Disclaimer

This summary contains information about the Embraer E190-100LR (E1) and E190-300 (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 here between information that is mandatory and therefore shall be adhered to, and other information which is of a more facultative nature and thus by no means compulsory.

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QUICK ACCESS LINKS

TECHNICAL

14-01 **Structural Limitations**	14-02 **AMS**	14-03 **Autopilot**	14-04 **APU**	14-05 **ELEC**	14-06 **Engine**
14-07 **Fire Protection**	14-08 **Flight Controls**	14-09 **Instruments**	14-10 **Fuel**	14-11 **HYD**	14-12 **Ice/Rain Protection**
14-13 **Gear Brakes**	14-14 **OXY**	14-15 **EGPWS TCAS**	14-98 **E1**	14-99 **E2**	14-99 **E2 Ops**

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
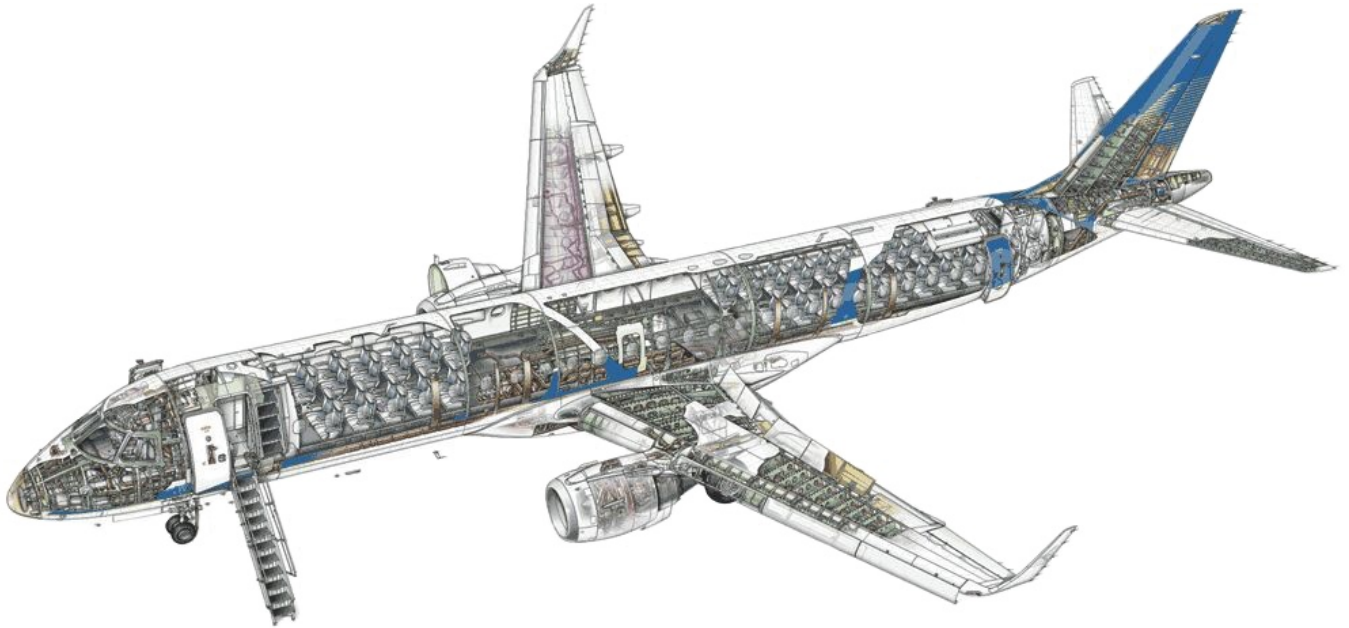
Limitations	Structural limits	MRM	**50'460**kg	(190LR)
		MTOM	**50'300**kg	
		MLM	**43'000**kg	
		MZFM	**40'800**kg	
	Speeds	M_{MO}	**0.82**	
		v_{MO}	**300**kts ≤ FL80, **320**kts > FL100	
		v_{RA} / M_{RA}	**250**kts < FL100, **270**kts / M **0.76** > FL100	
			(turbulent air penetration)	
	Altitude	Max operating	**41'000**ft	
	Load	F0	-1 .. 2.5g	
		Any flaps	0 .. 2g	
	TEMP	GND	-54 .. +52°C	
		FL410	-70 .. -21.5°C	

Dimensions			
	Wing span	**28.72**m	
	Length	36.25m	
	Height	10.57m	
	ENG clearance	0.51m	
	NLG to MLG	13.83m	(center to center)
	MLG width	**5.94**m	(center to center; wheel base)
	Min turning radius	**21.4**m	(restricted by stabilizer)

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 65kts
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: **Green** if vent flap closed
Emergency	**2** over-wing (E190/195 only), type III, **closable from inside only**
	No slides; set flaps 5
Cockpit windows	Direct view windows can be used as **EMG exits**
Limitation	Max SPD with open direct vision window: **160**KIAS
Sensors	Green = door vent flap closed
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 60kts open and locked
	40kts 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:
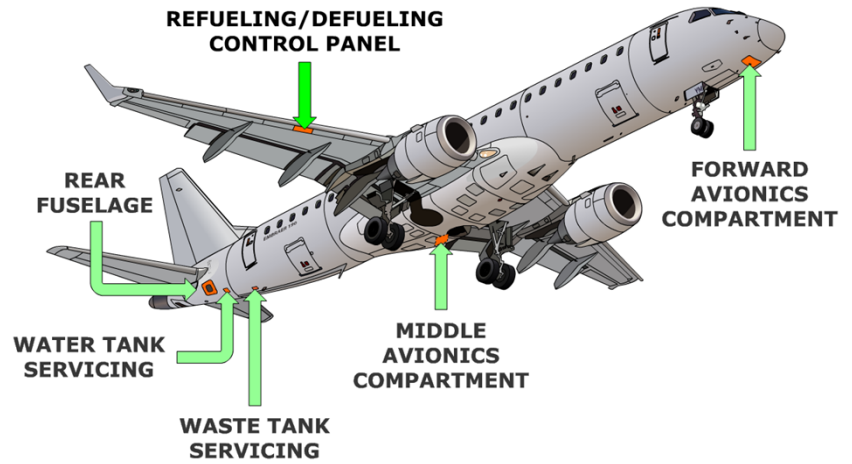
Antennas   Layout:
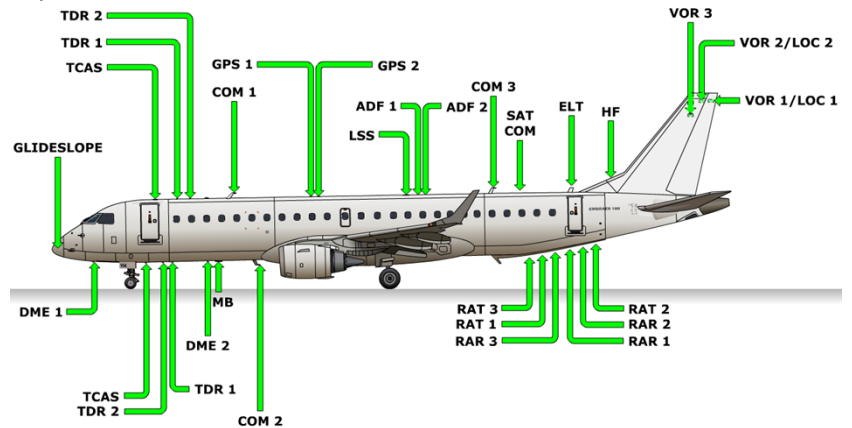
Exterior Lighting Nose LDG light   RH. **AC GND SVC bus**. Illuminates only if **gear down**
          LDG lights   2. **AC bus 1/2**
          Nose taxi light   LH. **AC GND SVC bus.** Illuminates only if **gear down**
                            Goes off during T/O (heat/VIB)
          Taxi lights   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

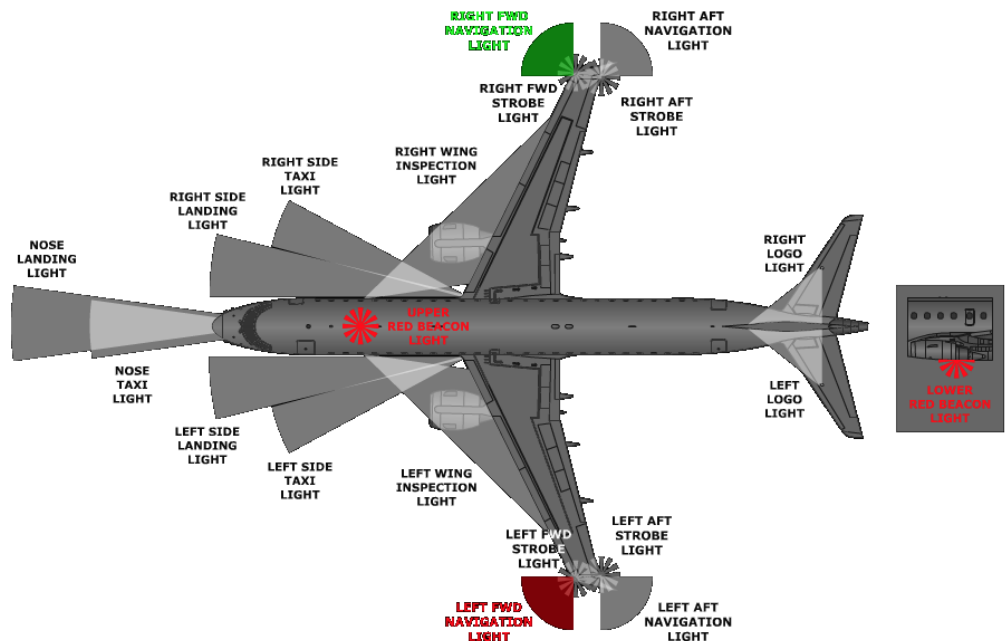| **Interior Lighting** | Cockpit | Chart (2), reading (3), dome (2, on **DC ESS bus 3**), flood/storm (2), integral (main, OVHP, pedestal) |
| | | OVHP knob OFF: **Maximum intensity** |
| | Cabin | Cabin (ceiling, sidewall), signs, reading, F/A call (2), **courtesy and stairway** (5; AUTO: PAX door; **RESET**: **5**min, HOT BATT bus 1), lavatory (2; ceiling, sidewall, on if occupied), galley (fwd, aft) |

