowover	A/P disengage, G/A
		ENG failure before FAF	Correct LDG config and distance
		ENG failure after FAF	G/A
		IRS 1 fail → Change of SRC → basic modes → **press TOGA twice**	
	Simulated A/L	MIN **2000m/500ft** required (OM-A 8.4.6.6.4) **Perform A/L on FFD on Mondays** (if required: refer to IFS - Latest Flights) or **6 months before SIM check** (one A/L) Criteriae: Within TDZ, centerline ±20m	
APP Lights	PAPI/VASIS	From **DA/MDA down to 200ft**, then use **aiming point** (OM-A 8.3.2.41.1)	
	MIN	CAT III at 50ft	Just over RWY threshold
		CAT II	300m before RWY threshold
	TD	300m after RWY threshold	
	RETIL	3 / 2 / 1 yellow lights, spaced 100m apart	
	End of RWY	900m	White/red center lights, edge lights **white**
		600m	**Amber** RWY edge lights
		300m	Red center lights
	TWY	Center lts	Green **Yellow/green within sensitive area** (green if outside)
		Edge lts	Blue



Visual APP

OM-A 8.3.2.37, SOPM 3-35-10 p. 19ff

Requirements	VIS **5**km, CEIL **3000**ft, LDG threshold continuously in sight, APP briefed, nighttime: only over flat terrain; only if traffic flow can be accelerated, instrument/visual APP can be utilized for **back-up**, **TCAS** operational
- **Circling**	See below (Circling APP)
- **Standard**	AOM / OM-B; via downwind Brief downwind ALT, if feasible ≥ 1000ft/AAE
- **Briefed**	If circling and standard not possible, e.g. **swing-over** Brief ALT, SPD, configuration schedule Mid base target ALT 1500ft/AAE Aim established at 4NM

Circling APP		OM-B 2.5.3.8 (E1: SOPM 3-35-10 p. 15ff)
		Not required to de-select ILS freq (as well not for visual swing-over)
	FAF	Set circling **MIN ALT**
		Gear **down** Flaps **3** **150**KIAS
		*Gear **up*** *Flaps **2*** ***160****KIAS*
	Circling ALT	ASEL to **MAP ALT**
	Established	LOC/**GS** Press **NAV** to disable GS vertical mode
		LNAV/**GP** Press **FPA** to disable GP vertical mode
		LNAV/FPA A/C will LVL off
	Break off	"**Breaking off**", **45°/35**sec
	Ab LDG threshold	TC, **20**sec (for 600ft/AFE; **extend** if higher
		Add 1sec per kt HWND, subtract ½sec per kt TWND)
	Base	LDG **flaps** / *Gear down, flaps **3**, **150**KIAS*
	Final	*LDG **flaps***, disconnect **A/P**
	G/A	Initial climbing turn towards landing RWY,
		follow missed APP procedure of IFR procedure of approach RWY
	Protection	PANS-OPS: MIN obstacle clearance 394ft
		4.2NM protected area (**do not break off before** 4.2NM)
		(TERPS NEW: 2.7NM, TERPS OLD: 1.7NM)
Circuits	1500ft	180kts, start turn
	Begin downwind	APP briefing. Downwind: 2NM from RWY
	Ab LDG threshold	TC, gear down, F3, 160kts
	20sec	F5/Ffull, 140/130kts, before LDG CL
	60sec	Start turn
	Mid base	Descend, set v_{APP}
	F0 LDG	210kts until base, final: $v_{RefFfull}$ + 60, descend
Steep APP		OM-A 8.1.2.6, OMM 1.4.2
		GS of **4.5° or more**
		TWND ≤ **5**kts, XWND ≤ **25**kts
		Max airport ELEV 10'000ft, max RWY slope -2%..+2%
		TLA < 70° for activation
		Ffull, AEO only, CAT I only, prohibited on contaminated RWY
		Stabilized at 1000ft/AFE or 3NM, whichever is earlier; A/P MUH 167ft
SRA		2D APP. OM-A 8.3.2.33.4
		VIS 5km, CEIL ≥ 1000ft/AAE
		EGPWS, LDG config and before LDG CL before FAF,
		COM2 for TWR/121.5
		Initiate MAP if COM interrupted for > 10sec
Stabilized APP		OM-A 8.3.2.39, SOPM 3-35-01, OM-B 2.1.9.4
		Latest at 1000ft/AAE (instrument APP VMC/IMC, VIS APP briefed),
		except circling APP and VIS APP via circling / standard visual: 500ft/AAE
	Criteriae	Max **half scale** deflection (NDB: ±5°; RNAV/RNP: XTK, VDEV), bank **< 10°**
		NPA **+100/-100ft**
		SPD v_{AP}+20 allowed down to 500ft/AAE, then **+10/-5kts**,
		V/S <**1000FPM** (3°) / <1200FPM (4°) / <1500FPM (6°)
		TL **not idle**
		Fully **configured**, **before LDG CL completed**
		(+FAP/F check, MAP ALT/HDG)
	< 200ft	Follow aiming point, not PAPI/VASIS
	30ft	Idle
	20ft	Flare. Consider SPD and increments (WND, ice, malfunctions)

Go-Around

Flaps retraction only when ≥ v_{FS}
CLB until reaching missed APP ALT (no rate reduction/acceleration)
E1 **Gear up** → **SPD up** to v_{REF}+20 / v_{APPCLB}

Discontinued APP OM-B 2.5.5.4. **Brief** if to be expected

Above MAP ALT	Disc APP **shall** be flown
Below MAP ALT	G/A **should** be flown

ALT, FMS, NAV/HDG (for details refer to Expanded CL)

No G/A after T/D	OM-A 8.4.6.2	Not allowed
	SOPM 3-40 15	Not allowed after REV deployment

Use of Automation

OM-A 8.3.18

Man flying VIS **5**km, CEIL **3000**ft, no adverse WX, day only, no dense traffic
A/P, A/P / FD **or** AT may be switched off
A/P off only when RWY in sight
T/O: VMC only
Include manual flying in briefing (TEM)

A/P	T/O	above FL**120**
	LDG	above FL**200**

Lights

Interior — OM-B 2.0.2.14f

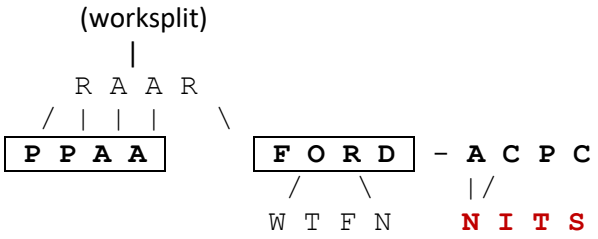
STERILE		On during taxi and below FL100
FSTN BELTS		On after arming slides, cycle when cleared for T/O, may be off above FL100, cycle 15min prior LDG, off after ENG stop
NO SMKG	**E1**	Always on
NO ELEC DEVICES	**E2**	On after ENG start, until leaving RWY after LDG

Exterior — SOPM 3-05-10 14, OM-B 2.0.2.16

NAV	A/C is energized
LOGO	SS-SR < FL100
BCN	ENG are running or A/C is moving
TAXI NOSE	A/C is moving on GND
TAXI SIDE	A/C is moving on GND, T/O until FL100, or LDG clearance received
STROBE	On RWY
LDG	< FL100. Low VIS: May be off (OM-A 8.4.5.3)

ABNORMAL PROCEDURES

Abnormal Procedures			Prepared or unprepared
	Declaring EMG		**Fire**, **Smoke** **Structural Damage** **Low Fuel** (< FR) **Severe Icing** **Security Threats** **Pilot Incapacitation**
	Duties		after "mayday" or "pan pan" call: OM-A 8.3.21.8
Decision Making	General		**Aviate**, **navigate**, **communicate**, **manage** Check **synoptic page**
	Wording		"**MW/MC** ..." - "**Checked**, **cancel MW/MC**" "**Check thrust**, **check performance**" (if performance-related) "**Your analysis, your action/QAC/QRH, my controls, my ATC**"
	Structure	**PF**	**PPAA** (+fly) → **CL** → **FORD**



RAAR	**R**ecognition	**A**nalysis	**A**ction (worksplit)	**R**eassessment (update LSP/RSP)
PPAA	**P**ower	**P**erf (thrust, gear, flaps, SPD BRK)	**A**nalysis (initial) (e.g. "ENG fail")	**A**ction (initial)
FORD	**F**acts	**O**ptions	**R**isk/Benefit	**D**ecision
WTFN	**W**eather	**T**errain	**F**uel	**N**AV aids / **N**OTAMs
ACPC	**A**TC	**C**abin crew	**P**assengers	**C**ompany (VHF/ACARS)
NITS	**N**ature	**I**ntentions	**T**ime	**S**pecials