		Rainbow lights	Orange:	LAV call
			Flashing orange:	Smoke in a LAV
			Blue:	PSU call
			Flashing red:	Cockpit EMG call
			Green:	Cockpit call
			Amber:	Sterile cockpit (ENG start - FL100; FL100 - ENG shutdown)
		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	
			Photo luminescent strips; red dots: end of way, Expose for **15**min, 7h luminescence	

| 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 storage tank for potable water (AOM 13-50; **drain** on N/S if <0°C)
		Water quantity indication only on **aft FAP**; capacity **90**l
		Pressure for water tank via **bleed air**
		WATER DUMP: 2 heated drain masts; inh if gear down or low drain TEMP
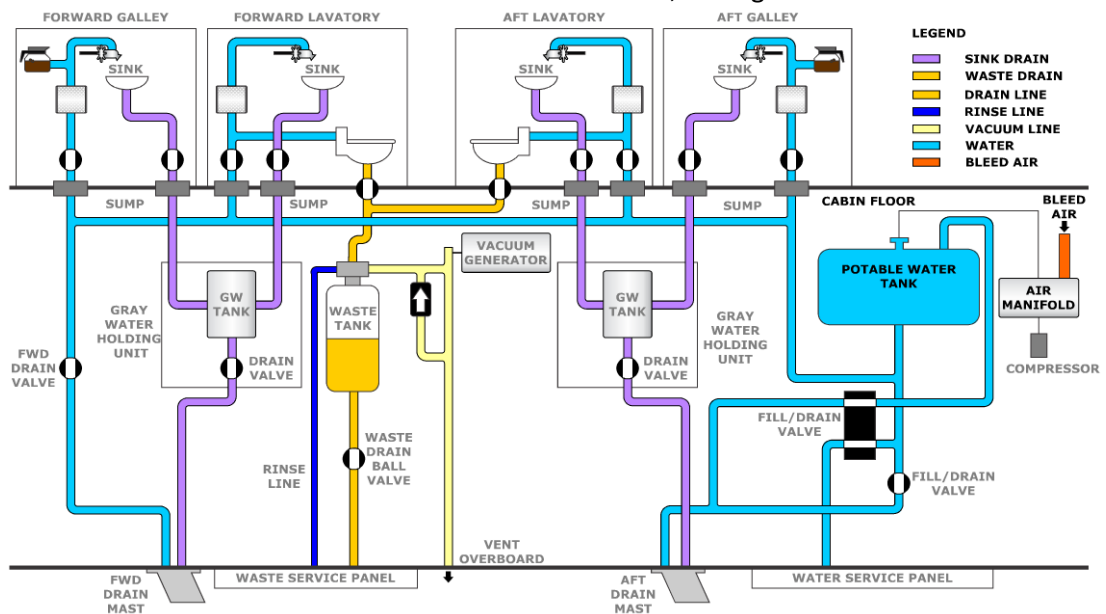
| | | (OAW: no compressor) |
| | Waste | Waste tank, vacuum generator, service panel drain valve. Capacity **95**l |

Emergency Equip Cockpit

CSPM 5.3.3 (p. 241f E1 / p. 443f E2)
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-A

E1-B/C
(E1-C: PBE is behind LSP)

E2
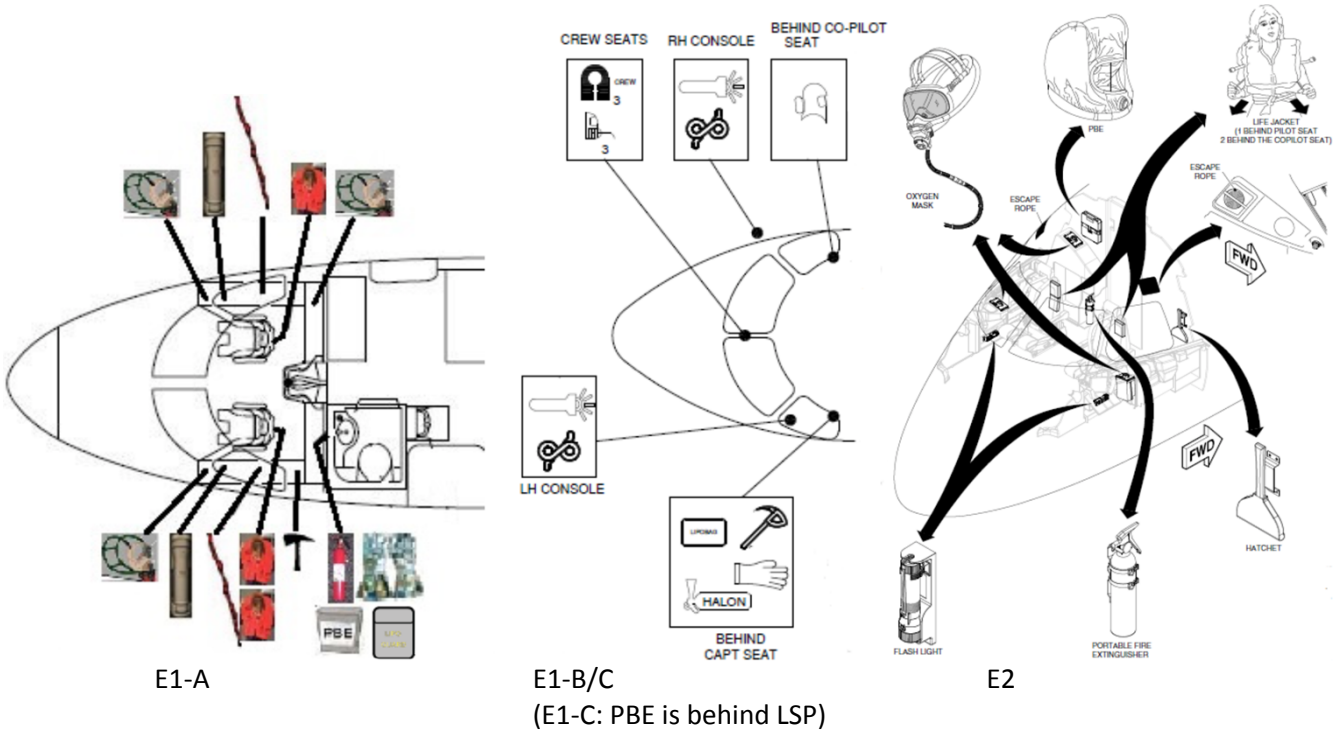
Cabin

CSPM 5.3.1 (p. 232ff E1 / p. 440ff E2)
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)]

## 14-02 AIR MANAGEMENT SYSTEM

Air Management System		Bleed air control, 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
Pneumatic System	Purpose	Supplies high TEMP/high PRESS bleed air
	Architecture	LH / RH side, cross bleed valve (ELEC controlled, pneumatically operated)
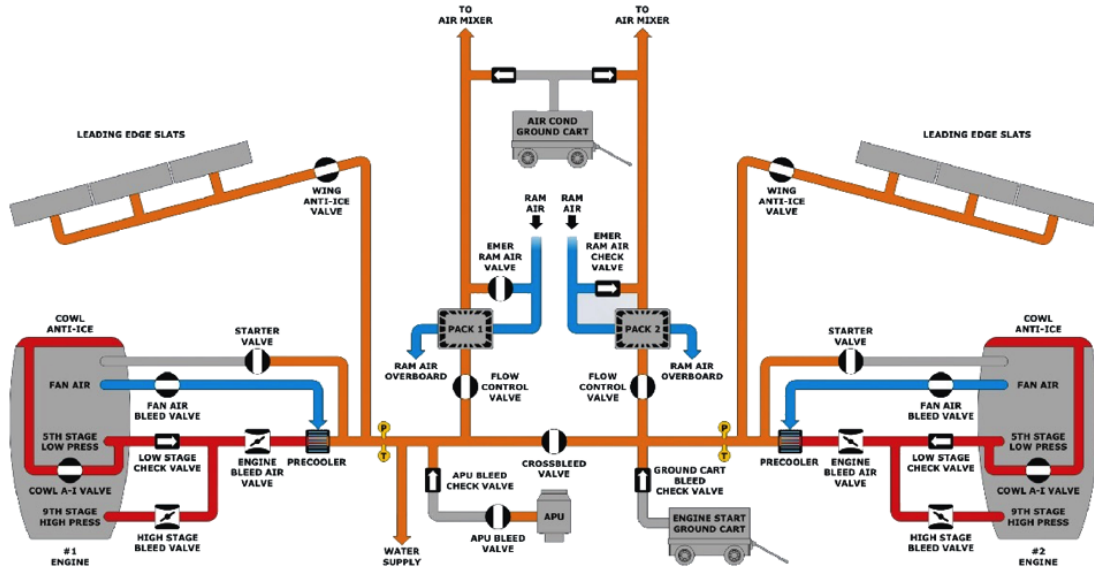
	Consumers		ENG starting, wing / ENG A/I protection, ECS, water PRESS
	Sources	**ENG**	LP / **5**th compressor stage, HP / **9**th compressor stage **alternately**
			LP to ENG cowl A/I and to check valve
			LP valve is always open; **HP** valve is pneumatically modulated according to PRESS sensor / required 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 channel)