Explicitly mention the term "NITS"
Timing with **absolute times**

PAX	If no risk	"Cabin crew and passengers **keep your seats**"
	Stairs/jetty	"Cabin crew rapid disembarkation"
	EMG	"**Emergency**, **open seat belt**, **evacuate**"

(OM-A 8.0.1.6 "FORD", OM-A 8.3.19.4, 8.3.22.3 "NITS")

Checklists			PF **confirms** QAC/QRH CL "**Question**" → "Go ahead" → "..." → "Yes/No" → "Agree/Disagree"
Vital items		requiring **confirmation**	**TL**, START/**STOP**, fire **handles** (pull only), **IDG** OM-A 8.3.0.2 **PF** Handles **TL** **PM** Handles **Start/Stop selectors**
		Wording	"Associated START/STOP selector confirm", "Number 2 confirmed"

	Priorities		Multiple messages	MW → MC → ADV Potential **root cause message** is highlighted by a yellow **chevron** (**>**)
			Manuals	OM-B → OM-A → AFM → AOM → SOPM E2: AOM and SOPM integrated in OM-B
	Performance		**SPDs and unfact LDG DIST from QRH** (PD30-2ff, PD35-2ff) (**not** from ePerf)	
			Conservative value	Unfactored LDG DIST of **1000m**
Recall Items (7)	**Smoke/fire/fumes**		(no EICAS msg)	
			Crew Oxygen Masks (headset back on neck)	DON, 100%
			Crew Communication	ESTABLISH
	ENG abn start		Affected engine: Start/Stop Selector (motor if FF has been observed)	STOP
	Jammed ELEV		Elev Disc Handle	PULL
	Jammed AIL		Aileron Disc Handle	PULL
E1	**Pitch tr runaway**		**A/P Disc** Button	PRESS AND HOLD
			Pitch Trim Systems 1 and 2 **Cutout** Buttons	PUSH IN
	Roll/yaw tr runaw		**A/P Disc** Button	PRESS AND HOLD
	Steering runaway		Steer Disc Switch	PRESS
			Use differential braking and rudder to steer the airplane	
QAC			OM-B 3 App 1	
	On back side		**ENG abnormal start, cabin ALT high**, **EMG descent**, **BATT overtemp**, **dual ENG failure**, **APU fire**, **CGO comp fire**, **jammed ctrl column/wheel**, **smoke/fire/fumes, smoke evacuation**, **CGO smoke**, **ENG fire/severe damage/separation**, **EMG evacuation**	
		E2 addt'l	**Gear lever** cannot be moved up, **ENG fire**; *no* EMG evac (read-and-do)	
	After QAC items		proceed then with referenced **QRH CL**	
	On GND		RSP reads, LSP does, **no** confirmation of vital items	
	Inflight		PM reads, PF does	
QRH	**NP**	Suppl proc	**ECS off T/O**, ENG **XBLD start**, ENG **GND pneumatic start**, ENG **BATT start**, **single ENG taxi**, hot WX operation, icing conditions, **cold WX** and cold soak operations, **lightning strike**, turbulent air penetration, **category II**, **autoland**, high ALT T/O / LDG, RNP (AR), steep APP, req EQ for special ops (RVSM, baro VNAV, category II, autoland, RNP)	
	S	Smoke	CRG, LAV, SMK evacuation, **SMK/fire/fumes**, EBAY SMK	
	NAP	**Non-annunciated procedures**		
		Emergency	CGO comp fire, ditching, **dual ENG fail**, EMG descent, EMG evac, ENG abnormal start, ENG severe damage/separation, forced LDG, **fuel leak**, gear lever can not be moved up, jammed control/rudder	
		Abnormal	**Abnormal LDG gear extension**, aural warning inadv annunciation, bomb on board, display unit blank without auto rev, EICAS msg miscomparison, ENG abnormal VIB, ENG **airstart** + envelope, ENG shutdown, ENG **tailpipe fire**, **LDG aural can not be canceled**, loss of all fuel QTY indications, loss of APU indications, loss of HYD system(s), loss of PRESS indication, MFD miscomparison, **OEI APP and LDG**, OXY leakage, partial or gear up LDG, PFD miscomparison, structural damage, **unreliable A/S**, volcanic ash, windshield impaired or cracked	

EAP		EMG / abnormal procedures **1** Airplane general (CGO/doors/lighting), **2** AMS (pneum/A/C/PRESS), **3** Autoflight, **4** APU, **5** ELEC, **6** ENG, **7** Fire protection, **8** Flight controls, **9** FMS/NAV/COM/instruments, **10** Fuel, **11** HYD, **12** Ice and rain prot, **13** LDG gear and BRK, **14** OXY
PD	Perf data	T/O, CRZ, APP, LDG
GR	**GND resets**	EICAS message index
QAP	**EMG evac**	CL (read and do)

Engine Failure

SOPM 3-15-10
Rotate at slower rate. Use **rudder** to keep wings LVL
Yaw trim **1 dot** (CLB/CRZ), **½ dot** (APP), neutral on final
(slip indicator ¼ to ½ off center, bank 0..5°)
Trim yaw before engaging A/P
E2: No yaw trim possible (beta mode)
QRH: "RELIGHTS" ≡ ENG starts
Always **start <u>XFEED</u>**, always **start <u>APU</u>**

During T/O	PPAA, consider following SID with **green dot SPD** (v_X) Indications **inhibited** between 80kts and 400ft
F4 T/O	v_{FS} might be higher than max selectable SPD until F3
OEI G/A	**No acceleration**; **climb to missed APP ALT**. **<u>No rudder if AP engaged</u>**

Types of failures **<u>ENG failure</u>** **<u>QRH</u>**
<u>Severe damage</u> **<u>QAC</u>** (fire, bang, vibr, noise, blocked N1/N2, ...)

Compressor surge	ENG deterioration (blade rupture, high wear, FOD, bleed fail) **Bang**, loss of thrust, maybe visible flames **Fluctuating** N1/N2, ITT increasing "**ENG FIRE, SEVERE DMG OR SEP**" after a bang, or "ENG SHUTDOWN", or may be self-recovering
Flameout	No combustion, fuel starvation, severe inclement WX, ash, FADEC, stall Loss of thrust. FADEC selects continuous IGN EICAS amber FAIL on N1, red oil PRESS QRH EAP "ENG **FAIL**"
Fire	Inflammable fluid on hot ENG parts, e.g. leak, rupture, ... Usually no loss of thrust Fire warning, EICAS red **FIRE** on ITT, **illuminated fire handle** QAC, QRH EAP "ENG FIRE" or QRH NAP "**ENG FIRE, SEVERE DAMAGE OR SEPARATION**"
on GND	LSP: "QRH: ENG 1/2 FIRE"
Tailpipe fire	**On GND only**; fuel in turbine casings during startup of shutdown Usually no indication QRH NAP "ENG **TAILPIPE FIRE**"
Severe damage	Mechanical damage Loud noise, loss of thrust; maybe fire warning (leaked hot air) or surge N1/N2/FF **drop**, ITT rise momentarily QAC or QRH NAP "ENG FIRE, SEVERE DMG OR SEP"
Separation	Physical separation from airplane **Amber dashes**, **thrust rating mode disappears** QAC or QRH NAP "ENG FIRE, SEVERE DMG OR SEP"
Seizure	Rotor blocked **N1 and/or N2 0**. - **E2**: N2 reads 0 if < 200KIAS QAC or QRH NAP "ENG FIRE, SEVERE DMG OR SEP"

Symptoms

	Bang	Fire Warning	Visible Flame	Vibration	Yaw	High ITT	N1 Change	N2 Change	FF Change	Oil Indication Change	Smoke in Cabin
Engine Separation											
Severe Damage											
Surge / Stall											
FOD / Bird Ingestion											
Seizure											
Flameout											
Fire											
Tailpipe Fire											
Hot Start											
Inadvertant Reverser Deploy											
Fuel Leak											

Symptoms very likely

Symptoms possible

Dual ENG failure Heading towards suitable LDG site, 90° abeam

SPD		Green dot. Consider APP SPD green dot	
ALT	E1	Aim for 0/+500ft	If too high, temp increase SPD
	E2	Aim for 0/-500ft	
	RAT	+1500ft if deployed	
High key		**1**NM, **5500**ft/AAE, **F1**	
Overhead		TC, **15**sec, downwind, **F2**	
Downwind		**4000**ft/AAE, TC	
45sec		Continuous final turn, gear down (manual extension)	
Mid base		**F3**	
TD		Aiming point at 25% of RWY	