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 pneumatic and PRESS SYS)
Normally, **pack 1** adjusts **cockpit** airflow, pack 2 adjusts cabin airflow


TWO PACKS COOL HOT BLEED AIR TO TEMPERATURE COMMANDED BY AMS

PACK BYPASS VALVE
HOT BLEED AIR
LEFT PACK OUTLET
EMERGENCY RAM AIR VALVE
RAM AIR
LOW PRESSURE GROUND CONNECTION PORT
HOT BLEED AIR
EMERGENCY RAM AIR CHECK VALVE
RAM AIR
RIGHT PACK OUTLET
HOT BLEED AIR
PACK BYPASS VALVE

RECIRC. BAY
RECIRC. FILTER
RECIRC. FAN

MIXER

FWD CABIN TRIM AIR VALVE
AFT CABIN TRIM AIR VALVE

GASPER SOV

RECIRC. FAN
RECIRC. FILTER

UNPRESSURIZED   PRESSURIZED   RECIRC. BAY

COCKPIT
FWD CABIN
CABIN
AFT CABIN
GASPERS

FWD E-BAY
CENTER E-BAY
AFT E-BAY

FWD CARGO BAY
FWD CARGO BAY SOV

LEGEND
⬛ ONE WAY CHECK VALVE
🔴 TEMPERATURE SENSOR
FILTER
FAN
EJECTOR
FLOW SENSOR

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 ventilation 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** controlled (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
	(*not* on HB-JVS)
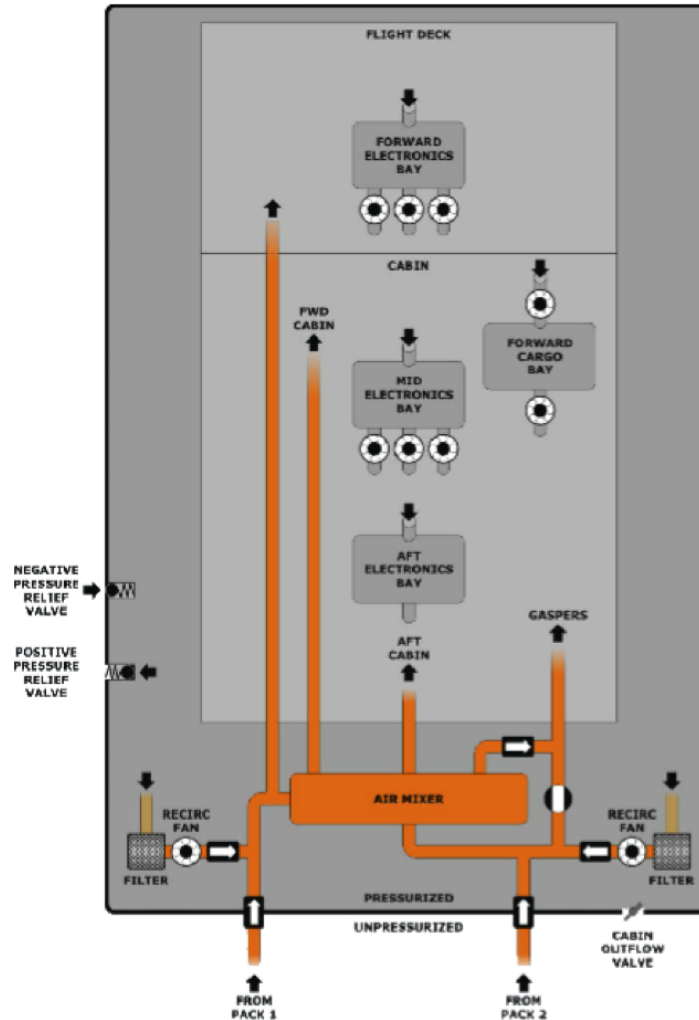
Indications	AMS CTRL FAULT advisory	One channel failed
	AMS CTRL FAIL MC	Both channels failed
	FWD/CENTER E-BAY FANS FAIL MC	Fans to RECIRC bays
	CRG FWD VENT FAIL MC	Fan failed or shutoff valve open when smoke has been detected
	RAM AIR FAULT advisory	EMG ram air vent valve failed clsd

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)

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

     Controls   Dual channel **guidance panel** (connected to FGCS), 2 quick DISC buttons,
       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 lateral/vertical mode
Row 3 |	Armed A/T mode, A/T engage, armed lateral/vertical 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   Max bank 17°, disable via BANK

       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 <u>Disarm ASEL</u> 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

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

VGP For NPA using VNAV glide path submode; press APP within 30NM 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** (VOR, LOC)

ILS Transition from FMS to ILS automatically via preview mode (**PREV**) or manually via **V/L** (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	(RETD armed) **ALIGN** captured, RLOUT 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 inh.
Simulated 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)

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 disconnect 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)
SPDт SPD on thrust. FPA, VS, GS, **PATH**, GP, ALT, ASEL; or when **FD** is **off**
SPDе 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. SPDт
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	MEH	**400**ft		
	MUH	**1000**ft	CRZ, DESC	
		50ft	APP	
		167ft	Steep APP	
Autoland	G/S	**2.5** .. **3.25°**		
	RWY	Max ALT	7340ft	
		Max slope	-1%..1%	

14-04 AUXILIARY POWER UNIT

Overview		Hamilton Sunstrand APS2300. 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
	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**
			3sec 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		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)
	ALT	Start	≤ **30'000**ft	
		Operation	≤ **33'000**ft	
		AC power	≤ **33'000**ft	
		Bleed air	≤ **21'000**ft	for ENG start
		Bleed air	≤ **15'000**ft	for A/C

14-05 ELECTRICAL

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)

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	GEN/CSD (hydro-mech), air-cooled, **40**kVA **115**VAC **3** phases, 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	
<u>**RAT**</u>	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	
	<u>QRH ELEC EMG</u>: **LDG configuration F3** (→higher APP SPD, **no A/L possible**)	
	(F5 still selectable, but F3 remains indicated)	
≥ <u>**130**</u>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 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 < <u>**-20**</u>°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 advi, reset GND only by maint	
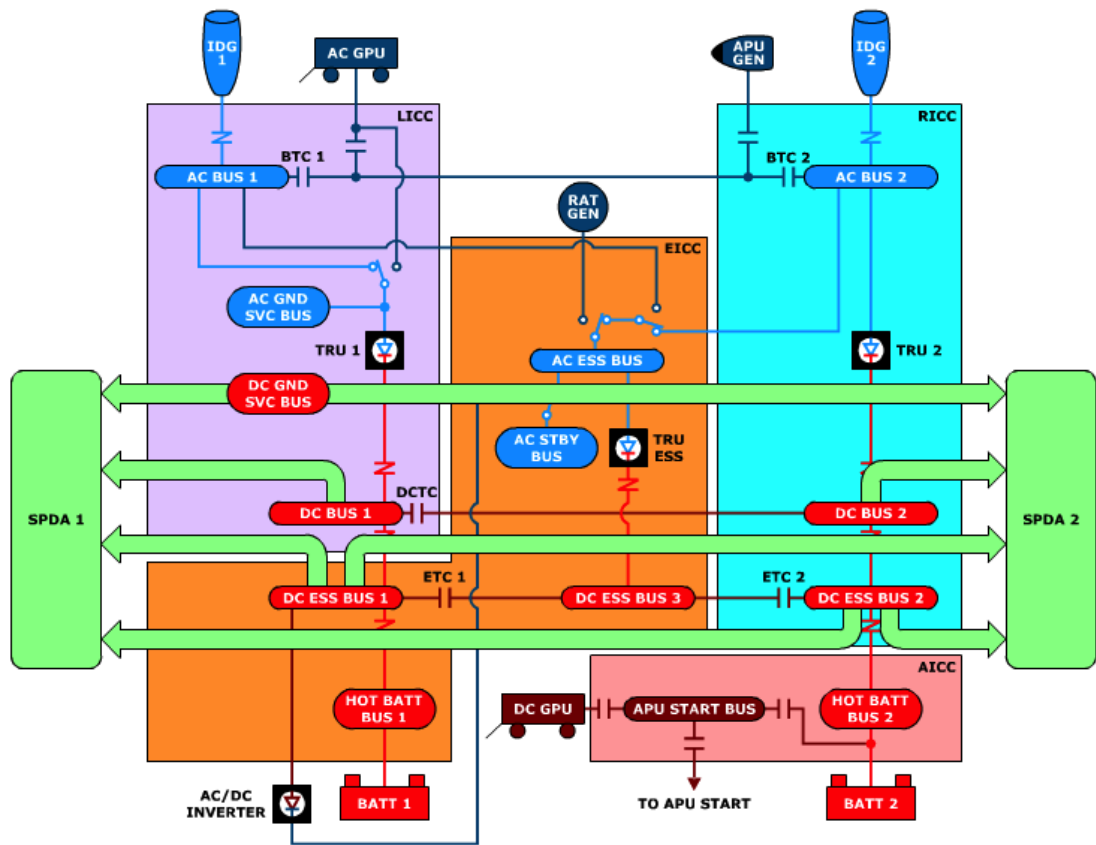
SPDA
2 independent SPDAs (fwd/center ELEC bays)
Protection, logic control, power supply
ELEC remote CBs; REMOTE CB TRIP advisory; resettable by crew
Powered by 4 separate DC buses each:
AMS, OXY, ELEC, ENG IGN & starting, fuel, water, HYD, APU, A/I, fire
protection, lighting. Load shedding: Galleys, 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	General Electrics GE CF34-10E5A1, 8391kg thrust / **18'500**lbs
	(max **5min AEO / 10min 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**
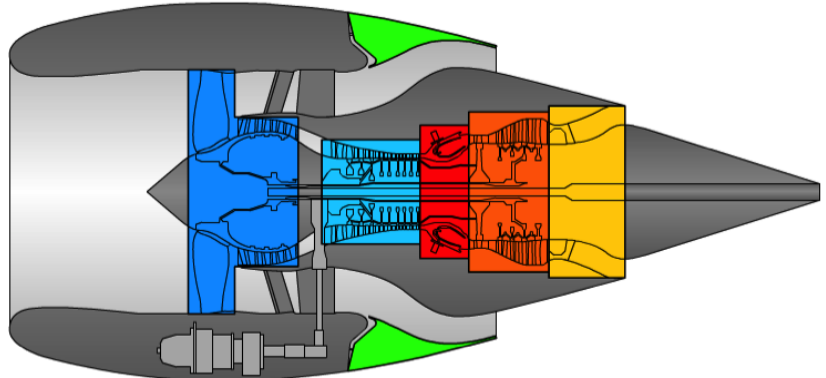
■	FAN SECTION	■	TURBINE SECTION
■	COMPRESSOR SECTION	■	EXHAUST SECTION
■	COMBUSTION SECTION	■	THRUST REVERSER
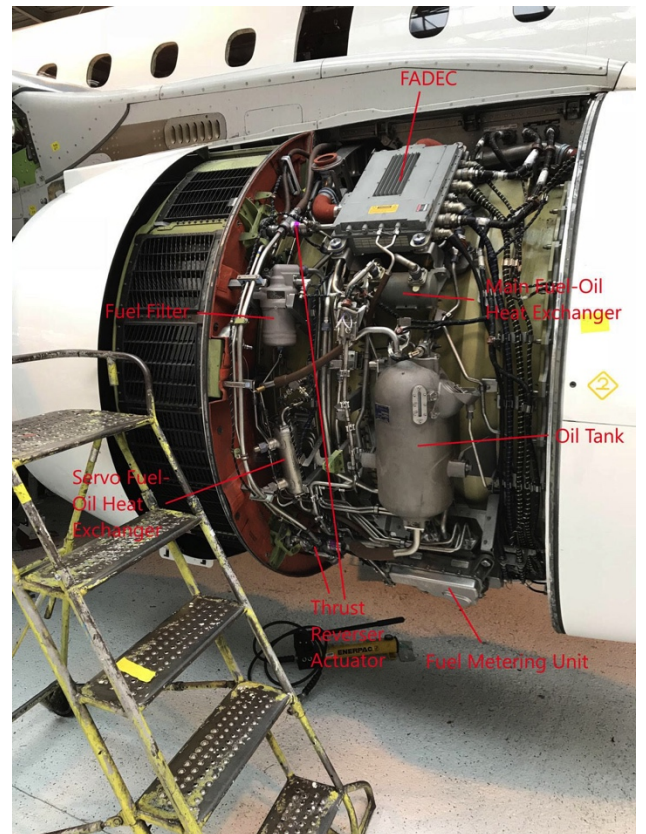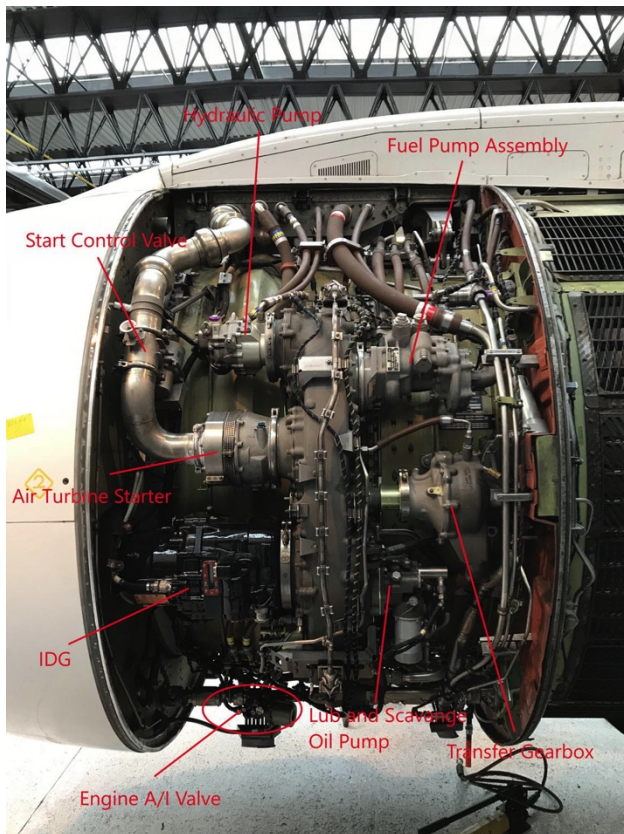
ITT sensor	Aft of combustion chamber
	ITT indication, hot start logic, flame out / overheat detection
AGB	Lube/scavenge oil **pump**, HYD **pump**, fuel **pump**, **IDG**, **PMA**
	Contains the ATS (driven by pneumatic, rotation transmitted through radial shaft drive to N**2**)

FADEC		**2 channels** each (secondary on standby; swapped at each ENG start)
	Tasks	Maintains requested N1, ENG protection (N1 limit), ATTCS
		Additionally: **N2 overspeed 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:
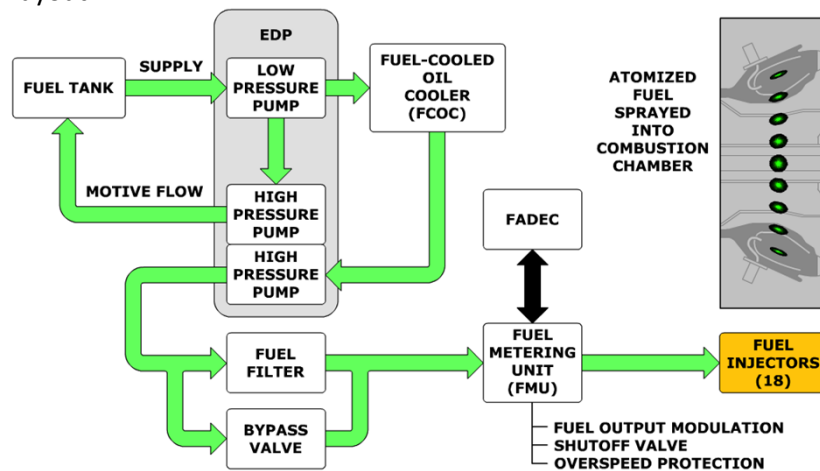
FCOC	Heat exchanger (maintains oil TEMP and heats engine fuel to prevent freezing)
Bypass	Bypass valve in fuel filter (ENG 1/2 FUEL IMP BYPASS MC)
FMU	Shutoff valve for normal shutdown, overspeed protection
	Fuel to variable stator vane actuators