Fire SOPM 3-10 16f

Inform ATC immediately

On GND	In case of any fire, even if extinguished: **EMG EVACUATION**
On final	Continue, land, EMG EVACUATION
CL	SMOKE EVACUATION If landing assured <15min
	SMOKE / FIRE / FUMES If more time available

Rejected T/O SOPM 3-15-05 1ff

Refer to Expanded CL

LSP "**Reject**", **disconnect AT**, let **RTO** decelerate to safe taxi SPD, "Cabin crew **at stations**"
Do not vacate RWY, except on high speed exit TWY
Try to turn A/C into WND. Set parking brake
"Cabin crew and PAX **keep your seat**" if no evacuation

RSP Check spoilers, "60kts", **"TWR, ... aborted T/O** RWY ..., request **fire brigade**", F5 (for possible evacuation) (refer to EMG EVAC)

"GO minded"	Short RWY, low VIS
Cabin call	Always abort T/O
Below 80kts	Idle **REV**
Beyond 80kts	MAX **REV**; high energy, only abort with a **ENG failure**, **fire**, **unflyable condition** (flap retraction, spoilers extension) or **pilot incapacitation**

EGPWS SOPM 2-83 1, 3-05-10 7, 3-15-05 22f, 3-35-01, 3-40 13f

OM-A 8.3.5 File report

OM-A 8.3.5.2 Exceptions

Terrain **A/P off**, **TL max** (→ A/T off), **G/A button**, **PLI** / max **15°** ANU **progressively**

Windshear OM-A 8.3.8.5 **APP shall be aborted**

T/O	Prefer **higher flaps** settings, **NADP-1**, **no flex**
LDG	**F5** if WS anticipated
	MC/MW enabled **10..1500**ft/AGL
	First indication **SPD trend vector**

MC	Positive WS	"Caution windshear"	Consider deviation
E2		"Monitor radar display"	Consider deviation
MW	Negative WS	3x "Windshear" MW. Action required:	
	w/o EGPWS wng	**A/P, A/T off** **TL max**, **TOGA**	**PLI** / max **15°** ANU
	w/EGPWS wng	**TL max**, **TOGA** + "**CHK thrust**"	**follow escape guidance cue**
E2	T/O	"WS ahead, WS ahead"	Consider reject
	APP/LDG	"**G/A, WS ahead**"	**G/A** (**no** WSHR proc, only if in WS)

Procedure **PF**: "**WS**", small inputs, keep wings LVL, anticipate SPD changes with trend vectors
PM monitors V/S and calls out if A/C is descending, FSTN belts, inform ATC
Maintain configuration (safer with LDG gear down when touching GND; flaps retraction could lead to a **stall**)
MW will be canceled at 1500ft/AGL

Out of WSHR	PM	"**Out of WSHR**",
	PF	**TL ≤ TOGA**, "**G/A**", press **TOGA**, on APP: "**F2/3/4**"
	PM	"**Positive rate**"
	PF	"**Gear up**, **restore**", check SPD up
	PM	Set $\underline{v_{FS}}$ or higher (E1) **FLCH**, **A/T**, **A/P**, check FMA
	PF	"**CLB sequence**"

TCAS SOPM 3-05-10 5f, OM-A 8.3.6.4

TA	PF	Hands on yoke, look out, "Traffic alert, two o'clock, high"
	PM	All external lights on, inform ATC, FSTN BELTS on, look out
RA	PF	**Both A/P off**, **A/T off**, guide FPA symbol to fly-to zone (**green rectangle**). If in a turn: **Wings LVL**
	PM	"**TCAS RA**", "**Clear of conflict**, **returning to** ..." / "... **resumed**" Contradicting instructions: "**Unable, TCAS RA**" File report
Recovery		**V/S**, **A/T**, **A/P**

Upset Recovery SOPM 3-25 32f: **Undesired aircraft state**
(e.g. pitch beyond -10°..+25°, bank beyond ±45°, inappropriate A/S)

General	1. Manage energy 2. Arrest flight path divergence 3. Recover to stabilized flight path (with primary flight ctrls, no trim)
First	E.g. "**Upset, I have control**", **disengage A/P and A/T** and FD Anticipate startle effect
ANU	First adjust **pitch**, consider **thrust reduction**, then **wings LVL**

If pitch is too high: Bank to 45..60° until pitch is lower

AND	First **wings LVL** (to generate lift) If SPD too high: TL idle / SPD BRK, adjust **pitch**
Stall	"**Stall**", **push to unload** / AND **-10°**, wings LVL, retract SPD BRK, apply **thrust if required** when pitch at -10 (do not chase ALT; underwing engines)
High ALT	**Slowly** to **full throttle** (underwing ENG), pitch **10° AND**
AOA	= angle between A/C **pitch** and **flight path** angle To reduce AOA: **Pitch to path**

Unreliable A/S SOPM 3-25 31
Disengage A/P and A/T
Refer to QRH **unreliable A/S tables**

Pitch Trim Runaway — **E1**
Recall items
Declare EMG, request ALT band and traffic separation
Avoid over-use of trim, press DISC button (overheating)
Use reduced flap setting for LDG, land w/o flare
Try not to change configuration
Pitch trim moves very **slowly** when only one system is engaged
E2 FLT CTRL HSTAB FAIL MC

Electrical Failures
ELEC EMG MW: Go into that CL even if **RAT** deployed / no MW any more (preparation for **F3 LDG**)
Priorities: MW - MC AC - MC DC - MC DAU/MAU/Avionics - ADV SPDA - other MC

Hydraulic Failures
1. **EAP** procedures (try to recover a single system), then
2. **Non-annunciated** procedures (loss of HYD systems)
OVTMP **Remain in that CL** (even when MW went out)

Inflight Diversion
WTFN; Fuel: incl. FR
AEO: AOM 6-35
OEI: AOM 6-30

Low Fuel
Fuel **leak**
Low on fuel
Compare sensed fuel (EICAS) to calculated (FMS - FLT SUM)
OM-A 8.3.7.4.2, OM-A 8.3.19.8
1. "Minimum fuel" when committed to land
2. (ZRH only) "Request Texaco"
3. (ZRH only) "Request Texaco bust"
4. "Mayday, mayday, mayday, fuel" if < FR (EMG)

COMM Failure
OM-C: Regional procedures
VMC: Squawk 7600, maintain VMC, land asap
IMC: Squawk 7600, maintain assigned SPD/LVL for **7**min, then resume FLP

Driftdown
SOPM 3-25 10ff: **A/T off**, **CON** thrust, **TL TOGA**
(A/T on for annunciated ENG failure)
Set ALT (FL**250** ok for OEI, or PERF - NEXT - EO RANGE - CONFIRM EO, set ASEL to EO MAX ALT), SPD to v_{DD} ≈ **Green dot** SPD,
then select **FLCH** (VNAV off) when at **green dot** SPD

Emergency Descent
SOPM 3-25 16ff
Check MIN/MAX ALT on terrain on MFD. Roughly **FL200**
Consider flying 5..10NM parallel (**turn 30° off to leave AWY**)
PF: "**QAC EMG DESC**", via PA: "**EMG DESC**", **OXY** masks
Set **ASEL** (e.g. FL150), out of VNAV, TL idle, **FLCH**, **SPD BRK**, **max SPD** (in case of **structural damage**: **maintain SPD**)
PM: **Lights** on, **FSTN BELTS** on, inform **ATC**
Call out every **10'000**ft
"**2000**ft to LVL off" — PM — SPD **250**kts
"**1000**ft to LVL off" — **SPD BRK** close
LVL off LSP: "Senior cabin ATTND **report to flightdeck**"

Decompression		TUC		
Slow	≥ **1min**		FL300	**1min**
Rapid	1sec .. 1min		FL350	**30sec**
Explosive	< **1sec**		FL400	**15sec**