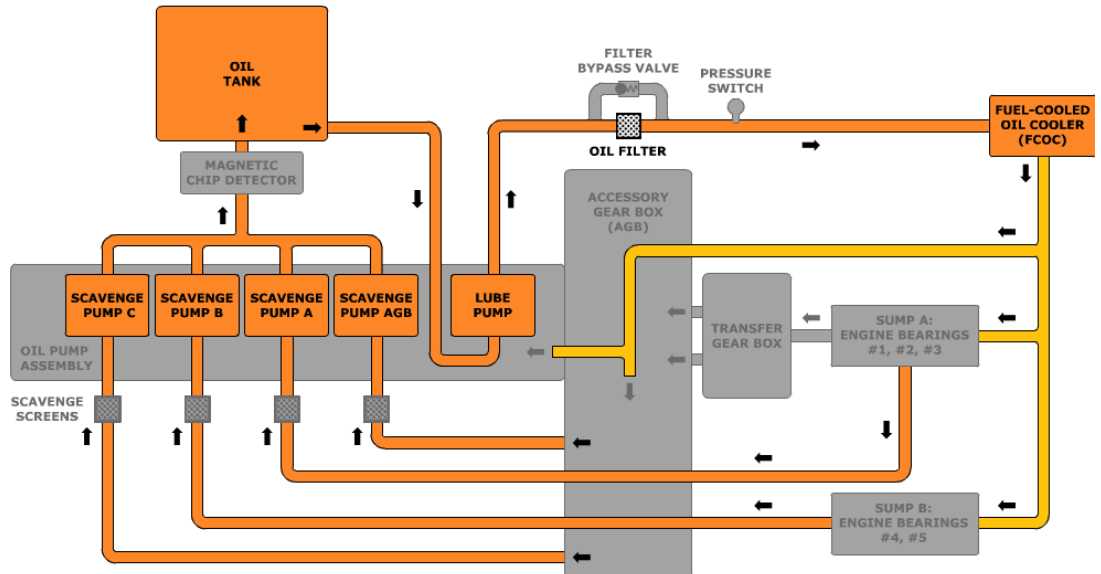| Oil System	Cooling, lubrication to N1 (3) and N2 (2) rotor shaft bearings and AGB, transfer gear box, oil pump assembly
	Oil is pressurized by **lubrication pump**, when core ENG is running

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 clsd
		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)

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
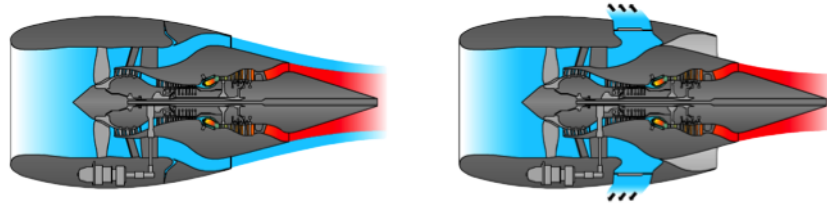
MIN REV (spring loaded) - MAX REV
FADEC has interlock function against inadvertent reverser deployment
ENG remains at idle thrust until the REV is fully deployed (green REV label)
After ENG failure, REV can only be selected within **30**sec
If one REV fails with MAX REV selected for both ENG, the operating 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			
T/O-1	**18500**lbf (AEO)	18500lbf (OEI)
T/O-2	17100lbf (AEO)	18500lbf (OEI w/ATTCS)
T/O-3	15450lbf (AEO)	16650lbf (OEI w/ATTCS)
GA	17100lbf (AEO)	18500lbf (OEI w/ATTCS)
CON	16255lbf (AEO)	16255lbf (OEI)
CLB-1	15950lbf (AEO)	
CLB-2	14020lbf (AEO)	
CRZ	13830lbf (AEO)	

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 configuration
THRUST RATING SELECT / MCDU TRS. Manually selectable underlined:

Take-off (reserve)	<u>TO</u>-1 (RSV), TO-2 (RSV), TO-3 (RSV)
Go-around (reserve)	<u>GA</u> (RSV)
Maximum continuous	<u>CON</u>
Maximum climb	<u>CLB-1</u>, <u>CLB-2</u>
Maximum cruise	<u>CRZ</u>

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**)

FLEX T/O 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

		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	Maximum N1 limit. "N1 red line"
		Green tick	Maximum 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	GND start		**740°**C	
		inflight start		**875°**C	
		max T/O / G/A		**983°**C	max **5**min
		max continuous		**960°**C	
	Oil	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)	
	Start	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	
	Warm-up			**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	
	APU inop	ENG **2**	GND pneumatic start	NP12-1	
		Disconnect pneumatic unit			
		ENG **1**	XBLD start	NP11-1	
		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			**2min** at/near idle before shutdown	

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
	Test	Press for **2**sec: 10 lights / 5 msg; fwd fan deactivates, fwd CGO shutoff valve if bleed air avail
		On GND, if pressed > 10sec, APU shuts down
		(not an indication, but a consequence)

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 cond still persists if handle illumination is off but CAS msg 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 button, 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** 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, 2 discharge tubes on TEMP
			No cockpit indications
	Test in cabin	LAV SMOKE MW for 7sec	

14-08 FLIGHT CONTROLS

|		
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)
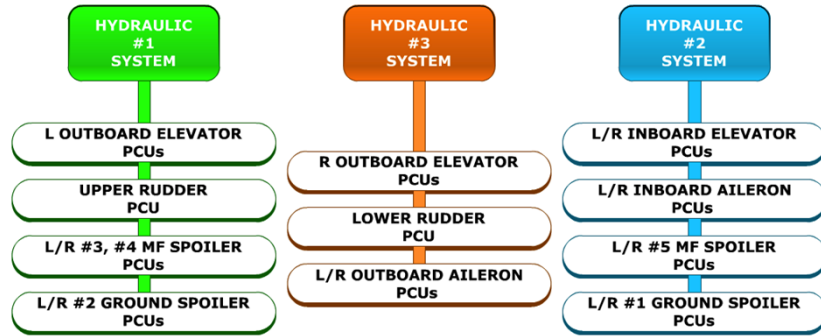
	HYD SYS 1	Middle/IB MFS panels; OB GND spoilers
	HYD SYS 2	OB MFS panels; IB GND spoilers
	SYS Inputs	Inputs: ADS 5, AFCS, LDG gear, FADECs

|		
Fly-by-Wire System		Controls PCUs **except ailerons** (these have conventional cable SYS)
		Flight control 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 power**; lead acid, charged by **DC ESS bus 3**, <u>15</u>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 controls **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**
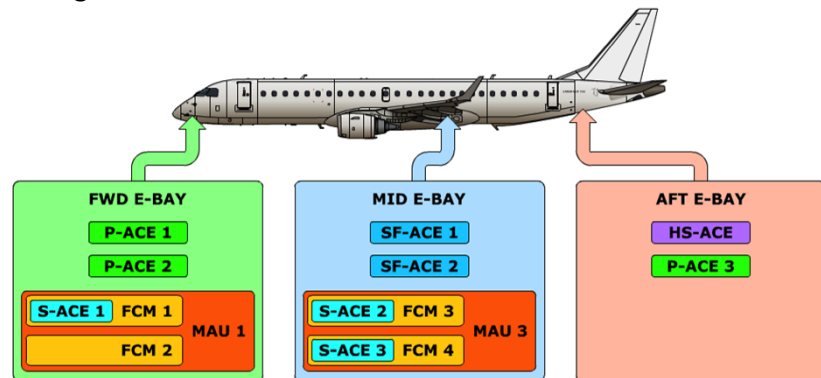
4 units	SF-ACE **1/2**	**Slats**, **flaps**. **ELEC**. One channel for **flaps**, one for **slats**
	HS-ACE (**1**)	**Horizontal stabilizer**. **ELEC**. One active and one stby ch
	S-ACE **1/2/3**	MFS (OB/IB/mid). Integrated in **FCM**
	P-ACE 1/2/3	**Rudder**, **elevators**. Connected to two PCU
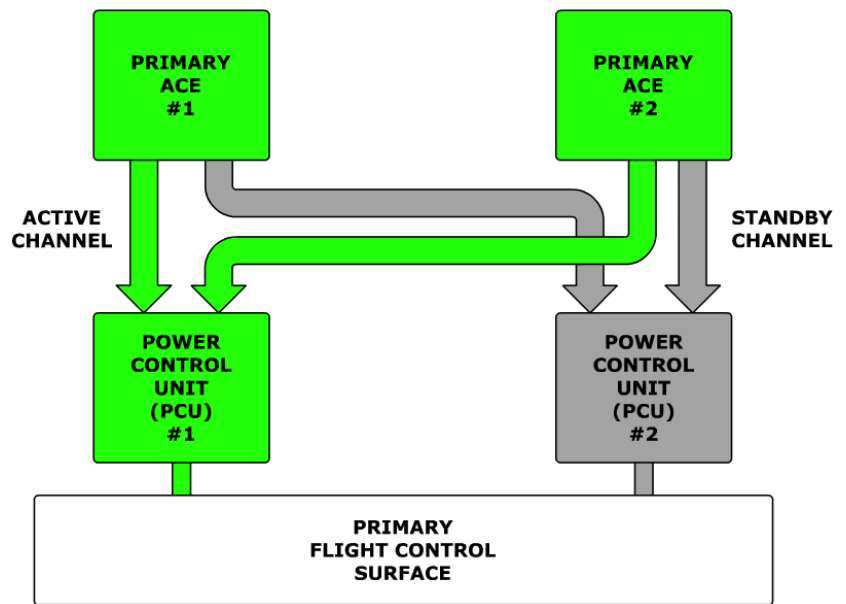
Rudder, elevator, stabilizer channel **switch** roles after first **power-up** on GND a day (odd-even-day-engage). Standby channel monitors active channel, takes over if active channel failed