Balked Landing
OM-A 8.1.2.2.7
G/A below MIN
OEI: Consider **EOSID**

Overweight Landing		SOPM 3-40 19f ROD max **300**FPM
Ditching		SOPM 3-40 24ff Refer to QRH (non-annunciated) Squawk 7700, cabin signs on, ELT on PACKs / BLEEDs out Max available flaps, gear up Reduce onboard fuel Parallel to waves
Emergency Evacuation		SOPM 3-10 18ff
	NITS	for CAB: Consider fire/smoke to restrict usage of **EMG exits**
	CL	**Switch off ENG first**, then Command not via ICU but **via PA**: "**Cabin crew at stations**", "**Emergency, open seat belts, evacuate**"
	Equipment	LSP Flashlight, life vest (if req) RSP Flashlight, megaphone, EMK, live vest (if req), via 1R SEN/1L Flashlight, first aid kit, EMG medical kit, live vest (if req) E190/2: 1R Flashlight, life vest (if req) 2L Flashlight, megaphone, life vest (if req) 2R Flashlight, first aid kit, portable ELT, life vest (if req)
Pilot Incapacitation		OM-A 8.3.14, SOPM 3-05-10 14f Obvious (complete) or subtle (incomplete) Failure to respond to a second request Always declare **EMG** Reduce workload 1. Recognition, "my controls", A/P, declare EMG 2. Take care of incapacitated crewmember 3. FRAMS, APP
	STOP	OM-A 8.0.1.3 **S**ituation clarification (what happens), **T**ell concerns/precautions, **O**pposition (emphasize), **P**an pan (take action) Write report if level 3 or 4 ("O" or "P")
Passengers	Medical EMG	OM-A 8.3.21.7 Decision tables CSPM 6 First aid
	Unruly PAX	ACSP 4.4, flow chart in ACSP 13.5 ACSP 4.5: 3 levels of incidents, 4 levels of unruly PAX
	Levels	1 Not interfering with safety: Verbal warning, inform CMD 2 Continued disturbance: Inform CMD, de-escalate, written warning (yellow card), PDR 3 Continued disturbance, serious threat, unscheduled LDG, restraints used: Inform CMD, complete PDR (w/witnesses), refer to police on ARR, if possible obtain copy of police report. CMD to request police to meet PAX at A/C, inform OCC
	Actions	Inform OCC about actions prior DEP, fill out PDR, de-brief crew
Bomb Threat		ACSP 13.7; CL in forms folder Squawk 7700 LRBL: LH window secondlast/last row (E1) / RH aft door (E2)
Hijack		ACSP 13.6: "Cabin attendant six", squawk 7500, land ASAP, contact OCC

Human Trafficking	CMD: Send ACARS to OCC, "Suspected HT inflight", suspected trafficker information (seat number, physical description, ...), potential victim information, indicators, any additional information. E.g. request police at destination. Make sure they are identified to police before deboarding. File OR. Debrief with crew.

EXPANDED CHECKLIST

EXT. INSPECTION	PM	Whenever A/C has been left unattended	
		LG	Uplock hooks unlocked, GND locking pins removed, BRK wear indicators (no less than flush)
		OXY	Discharge indicator green disc
		Ext lights	Check (**FFD**)
INT. INSPECTION (read and do)	PF	Maint status	FFD check blue doc folder
		Daily check validity	2d (E1) / **3d** (E2), excl. day of check
		Cockpit EMG EQ	PBE, fire ext, gloves, crash axe, life vests, esc ropes, flashlights, pins, LIPO bag, EMK
		OVHP	All 12 o'clock / AUTO / in, exc (**4**) **GPU**, **BATTs**, **EMER LT**, HYD **3A**; guarded switches out
POWER UP (read and do)	PF	BATTs	DU 1/4. ≥ **22**V on status page, FMS 2 **Wait for 4 msg** / **GPS time before GPU** Do not move A/C during ELEC PBIT
		Fire ext panel	**6** lights, **6** MW (incl FIRE on EICAS), later **3** MC
		APU ctrl panel	EMER STOP out; ≥ **-20°C** FADEC ready when no dashes
		DVDR ctrl panel	TEST for **3**sec (fwd only)
		HYD panel	If HYD fluid **≤ -18°C** QRH NP16 If FLT CTRL BIT EXPIRED 3xON, 30sec, 2xAUTO/OFF
		Cockpit door panel	Close door, press and hold **TEST**, check alarm / UNLOCKED on, push in LOCK, check latch, push out LOCK
	H/O of powered-up A/C		FIRE EXT, DVDR, CBs
BEFORE START	Flow LSP	Manuals	Techlog, AOM, QRH; airworthy, M&B, radio sta, NAV kit
		OXY	MIC cold, flow indicator, SPKR, 100%, check PRESS
		Glareshield	Lights/display ctrl, set **QNH**, SPD **FMS**
		Rev panel	Check
		Flight instruments	No flags (Δ ≤ 75ft), **ALT** SEL (**SID** / MSA **x900**), **HDG**, **SRC**
		IESS	Set
		MFD	**WX** (ACT, TURB, **2.5**, **5**°) - **TCAS** (EX) - **MAP** (all exc EO SID; PF **WX**; PM **Terr**), **PLAN** (all exc EO SID, WPT cnt)
			Status ENG **oil level**, **BRK EMER accumulator**
			Pages **ELEC** - **Flt Controls**
		EICAS	Check
		Autobrake	Select **RTO**
		Center pedestal	FLIGHT CONTROL MODE, SHAKER CUTOUTs, IGN AUTO, EICAS FULL, SPD BRK, TL, **ACP** (VHF1/2, INPH, HDPH, PA, RAMP)
		Trim panel	1/day. ELEC **PBIT done**: **Main**/**backup pitch** 3sec, **2up**
		Check	**Steer disengage**
		FMS	MENU - DISP SETUP - SVS ON, MENU - MISC - SETUP
		Turnaround	**OXY**, **SPD FMS**, **ALT**, **MFD**, **SRC**, **RTO**, **FMS**

Flow RSP	**J/S OXY**, ACP	MIC cold, flow indicator, SPKR, 100%; set **ACP**
	OVHP	(**5**) **annunciator test**, **EMER LT on** (lights/2 msg) / **arm**, **NO SMKG** on; **NAV** light on, **LOGO** (night, low VIS), HYD pump **3A off**
	OXY	MIC cold, flow indicator, SPKR, 100%, check PRESS
	Glareshield	Lights/display ctrl, set **QNH**, **FMS**, **reset clock**
	Rev panel	Check
	Flight instruments	No flags (Δ ≤ 75ft), **ALT** SEL (**SID** / MSA **x900**), **HDG**, **cpl**
	MFD	**WX** (ACT, TURB, **2.5**, **5**°) - **TCAS** (EX) - **MAP** (all exc EO SID; PF **WX**; PM **Terr**), **PLAN** (all exc EO SID, WPT cnt)
	Pages	EICAS - Status
	EICAS	Check
	Center pedestal	LG WRN, GND PROX, DISC handles, **ALTN gear** ext, **ACP** (VHF1/2, INPH, HDPH, PA, RAMP)
	Trim panel	1/day. ELEC **PBIT done**: **Main/backup pitch** 3sec, **2up**
	Turnaround	OXY, FMS, ALT, MFD, SRC, **reset clock**, FMS, RTO
Flow PF	**FMS**	**NAV - NAV IDENT** - check NDB (new NDB activates at 0000Z) NEXT - **POS INIT** - load GPS 1 **DLK** - PRE FLT - INIT (2 3LC, **FLT NO** [**not** C/S], SKED, AUTO INIT) [call sign 2L, flight ID OWA] Cost index: **13** (E290) / **12** (E295) (HWND: Consider ↑) > **RTE** 6R - DEST / ALTN / FLIGHT ID (SWR C/S) SEND, DLK FPL, APPLY ACTIVE, ACTIVATE (or: enter AWY LH, WPT RH / FMS FPL ID D...) 6L **TRS** TO **DATASET**, FMS TAKEOFF, CLB **2** (E190) / **acc OFP** (E195) 6R TAKEOFF INIT -6R-> TAKE OFF -6R-> DEP LIMIT -6R-> ACT FLIGHT PLAN > **PERF** 6R - PERF INIT - **RES** ..., **TO/LDG** 200, **ALTN** ... (PASS: #persons on board, incl. crew)

	> **DEP LIMIT**	NADP-**1**	NADP-**2**
	SPD LIMIT	**v_2+10**	**v_{FS}+10**
(end of NADP)	AFE LIMIT	**3000** ZRH:3500	**3000**
(VNAV, thrust red)	VNAV CAP AFE	**1500**	1000
	VNAV CAP EO	**ePerf** / min1000	**ePerf** / min 1000

RADIO - **NAV setting**, manual/automatic tuning
(RNAV 1: Autotune)
NAV - **FIX INFO** (acc ENG fail procedure)
ZFM, MACTOW

LSP	"BEFORE START CHECKLIST **to the line**"