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
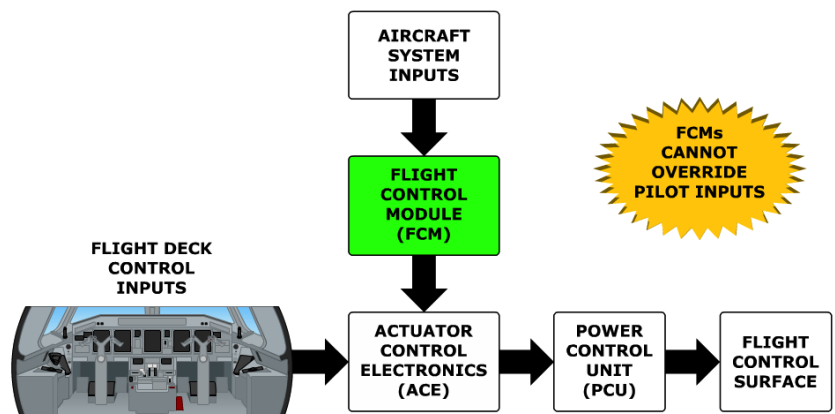
Normal mode   FCM provide gain schedules and control limits to the P-ACE units

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
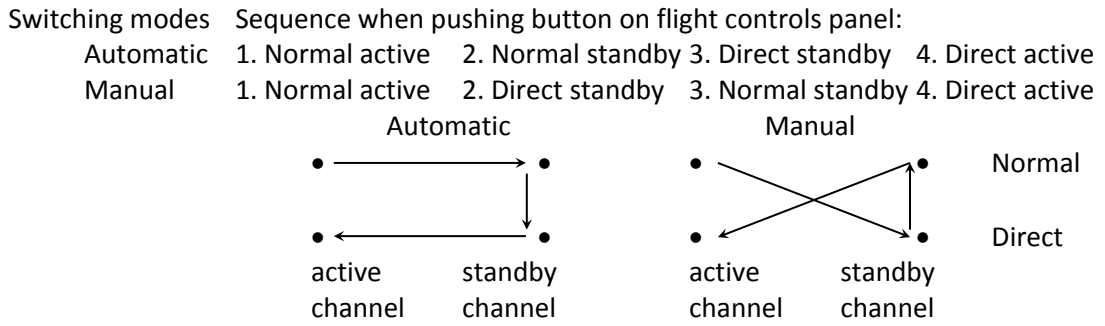
Roll Control

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
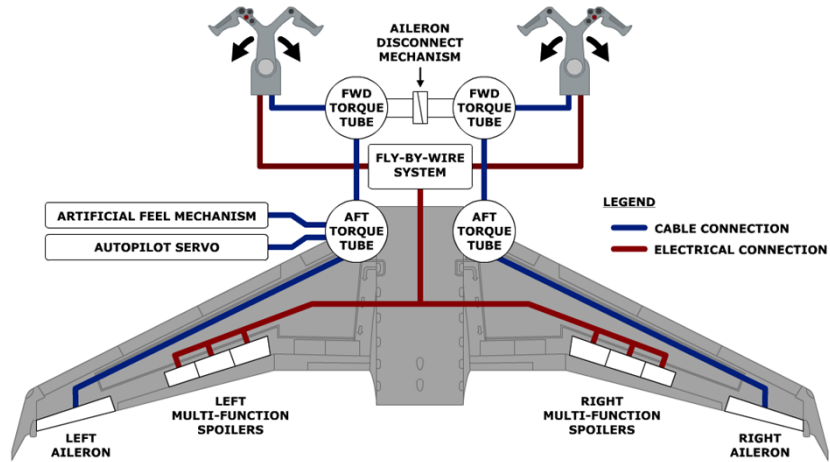
Disconnect handle only re-connectable on GND only by maintenance
Only 1 spoiler panel avail. Artificial feel only available if RH side jammed
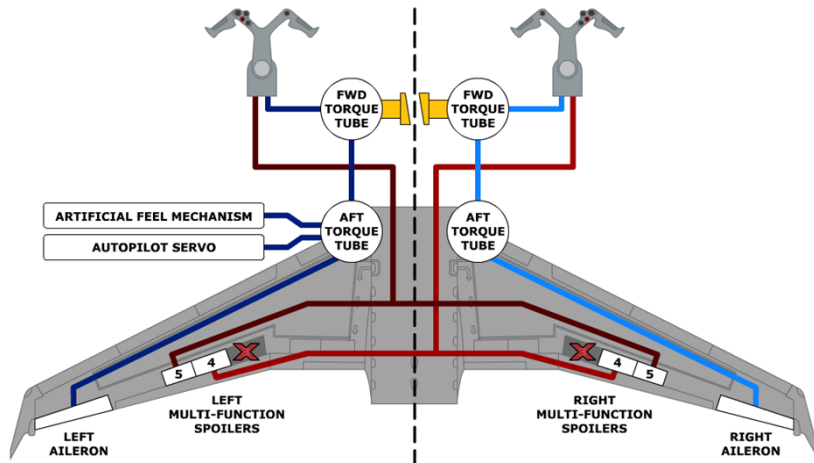
1 **PCU failed**	Aileron **force authority halved** (**AILERON LH/RH FAIL** advisory from FCM)
HYD failed	Associated PCU acts as damper. Aileron inoperable if both HYD failed
Roll trim	Adjusts the neutral feel POS. 3sec cutout. Quick DISC button
	Requires **constant force**

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 because of 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, flaps 5 or full. 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 spoiler 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 conditions					
	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 slot (fowler) (main flap panel / rear panel), 2 actuators each					
	Operation	**0**	slat 0°	flap 0°	v_A **210**kts	detent / stop	
		1	slat 15°	flap 7°	v_A **180**kts	detent	
		2	slat 15°	flap 10°	v_A **160**kts	detent	
		3	slat 15°	flap 20°	v_A **150**kts	detent	
		4	slat 25°	flap 20°	v_A **140**kts	gated / stop, for G/A	**T/O**
		5	slat 25°	flap 20°	v_A **140**kts	detent	**LDG**
		FULL	slat 25°	flap 37°	v_A **130**kts	detent / stop	

Slats extend first, **then the flaps**. Flaps retract first, then the slats ("flaps are under the slats")

F5 / FULL 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

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	$v_{FE,Flaps\ 1}$
		215KIAS	$v_{FE,Flaps\ 2}$
		200KIAS	$v_{FE,Flaps\ 3}$
		180KIAS	$v_{FE,Flaps\ 4,\ 5}$
		165KIAS	$v_{FE,Flaps\ Full}$
	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** (+10kts in icing conditions)	

14-09 FLIGHT INSTRUMENTS/COMM/NAV/FMS

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

ICE DET   ICE DET
ADSP 4   ADSP 3
TAT 2   TAT 1
ADSP 2   ADSP 1
DME1 ANT
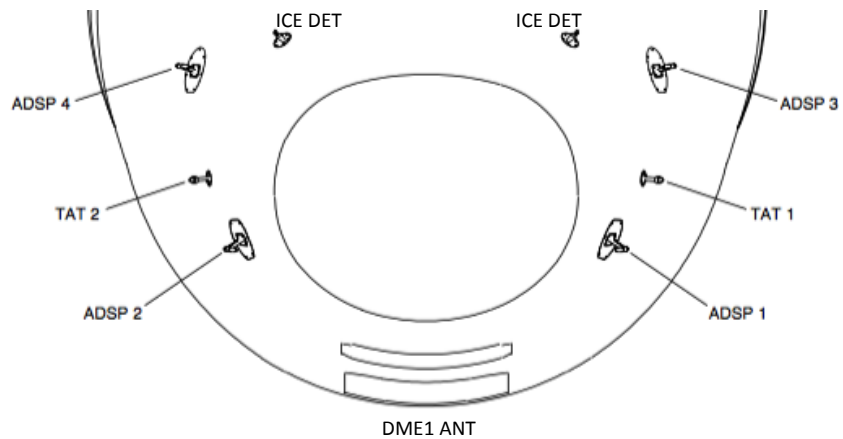
ADS **1**:	TAT 1	ADSP 1/2	ADA 1	→ **LH PFD**
ADS **2**:	TAT 2	ADSP 3/4	ADA 2	→ **RH PFD**
ADS **3**:	TAT 1	ADSP 3/4	ADA 3	
ADS **4**:	ADSP 3/4	IESS		→ **IESS**
ADS **5**:	sends information to the **flight control SYS**			

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 primary 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	$1.13v_S$ (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	Drift-down 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 pointer
		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		≤ **2'500**ft/AGL. For low ALT awareness, min ALT annunciation, RA indic
		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/close to 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**
		90sec alignment phase (INIT 90 s flag - do not move)
		CAGE: press for ≥ 2sec
Stby Magnetic Compass		
Clock		UTC time, elapsed time, date, chronometer. Powered by DC ESS bus 1
		CHR or wheel button 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 frequency
		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, ADF (1), DME, ILS, XPDR. Located in MRC
		No ADF/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 UNAVAILABLE, 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 radar
		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 alignment. 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