	Awareness brief 8.3.2.3.2	CMD (lead)	TEM - TWO-P (**Threats**: **T**errain, **W**X, **O**ps, **P**ilot cond) (Ops: A/C variant, limitations, procedures)
	DEP briefing	PF	**What-if** (dct, WSHR, ...), **SID** (acc **MCDU**), **manual flying**
	8.3.2.14	PM	Verify SID acc chart (chart number, instructions, ...)
	T/O briefing	CMD	T/O rejection (until v_1) (first route sector only)
	8.3.2.15	PF	After v_1: OEI DP (**ePerf master**), manipulations, acceleration (1000ft/AGL or after turn), climb to (above MSA), hold/troubleshoot, **MLM**
		PM	Short read-back, check OEI DP acc chart
	EFB	Prior flight	Remaining fuel, actual block, uplift, density, **sec search**, ATIS, clearance, fuel slip, **loadsheet**, NOTOC, **ePerf**, doors closing time
	ePerf completed	Prelim loadsheet	ZFM Δ ≤ **300**kg, CG ±**2**%
		RSP	Insert **ZFM**, PERF - TO - 2/2 - **flaps**, PERF INIT 3/3 - T/O **SPDs**, **TRS** - T/O data set, set **trims** REF A/I **Icing cond** up to 1700ft / wet RWY < **5**°C TAT: ALL, ≤ **10**°C TAT: ENG Check **N1 target** (ePerf value **+0.5**%/**-0.1**% (A/I ALL with FLEX: after ENG start) (SOPM 2-25, 3-31)
		LSP	DEP/APP **SPDs** (**v_2+10**/160 NADP1 / **v_{FS}+10**/210 NADP2), SID, ALT, XPDR, **NAV**, **SPD FMS**, **TOGA** **APU** on
	S/U received	RSP	RED **BCN on**, HYD PUMP **3A on**, XPDR **TCAS ON**
		LSP	"Cabin crew **arm the slides**", **FSTN BELTS** on, check all doors closed + "all slides armed", **LOCK** door, **STEER** OFF (pushback: Ask for green light) "BEFORE START CHECKLIST **below the line**" ("Fuel qty", "Fuel ob ...", "MIN fuel ...", 2x"checked") **Start** ENG 1, then 2 (START for ≥ 2sec; max **740**°C) (E2: Switch off at 900°C) TC START - 50% N2 (**90**sec starter limit), "**normal start**" RSP: TC FF
AFTER START		LSP	**STERILE**/**NO ELEC** on Remove **GND EQ**, nose gear/RAT pins "Set **flaps**..., **flight controls check**", STEER off ↓ ↑ ← →, RSP: Follow LSP on rudder check **STEER**, clear signal, FltCtrl page "**APU off**, **AFTER START** CHECKLIST", select **MAP**
		RSP	XPDR TA/RA acc local requirements
		LSP	"Ready for pushback, brakes released/set", "Remove towbar" if not yet ready
		LSP+RSP	"Left / right side clear, **clear signal** received"
	Lights	LSP	2xTAXI (w/PKG BRK)
		RSP	**STROBE** when entering or crossing RWY

BEFORE TAKEOFF

	LSP	Check EICAS (msg, thrust rate, ATTCS, flex) Line-up approved: "**BEFORE TAKEOFF** CHECKLIST" "RWY ... identified" (or RAAS)
	RSP	"Cabin crew **prepare for DEP**" (1min; JABED) **STROBE** on, BRK TEMP green, check EICAS, select **T/O CONFIG**, **checklist**, select **MAP**
CLR received	RSP	**LDG/taxi side** lights on, **nose** light off, FSTN **BELTS**
	PF	**Arm AT** when aligned, check EICAS, **fuel**, HDG

TC before line-up (90sec on RWY, OM-A 8.3.2.10.4.6)
TC with T/O (10min max thrust, or via ET clock)

Take-off	**PF**		**PM**
	"**Cleared for T/O**", TL to **40**% (2nd dash), "**T/O**", BRK release, TL to 60% / AT		
WND	**TWND** > 13kts or XWND > 30kts: 60% N1, release BRK, PM: A/T on at 30kts		
	"Check thrust"		"Thrust checked". "80kts"
	"Checked"		"v_1, rotate, positive rate"
	Rotate **3°/sec** to **18° ANU**, then FD, "Gear up"		
400	"Engage **A/P**"		(NADP-1: 1500ft; NADP-2: 1000ft)
3000, > F_{bug}	"**Climb Sequence**"		Retract flaps/slats according bug, "**Flaps 0**"
	"**Checked**, **after T/O CL**"		By heart: Gear, flaps; **A**PU, **A**ir cond, **P**ress "After T/O CL completed"
Clrd to LVL	"Set altimeter STD"		"Set"
	"**Reading** FL... **now**"		"**Compared**"

Rejected T/O	*LSP*	*"**Reject**", TL idle, disconnect **AT**, set REV,* *60kts idle REV, 30kts idle thrust, **PRK BRK** on,* *"**Cabin crew at stations**", request CL (QAC or QRH)* *"Cabin crew keep your seats" when vacating RWY*
	RSP	*Monitor deceleration, verify REV, cancel warning,* *"**60**kts", **ATC**: "... stopping", set **F5** for possible EVAC*

OEI Take-off	***PF***		***PM***
			"ENG failure"
	*"Check thrust"; **no** firewall*		*"Thrust checked", "Rotate"*
	*Rotate **1.5..2°/sec** to **10° ANU***		*"Positive rate"*
	"Gear up", v_2 .. v_2+10, initially half rudder pedal input		
	***Center sky pointer**, **disregard FD**, smooth inputs*		
400	*"Select **HDG**, check bank, engage **A/P**" (E2: 200ft)*		
	Rudder trim 2x3sec / 1 dot; slip ¼..½ off center, bank 0..5° for least drag		
F_{bug}	*"**CLB sequence**"*		
v_{FS}	***Continuous***		
	*PPAA: **Flame-out***		*→ **QRH** ENG FAIL*
	damage/separation/fire		*→ **QAC** (incl. bottles)*
	"QRH/QAC ..., my ATC"		*"TL1/2 idle"*
	"TL idle confirm"		*"1/2 confirmed"...*
	"1/2 idle"		*"START/STOP STOP confirm"*
	*"1/2 confirmed" ... **After T/O CL***		

AFTER TAKEOFF	FL100	Early release of cabin crew: STERILE OFF, "Cabin crew **released**" (after FL100 only)		
		PM	"**FL100** / 10'000", PF: "Checked"	
		PM	**LDG** / **TAXI SIDE** / **LOGO** off, "FSTN BELTS? STERILE?" IFS: Block / T/O times, delay codes, ETOs, fuel chks	
		PF	PROG - **AUTOTUNE** - select (PREV must be off), NAV - **FIX INFO** - set **fix** (**50**NM/cabin sign, **30**NM/APP PREV) **CLB-1** if ROC < 1000FPM, ALT constr, CLB-1 by FADEC	
	EFB	PM	Off block, T/O time, delay codes, services Fuel check after TOC, every 60min, before TOD (**DLK** - FLT TIMES; **NAV** - FLT SUM) RVSM, ATIS, ePerf	
Approach Briefing	MCDU	PERF	DESCENT	TL
		> LANDING	LANDING INIT (TEMP, WND, flaps, APP type, ice)	
		> LANDING	LANDING	
		> GA LIM	SPD LIMIT	**210**
			LIMIT/**CAPs** (3)	**MAPP ALT - A/P ALT**, **rounded down** to next 100ft
		> APP SPD	Clean 210 (210..220), F1 180 (180..220), F2 180 (160..205), F3 160 (150..190), F4 140 (140..170), LDG flaps VAP	
	CMD (lead)	Awareness briefing. TEM - **TWO-P**		
	Abbr. brief	Chart number, revision date, MIN, MAP (initial actions), FRAMS		
	PF	**Clearance limit**, type of **APP**, **chart** number, MSA; **PF**: **Chart**, PM: MCDU; **transition ALT**, vital ALT, **MIN** / set RA/BARO, **MAPt**, APP/RWY lights, offset RWY, missed APP, **holding**, NAV setting, A/C **config**, **autoflight**, A/C technical status (e.g. low VIS downgrade), **fuel** (700kg = 1/2 h), stabilization criteriae, ALTN/WX, **perf**; **config**, **autobrake**, **NAV setup**, **REV** **What-if** (WSHR, discontinued APP, short LDG/vacate), **RAIM**, manual flying, A/C variant (limitations, procedures), G/A ALT FMS limits vs CLB instructed by ATC (**disarm VNAV**)	
	FRAMS	If under time pressure (RWY change, G/A, abnormal/EMG) Setup APP **F**MS, **R**adio aids/**bearings**, **A**utobrake, **M**IN/MAP ALT, **S**PD		
	v_{AP} (until 50ft) A/L	**= v_{REF} + ½HWND + gusts** (gust - WND) $v_{REF\ NEW} = v_{REF}$ + 5kts	Increment **5**..**20**kts (E2: as well for **ice** / **low VIS** / **A/L**) ePerf tool includes this increment Overwrite TOLD calculation	
HOLDING	Icing conditions	E1	Green dot, min 210kts	AOM 3-75, SOPM 2-75
		E2	Green dot	OM-B 2.8.3.2.12

APPROACH		**PF**		**PM**	
		"**CRS** ..."	←	"[identifier], [freq], CRS ..." (**PROG** page)	
		Extend **flaps** > **green dot SPD**		"**FL100** / 10'000ft"	
		"Checked"		**LDG** / **LOGO** / **STERILE** on	
	Cleared to ALT	"...ft set"		"Checked"	
		"Set altimeter QNH ...."		"Set"	
		"**Reading** ...ft **now**"		"Compared"	
	< FL100	"**APPROACH checklist**"		Use **CL**. "...Altimeters?"	
		"Set and cross-checked"		"Checked, APP checklist completed"	
	15min LDG			**FSTN BELTS** on / cycle	
	Vectors	Activate vectors, APP SPDs (activated with F1)			
	APPR mode	"**APP 1**/... **armed**"		"Checked"	
	FAP				(210kts)
	Base 12NM	"Flaps 1"		"**LOC**|**CDI alive**"	(180kts)
	Bef intcpt 10NM	"Flaps 2"		"**G/S** | **GP alive**"	(160kts)
	1 dot|2NM 7NM	"Gear down, flaps 3"			(150kts)
	2NM before FAF	when not using VGP		"**Two miles to go**"	
	On G/S|FAF	"**Set MAP ALT** "		"...ft set"	
		"Checked"			
	Cleared to land			TAXI **SIDE** on	

BEFORE LANDING		**PF**	**PM**	
	5NM	"**Landing flaps**" (consider via **F4** if green dot > 155kts)		(140kts)
		Set APP SPD, "**Before LDG CL**"	"**Landing gear**?" (may be by heart)	
		"Down"	"Down. **Slat/flap**?"	
		"5 / full **set**"	"5 / full set, BEFORE LANDING CL completed"	
	Before LDG	*Fuel XFEED off, rudder trim neutral*		
	"2500"	"Checked"	"Checked"	
	1000ft	"**Verified**" / "**G/A**"	"**1000 stabilized** / **unstable**"	
	"500"	"Checked"	"Checked"	
		"In sight"	"RWY/APP lights in sight" (all APP except low VIS)	
	"MIN"	"**Continue**"	"Checked"	
	Touchdown	Open REV (wet/slippery/contam: **full REV**)	Check spoilers, REV	
	60kts	MIN REV	"**60kts**"	
	30kts	Close REV		

Discontinued APP				
	PF	(vert/long)	"**Discontinued APP**", press **ALT**	
			Check **ASEL**, select **VS**/**v_{FS}**	
	PM	(lat)	Select **FMS** (both sides), **MAP prompt**	
			(available after IAF, FPLN page - NEXT - 6L), **LNAV**	
			"**Positive rate**" / "**descending**"	
	PF		"**Gear** up", "CLB sequence"	

Go-Around					
	OEI		*Initial **pitch 10°**, monitor **SPD***		
			No intermediate acc; direct CLB to MAP ALT		
	PF		"**G/A, flaps 2/4**" (≥v_{FS}), **TOGA**, TL to TOGA		
		E1	F5 → F3	Ffull → F4	*OEI: F**3***
		E2	F**5** → F**2**	F**full** → F**4**	*OEI: F**2***
	PM		Check G/A thrust, "**Positive rate**"		
	PF		"**Gear up**, **SPD up**"		
			Check **FMA** GA/TRACK/GA + **SPD up**		
	PM		**Select v_{FS}**, advice ATC		
	400ft	*PF*	*"Select HDG, check BANK"*		

	MAP ALT	PF	F_{bug}	"**CLB sequence**" ***FLCH**, call single flaps*
		PM		Select **210**kts, retract flaps, "**Flaps 0**"
		PF		*"**Continuous**",* "AFTER TAKEOFF checklist"
		PM		"AFTER TAKEOFF checklist completed"
	v_{FS}	*PF*		*"Select NAV"*
Rejected Landing				SOPM 3-40
		Prior T/D		Perform G/A. T/D may occur
		After T/D		Perform G/A, **disengage A/P / A/T**
		After REV		No rejection after REV deployment
After Landing Sequence		LSP	E2	**TC** for 3min cool-down time after T/D
				"My controls" at normal taxi SPD
				"**AFTER LANDING** sequence "
				ELEC page
		RSP		**STROBE** off, **TAXI** nose/side on, **LDG** off
			E2	NO ELEC DEVICES off
				flaps 0, **trim** 2up, **status page**
				APU start if required (consider **bleed off**)
			E2	Consider **APU off** until GPU on (ENG cool-down)
Single ENG Taxi-in			E1	Cooling ENG **2**min at/near idle
				(dashes instead of SPD bugs, BATT2 online again)
				Omit if **TWY** slippery or contaminated
		LSP		"Stop ENG 1/2"
		RSP	ENG1	**HYD PUMP 1** ON, EICAS (E1 only)
				(chk "HYD PUMP NOT AUTO")
			ENG2	Not during **APU** start
			Then	STOP, "ENG 1/2 off"
SHUTDOWN		RSP		XPDR **2000 STBY**
		LSP		TL idle, PKG BRK set, MFD **ELEC** page, check
				APU/**GPU** on (wait **10**sec prior ENG shutdown)
				STOP, HYD pump **3A off**, RED **BCN** off,
				STERILE off, "Cabin crew **disarm slides**",
				"**SHUTDOWN** checklist"
				4 red door ind + "all slides disarmed" confirmation:
				FSTN **BELTS** off
		EFB		Post Reporting
LEAVING THE AIRPLANE (read and do)		RSP		All lights/signs/**EMER LT** off
				9/**28**/**1** msg + **TERR FAIL**: **BATT**s off
		LSP		**GPU** off
				If cleaning personnel O/B: They shall switch on GPU
				If **A/C unattended**: OM-B 2A.1.6

FLIGHT TIME LIMITATIONS

Reference	OM-A 7
Duty Period	Report for duty - On-block+30min Positioning by plane: STD-30min
Flight Duty Period	STD-60min - On-block Maximum: OM-A **7.1.7.1ff** One single break possible (split) Duties before shall count to FDP
Acclimatized	+/-2h to time zone
WOCL	0200-0559; included in "Max FDP Tables" (OM-A 7.1.7.1ff)
Local Night	8h between 2200-0800LT
Duty Hour Limit	60/110/190 in any consecutive 7/14/28 days
Block Hour Limit	100/900/1000 in any consecutive 28 days/calendar year/12 months
Extension w/o Inflight Rest	OM-A 7.1.7.3 Must be planned in advance Max 2x in any 7 consecutive days Pre/Post flight rest periods increased by 2h, or Post flight rest period increased by 4h Max 5 sectors when WOCL is not encroached, 4 sectors if encroached by max 2h or max 2 sectors if more Not to be combined with split duties or with inflight rests
Split Duty	Max FDP may be increased by max 50% of GND break (min break duration 3h)
Standby	Max 16h, notification time min 75min Max 18h combined with FDP 25% of standby time counts as duty time If standby ceases within the first 6h, max FDP counts from reporting If standby ceases after the first 6h, max FDP is reduced by the amount of standby time exceeding 6h If standby starts between 2300-0700, this time does not count towards FDP reduction (assumed sleep)
Kurzarbeit	Crew member must be reachable and ready to commence any duty within 24h
Minimum Rest	Homebase: At least as long as the preceding duty, min 12h (suitable accomodation: 10h) Outstation: At least as long as the preceding duty, min 10h; 8h of uninterrupted sleep
Recurrent Extended Recovery	Minimum rest period increased periodically to a weekly rest period, 36h including two local nights No more than 168h between these periods Increased to 2 local days twice every month

Early Start / Late End	0500-0559 / 2300-0159
Night Duty	Encroaching any portion of 0200-0459 Limited to 10h (except split duty)
Disruptive Schedule	Disrupting sleep opportunity Transition from late/night to early: Rest period shall include 1 local night ≥ 4 night duties or early start or late finish between 2 extended recovery rest periods: Second extended rest period is extended to 60h
Delayed Reporting	1h homebase / 30min outstation, informed by phone Delay < 4h: Max FDP is calculated based on the original reporting time, FDP starts at delayed reporting time Delay ≥ 4h: Max FDP is calculated based on the more limiting of original or delayed reporting time, FDP starts at delayed reporting time Flight canceled after reporting: GND duty will be added until cancellation (or 30min after cancellation if any flight has been performed)
Commander's Discretion	For unforeseen circumstances, exceptional, should be avoided at home base where standby crew would be available Max FDP increase of 2h Consult any crew members on their alertness levels