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** 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 LIMITAcceleration → 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 lower than scheduled SPD)	
		ACT APP SPEEDS 30NM from A/P. Manual SPD intervention via LSK 1R	
		Within 30NM: ACT APP SPD prompt appears	
	RNP	**DEGRAD** if **EPU** > RNP value, or if FMS position integriy > alarm limit	
		Pre 27.1	**Direct to**: ACTIVE to cont on FPL, DIRECT to insert new WPT (discont) for fuel chk NAV - NEXT - CROSS PTS - PT ABEAM
	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
		LNAV engages at 200ft/AFE, BANK will engage. A/C follows missed APP rte	
		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 COMM 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
		NAV - FLT SUM	Flight summary, **_fuel used_**
		PERF - LANDING	**LDG mass** (actual mass: MFD - status page)

	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
	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

14-10 FUEL

Fuel System   Storage (2 vented integral type tanks), distribution, indication
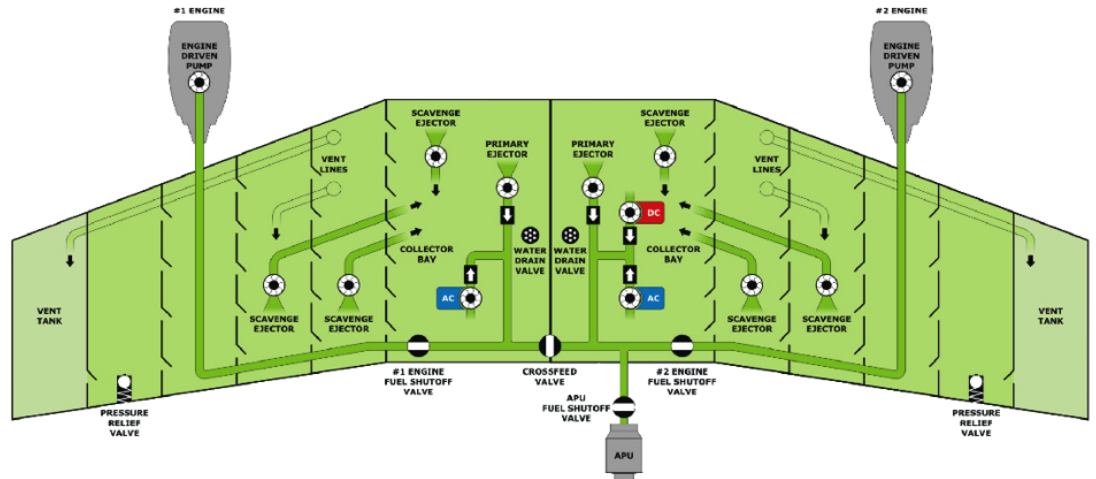
Each wing	**Surge** tank (= vent tank; outward; NACA air inlet, flame arrestor, surge relief valve) - **main** tank - **collector bay** (inward, with **low level sensor**, **independent** from fuel quantity sensing probes)
	Dry bay (near ENG pylon, to prevent rupture if rotor bursts)
	Wing ribs with 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**, on **during XFEED** on cross-side ENG, **APU**
		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

Valves	ENG, APU, XFEED (on DC ESS bus 3; both ENG fed from same tank)
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)
	Only way to close fuel shutoff valve: Fire handle

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
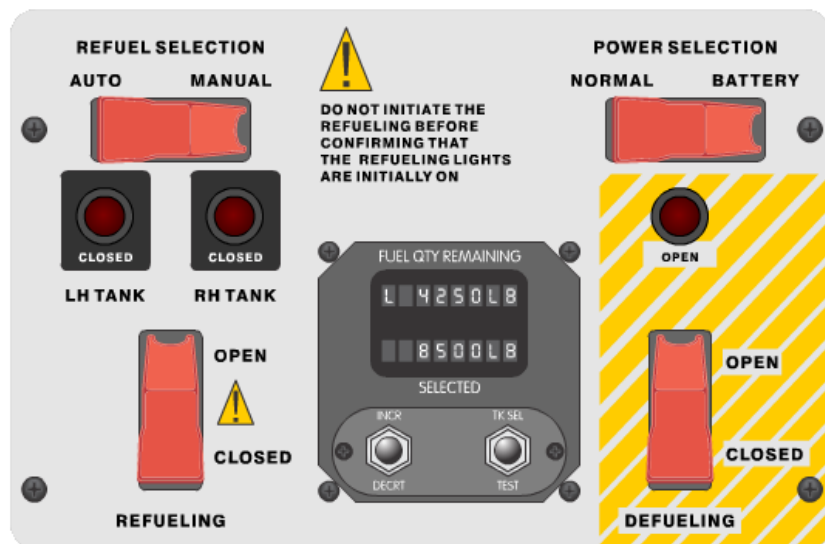
	DC bus 1/2 or HOT BATT bus 2 (select via POWER SELECTION switch)
	AUTO (FCU) or MANUAL
	Automatic SYS check once refuel line is plugged in. Successful if two CLOSED lights illuminate
	Start via REFUELING to OPEN
Fail-safe MECH	Refueling shutoff valve when quantity in tank exceeds certain value STOP L/R 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

Limitations	Capacity	**13'100**kg (2 x **6'550**kg) usable, 2 x **46**kg unusable
	Low level MW	< **400**kg per tank
		(if <1200kg 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		3000psig 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**
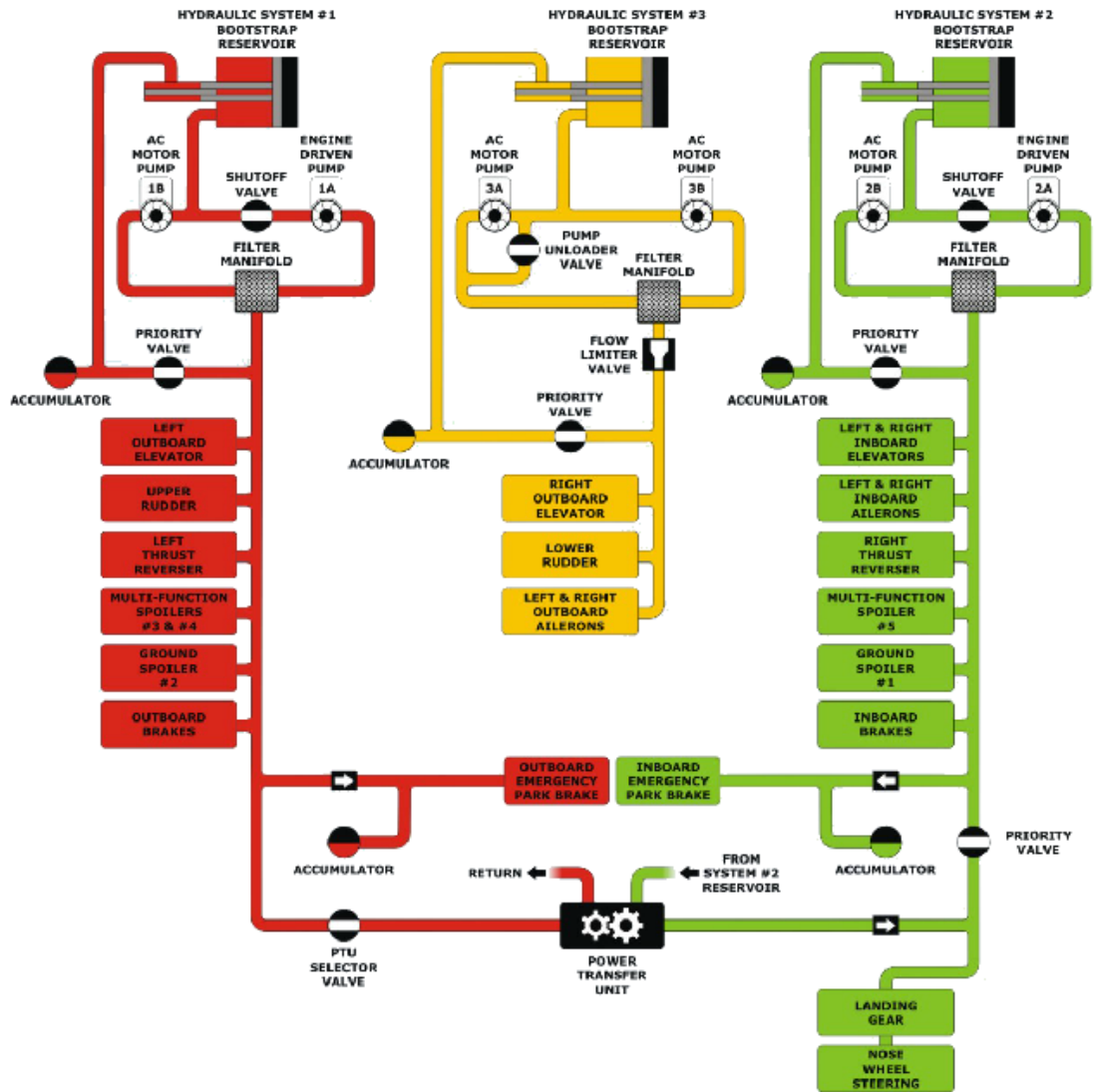
HYD PUMP 1 on if taxi on ENG 2 only   NWS on HYD SYS 2
(otherwise: BRK FAULT)