ADMINISTRATIVE

Responsibilities	CRP	Ahead of released duty plan; vacation
	CCO	Released duty plan
	OCC	Actual operation (flight plan, slots, second DEST ALTN, T/O ALTN, ...)
Uniform		OM-0 2
Expenses		**Expenses form** only required for single day simulator sessions abroad (no N/S) APM - APM 4 Forms - Human Resources - Expenses Form - Excel.xls
Medical		Invoice with address Helvetic Airways, Steinackerstrasse 56, 8302 Kloten 300dpi PDF scan to accounting@helvetic.com and to tng@helvetic.com
STBY		1:15 alert time from call until report for duty
Sick / Unfit to Fly		Inform CCO by phone (OM-A 2.6.1) On return: Inform OCC latest 1700LT about actual fitness status Medical certificate required from the **third day of sickness** on (personal@helvetic.com)
Checks		LPC combined with OP1 OPC combined with OP2 Briefing 75min for LPC/OPC 60min for OP1/OP2 Line Check C/I 15min earlier (as well for line introduction)
	EBT	Safety + effectiveness + efficiency Threats (external) + errors (internal)
Positionings		Check **WinOps3**; double click on pink box
Wishes / Locked Days		Until 25th For 01.-15. two months ahead Until 10th For 16.-31. one month ahead
Change Requests		OM-A 2.4.6.8
Vacation		42 days (41 years+) **Critical weeks** CW05-08, 15-18, 28-33, 40-42 Only 2 weeks in a row, only 5 weeks in total (w/children) High production JUN, JUL, AUG Festive period No VAC 24. - 26.12, 31.12. - 01.01. By end of OCT All VAC for next year shall be entered *By end of NOV* *VAC JAN-APR are confirmed* By end of FEB VAC MAY-DEC may be rearranged *By end of MAR* *VAC MAY-AUG are confirmed* By end of JUN VAC SEP-DEC may be rearranged *By end of JUL* *VAC SEP-DEC are confirmed* OM-0 9 8 Special Regulation 'Save All' only works with no remaining VAC days
Part-Time		Enter availabilities until 5th of preceding month
	40%	3 locked days per week, max 4 weekend days per month
	60%	2 locked days per week, max 3 weekend days per month
Freelance		Enter availabilities until 5th of preceding month
	Quattro	6 days available, min 3 weekend days / holidays
	Otto	12 days available, min 4 weekend days / holidays

3. ABBREVIATIONS

3LC	Three Letter Code
4P	Philosophies, Policies, Procedures, Practices
A-CMD	Airport Collaborative Decision Making
A/C	Air Conditioning, Aircraft
A/D	Aerodrome
A/I	Anti-Icing
A/L	Autoland
A/P	Autopilot
A/S	Airspeed
A/T	Autothrottle
ABAS	Aircraft Based Augmentation System
ABC	APU Bus Contactor
ABM	Autobrake Module
AC	Alternating Current
ACARS	Aircraft Communication Addressing and Reporting System
ACC	Acceleration
ACE	Actuator Control Electronics
ACL	Aircraft Cabin Log
ACL	Anti-Collision Light
ACM	Actuator Control Module
ACM	Air Cycle Machine
ACMP	AC Motor Pump
ACP	Air Conditioning Packs, Audio Control Panel
ACPC	ATC, Cabin, Passengers, Company
ACT	Altitude Compensated Tilt
ADA	Air Data Application
ADC	Air Data Computer
ADD	Acceptable Deferred Defect
ADDE	Additional Fuel Enroute
ADDISO	Additional Fuel Isolated Airport
ADDNAR	Additional Fuel No Alternate Required
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADS	Air Data System
ADSP	Air Data Smart Probes
AED	Automatic External Defibrillator
AEO	All Engines Operative
AES	Assisted Engine Start
AFCS	Automatic Flight Control System
AFU	Artificial Feel Unit
AGB	Accessory Gearbox
AGCU	Auxiliary Power Unit Generator Control Unit
AGL	Above Ground Level
AICC	Auxiliary Integrated Control Center
ALT	Altitude
ALTN	Alternate
AMS	Air Management System
AND	Attitude Nose Down
ANU	Attitude Nose Up
AOA	Angle Of Attack
AOG	Aircraft on Ground
APM	Aircraft Personality Module
APP	Approach
APU	Auxiliary Power Unit
APV	Approach Procedure with Vertical Guidance
AR	Authorization Required
ASCB	Avionics Standard Communication Bus
ASD	Accelerate - Stop Distance
ASEL	Altitude Selector
ATL	Aircraft Technical Log
ATS	Air Turbine Starter
ATT	Attitude
ATTCS	Automatic Take-Off Thrust Control System
ATTND	Attendant
AVI	Life Animal
BALS	Basic Approach Light System
BATT	Battery
BCM	Brake Control Module
BIT	Built-In Test
BOD	Bottom Of Descent
BOID	Break-Out Increase Device
BRK	Brake
BTC	Bus Tie Contactors
BTMS	Brake Temperature Monitoring System
C/S	Call Sign
CA	Corrective Action
CAMP	Crew Applied MEL Procedure
CAP	Capture
CAS	Calibrated Airspeed
CAS	Crew Alerting System
CB	Circuit Breaker
CCD	Cursor Control Device
CCPS	Cockpit Control Position Sensor
CDA	Continuous Descent Approach
CEIL	Ceiling
CGO	Cargo
CL	Centerline
CL	Checklist
CLB	Climb
CMC	Central Maintenance Computer
CMD	Commander
CMF	Communication Management Function
CMS	Cabin Management System
CMV	Converted Meteorological Visibility
COMM	Communication
CPDLC	Controller-Pilot Data Link Communications
CPC	Cabin Pressure Controller
CPCS	Cabin Pressure Control System
CRS	Course
CRZ	Cruise
CSD	Constant Speed Drive
CSS	Cabin Surveillance System
CTC	Contact
CTOT	Calculated Take-Off Time
CVR	Cockpit Voice Recorder
D/I	De-Icing
DA	Decision Altitude
DB	Database
DC	Direct Current
DCS	Departure Control System
DCTC	DC Bus Tie Contactor
DEP	Departure
DESC	Descend, Descent
DEST	Destination
DH	Decision Height
DIP	Diplomatic Shipments
DISC	Disconnect
DLA	Delay
DOI	Dry Operating Index

DOM	Dry Operating Mass
DPNA	Disabled Passenger
DU	Display Unit
DVDR	Digital Voice Data Recorder
EBT	Evidence-Based Training
ECL	Electronic Checklist
ECS	Environmental Control System
EDP	Engine Driven Fuel Pump
EDS	Electronic Display System
EFB	Electronic Flight Bag
EGNOS	European Geostationary Navigation Overlay Service
EGPWS	Enhanced Ground Proximity Warning System
EGT	Exhaust Gas Temperature
EICAS	Engine Indication and Crew Alerting System
EICC	Emergency Integrated Control Center
ELEC	Electrical
ELEV	Elevation
ELPU	Emergency Light Power Unit
ELS	Emergency Light Switch
ELT	Emergency Locator Transmitter
EMB	Embraer
EMG	Emergency
ENG	Engine
EMK	Emergency Medical Kit
ENR	Enroute
EOBT	Estimated Off-Block Time
EPU	Estimated Position Uncertainty
EQ	Equipment
ERA	Enroute Alternate
ESAN	Emotional Support Animal
ESS	Essential
ET	Elapsed Time
ETA	Estimated Time of Arrival
ETC	Elevator Thrust Compensation
ETE	Estimated Time Enroute
ETTS	Electronic Thrust Trim System
EXT	External
F/A	Flight Attendant
F0	Flaps 0
FADEC	Full Authority Digital Electronic Control
FALS	Full Approach Light System
FAP	Flight Attendant Panel
FBW	Fly-By-Wire
FCC	Flight Control Computer
FCM	Flight Control Module
FCOC	Fuel-Cooled Oil Cooler
FCU	Fuel Conditioning Unit
FD	Flight Deck
FD	Flight Director
FDM	Flight Data Monitoring
FDP	Flight Duty Period
FDR	Flight Data Recorder
FDR	Flight Duty Regulations
FF	Fuel Flow
FFD	First Flight of the Day
FGCS	Flight Guidance Control System
FMA	Flight Management Annunciator
FMU	Fuel Metering Unit
FMS	Flight Management System
FOD	Foreign Object Debris
FOL	(Embraer) Flight Operation Letters
FOM	Figure Of Merit
FORD	Facts, Options, Risks/Benefits, Decision
FPL	Flight Plan
FPM	Feet Per Minute
FPR	Flight Path Reference
FR	Final Reserve
FWD	Forward
FZDZ	Freezing Drizzle
FZRA	Freezing Rain
G/A	Go-Around
G/S	Glideslope
GAGAN	GPS Aided Geo Augmented Navigation
GBAS	Ground Based Augmentation System
GCU	Generator Control Unit
GEN	Generator
GLS	GBAS Landing System
GMU	GPS Monitoring Unit
GP	Glide Path
GP	Guidance Panel
GPS	Global Positioning System
GPU	Ground Power Unit
GPWS	Ground Proximity Warning System
GRF	Global Reporting Format for Runway Surface Condition Assessment and Reporting
H/O	Handover
HDOP	Horizontal Dilution Of Precision
HDPH	Headphone
HF	High Frequency
HMU	Height Monitoring Unit
HOT	Holdover Time
HP	High Pressure
HP	Holding Pattern
HSA	Horizontal Stabilizer Actuator
HSCU	Horizontal Stabilizer Control Unit
HSI	Horizontal Situation Indicator
HUM	Human Remains in Coffins
HW	Hardware
HWND	Headwind
HYD	Hydraulic
IALS	Intermediate Approach Light System
IB	Inboard
ICC	Integrated Control Center
IDG	Integrated Drive Generator
IED	Improvised Explosive Device
IESS	Integrated Electronic Standby System
IFBP	Inflight Broadcast Procedure
IFE	In-Flight Entertainment rack
IGN	Ignition, Igniter
ILS	Instrument Landing System
INAV	Integrated Navigation
INPH	Interphone
INT	Internal
INV	Inverter
IOBT	Initial Off-Block Time
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
ISO	Instead Of
ITT	Interstage Turbine Temperature
J/S	Jump Seat
JABED	Jumpseat, Airport, Brace for impact, Evacuation, Duties

KIAS	Knots Indicated Airspeed
L/U	Line-Up
LAV	Lavatory
LDA	Landing Distance Available
LDG	Landing
LED	Light Emitting Diode
LFE	Landing Field Elevation
LH	Left-hand
LICC	Left Integrated Control Center
LMC	Last-Minute Change
LMC	Line Maintenance Control
LOC	Localizer
LP	Low Pressure
LRBL	Least Risk Bomb Location
LRC	Long Range Cruise
LRMU	Line Replaceable Modules & Units
LS	Loadsheet
LSA	Low Speed Awareness
LSP	Left Seated Pilot
LSS	Lightning Sensor System
LVDT	Linear Variable Differential Transformer
LVL	Level
LVP	Low Visibility Procedures (< CAT I)
LVTO	Low Visibility Take-Off (< 550m)
M	Mach
MAP	Missed Approach
MAU	Modular Avionics Unit
MB	Marker Beacon
MC	Master Caution
MCDU	Multi-function Control Display Unit
MDA	Minimum Descent Altitude
MDH	Minimum Descent Height
MECH	Mechanical, Mechanism
MEH	Minimum Engagement Height
MEL	Minimum Equipment List
MFD	Multifunction Display
MFS	Multi-Function Spoilers
MIC	Microphone
MID	Mid-Zone (RVR)
MLA	Manoeuvre Load Alleviation
MLG	Main Landing Gear
MLM	Maximum LDG Mass
MMRC	Mini Modular Radio Cabinet
MRC	Modular Radio Cabinet
MRM	Maximum Ramp Mass
MSAS	Multi-functional Satellite Augmentation System
MSG	Message
MTOM	Maximum T/O Mass
MUH	Minimum Use Height
MW	Master Warning
MX	Maintenance
MZFM	Maximum Zero Fuel Mass
N	Nitrogen
N/S	Nightstop
NALS	No Approach Light System
NAP	Non-Annunciated Procedures
NAV	Navigation
NBPT	No Break Power Transfer
NDB	Navigation Database
NDB	Non-Directional Beacon
NIL	No Items Listed
NIT	Night
NITS	Nature, Intent, Timing, Specials
NLG	Nose Landing Gear
NOTOC	Notification to Commander
NPA	Non-Precision Approach
NWP	Newspapers, Press
NWS	Nose Wheel Steering
NWSCM	Nose Wheel Steering Control Module
OAT	Outside Air Temperature
OB	Onboard
OB	Outboard
OEI	One Engine Inoperative
OFV	Cabin Outflow Valve
OBIGGS	On-Board Inert Gas Generation System
OVHP	Overhead Panel
OVRD	Override
OVTMP	Over-Temperature
OXY	Oxygen
PA	Passenger Address, Precision Approach
PAX	Passenger(s)
PBE	Protective Breathing Equipment
PBIT	Power-up Built-In Test
PBN	Performance Based Navigation
PCU	Power Control Units
PDP	Pre-Determined Point Procedure
PDR	Passenger Disturbance Report
PDU	Power Drive Units
PFD	Primary Flight Display
PKG	Parking
PLI	Pitch Limit Indicator
PMA	Permanent Magnet Alternator
POS	Position
PPAA	Power, Performance, Analysis, Action
PRA	Pre-Recorded Announcement System
PRESS	Pressure, Pressurization
PRI	Primary
PRM	Person with Reduced Mobility
PSEM	Proximity Sensor Electronic Module
PSS	Proximity Sensor System
PSU	Passenger Service Unit
PT	Point
PTU	Power Transfer Unit
PWR	Power
QAC	Quick Access Checklist
QRH	Quick Reference Handbook
RA	Radio Altimeter
RAAR	Recognition, Analysis, Action, Reassessment
RAAS	Runway Awareness and Advisory System
RAIM	Receiver Autonomous Integrity Monitor
RAR	RA Receiver
RAT	Ram Air Turbine, RA Transceiver
RCAM	Runway Condition Assessment Matrix
RCC	Runway Condition Code
RCF	Reduced Contingency Fuel Procedure
RCR	Runway Condition Report
RDO	Radio
REACT	Rain Echo Attenuation Compensation Technique
RETIL	Rapid Exit Taxiway Indicator Lights
REV	Reverser
RH	Right-hand
RICC	Right Integrated Control Center
RNAV	Area Navigation
RNG	Range

RNP	Required Navigation Performance
RSP	Right Seated Pilot
RTA	Receiver Transmitter Antenna
RTA	Required Time of Arrival
RVDC	Rotary Variable Differential Transformer
RWY	Runway
RWYCC	Runway Condition Code
S/U	Startup
SA	Situational Awareness
SAT	Satellite
SAT	Static Air Temperature
SATCOM	Satellite Communications
SCV	Starter Control Valve
SEC	Secondary
SELCAL	Selective Calling
SIM	Simulator
SLOP	Strategic Lateral Offset Procedure
SMK	Smoke
SMS	Safety Management System
SOV	Shut-Off Valve
SPD	Speed
SPDA	Secondary Power Distribution Assembly
SPKR	Speaker
SPS	Stall Protection System
SR	Sunrise
SRA	Surveillance Radar Approach
SRC	Source
SS	Sandstorm
SS	Sunset
SSPC	Solid State Power Controller
STAB	Stabilizer
STBY	Standby
STCR	Stretcher
STD	Scheduled Time of Departure
STOP	Situation Clarification, Tell your concerns, Opposition, Pan-pan
SVS	Synthetic Vision System
SW	Software
SWIFAT	Speed, Wind, Ice, Flight level, ATC, T/O mass
SYS	System
T/D	Touchdown
T/O	Take-Off
TALPA	Take-Off and Landing Performance Assessment
TAS	True Airspeed
TAT	Total Air Temperature
TC	Time Check
TCAS	Traffic Collision Avoidance System
TCF	Terrain Clearance Floor
TD	Touchdown
TDR	Transponder
TDZ	Touch-Down Zone
TEM	Threat and Error Management
TEMP	Temperature
TL	Thrust Lever
TL	Transition Level
TLA	Thrust Lever Angle
TMS	Thrust Management System
TNG	Training
TOBT	Target Off-Block Time
TOC	Top Of Climb
TOD	Top Of Descent
TOLD	Take-Off and Landing Distance
TRS	Thrust Rating Select(ion)
TRU	Transformer Rectifier Unit
TSA	Tail Strike Avoidance
TSAT	Target Start-Up Approval Time
TWND	Tailwind
TWO-P	Terrain, Weather, Operational, Pilot Condition
TWR	Tower
TWY	Taxiway
VASIS	Visual Approach Slope Indicator System
VDOP	Vertical Dilution Of Precision
VDR	VHF Digital Radio
VIB	Vibration
VSD	Vertical Situation Display
VSV	Variable Stator Vanes
VTA	Vertical Track Alert
W/S	Windshield
WAAS	Wide Area Augmentation System
WCH	Wheelchair
WED	Water Equivalent Depth
WHCU	Windshield Heater Control Unit
WML	Windmilling
WND	Wind
WOW	Weight on Wheels
WPT	Waypoint
WS	Windshear
WSHR	Windshear
WTFN	Weather, Terrain, Fuel, Navigation aids / NOTAMs
WX	Weather
XBLD	Cross Bleed
XFEED	Cross-Feed
XPDR	Transponder
XWND	Crosswind
YD	Yaw Damper
ZPRL	Zero Pitch Reference Line