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	**If reservoir TEMP ≤ -18°C**, prior ENG start
		(referenced in QRH NP16-1)
		4 ACMP on, engage NWS, check flight controls,
		when SYS 1-3 > -10°C: ELEC PUMP 2 off,
		PTU ON, 30sec, all AUTO, ELEC PUMP 3A OFF
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 vlv)
	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)
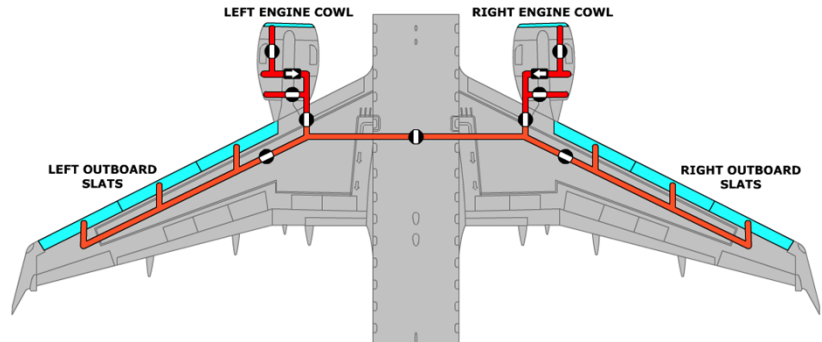
SRC	**APU bleed cannot be used for A/I**. If REF A/I is ENG or ALL for T/O or ice is detected during T/O with APU bleed, the APU bleed valve will close and PACKS will switch off		
ENG cowl	Bleed air from **5th stage compressor**, piccolo tube around cowl ENG A/I valve powered by DC bus 1/2, ELEC controlled by AMS, pneumatically operated. ELEC PWR required to maintain closed POS A-I ENG 1/2 FAIL MC if valve is closed but commanded open, or duct fail		
Wing	A/I valve located in wing pylon, telescoping duct, piccolo tubes inside slats 2x3 slat skin TEMP sensors (1 on slat 2, 2 on slat 4, one 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 displayed		
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 w/no ice any more**</u>		
MCDU ENG/ALL	On when wheel speed > 40kts until **1700**ft/2min, then AUTO MODE		
ON	**ENG** on if ENG **running**, **wing** on if A/C **airborne**, A-I MODE NOT AUTO adv		
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 and Wipers

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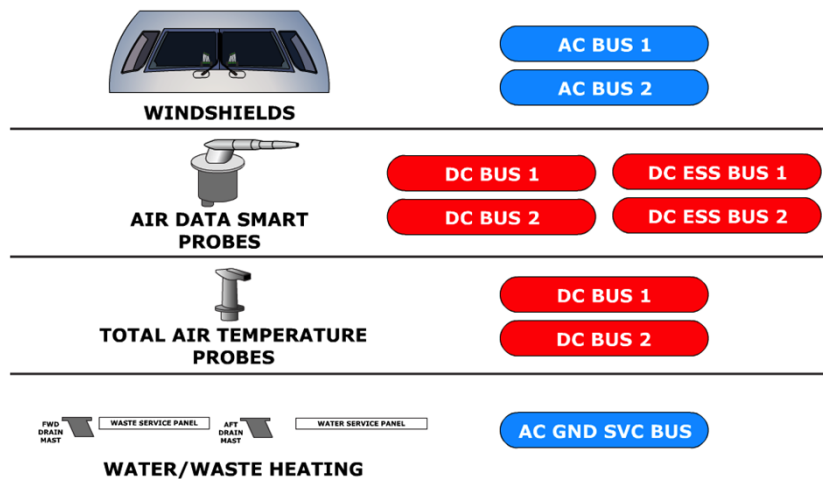
Windshield heat

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 minutes - **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
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

14-13 LANDING GEAR AND BRAKES

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**	

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, call maintenance

Warnings	**LDG GEAR** aural	F0-4 1 TLA < **38°**(AEO)/**57°**(OEI), RA < **700**ft
	(E2: + flashing amber box)	(E2: 45°AEO/60°OEI)
		(**LG WRN INHIB** only if 2 **RAs failed**)
		F5-full 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

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°
	Nose gear panel: green TOWING light if PKG brake not set / brakes not applied
	STEER OFF status message

Indications	STEER FAIL MC	Failure in steering system
	STEER FAULT advisory	Degradation in steering system

Brake System   Brake **by wire**; ELEC commanded, HYD actuated
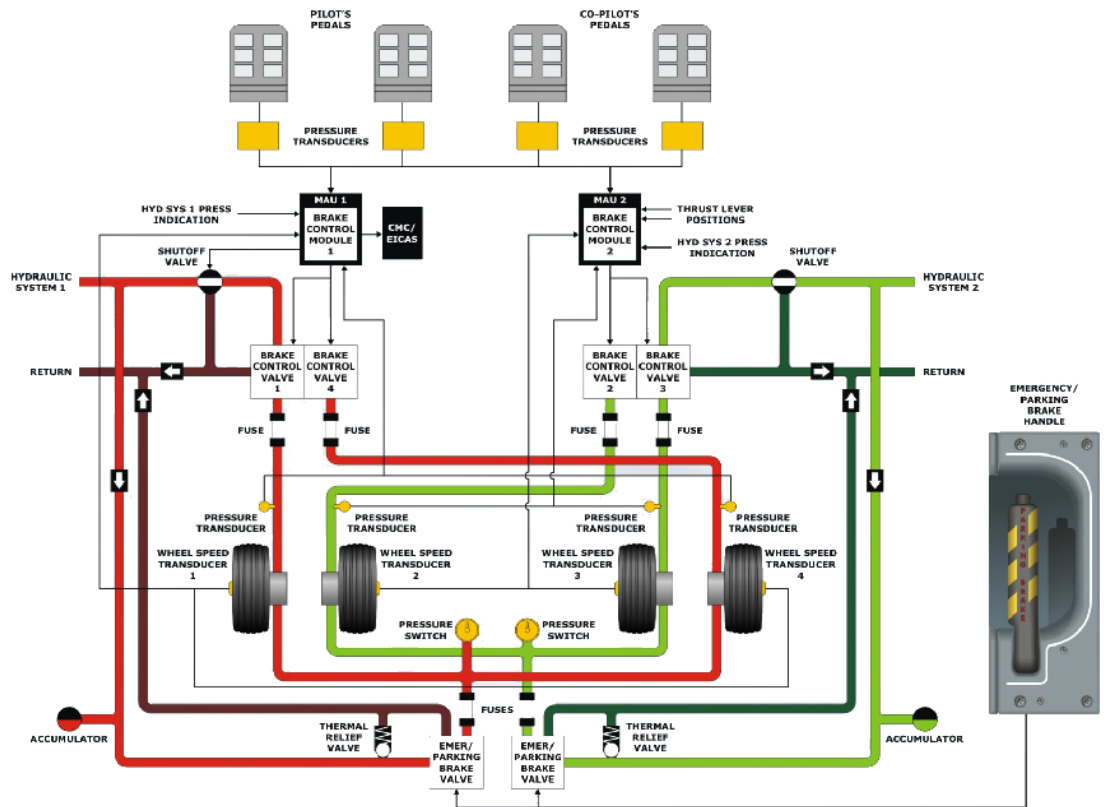
Sources	HYD SYS **1** **OB** brakes (HYD SYS 3 not involved)
	HYD SYS **2** **IB** brakes
Fusible plug	Attached to wheels, melting to relieve tire PRESS in case of tire **overheat**
BCM functions	Antiskid protection, automatic wheel braking, locked wheel protection, T/D protection. - No braking while 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	
	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 overheat (>739°C)

Limitations	Gear retraction	**235**KIAS	v_{LOR}		
	Gear extension	**265**KIAS	v_{LOE}	= v_{LE}	(gear extended)
	Tire speed	**195**KIAS	$v_{maxTire}$		
	Recomm 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**ft³, **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
22/12min. No protection from smoke (diluter type)
Doors are ELEC actuated (DC bus 1/2)
AUTO: Above 14'000ft / at **14'500**ft; **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

Portable OXY

4 bottles, **11**ft³, **1800**psi (0.3m³ OXY), 2 continuous flow masks
2l/min (walking in cabin; left = low), **4**l/min (first aid)
Discharge 2700..3000psi

Min dispatch	**1200**psi (30min)

PBE

5 PBEs. **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 position 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	"sink rate", "pull up"
			(parameters adapted in **steep** APP mode)	
		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 ALT calls: 1000, 500, 200, 100, 50, 40, 30, 20, 10 and MIN	
		Mode 7	**WS** alerts "Caution windshear" MC or 3x"windshear" MW	
			10 .. 1500ft, 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; abv/blw/exp: **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

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

14-98 TYPE VARIANTS

Variants		
E190-E1-**A**	HB-JVM, HB-JVN, HB-JVO, HB-JVP, HB-JVQ, HB-JVR (all ex Niki)	
E190-E1-**B**	HB-JVS (ex TACA), HB-JVT (ex Virgin Australia)	
E190-E1-**C**	HB-JVU, HB-JVV (all ex Air Canada)	
E190-E2	HB-AZA (10/2019) HB-AZB (11/2019) HB-AZC (12/2019) HB-AZD (04/2020)	
	HB-AZE (05/2020) HB-AZF (06/2020) HB-AZG (*06*/2020) HB-AZH (*01*/2021)	
	HB-AZI (*02*/2021) HB-AZJ (*04*/2021) HB-AZK (*05*/2021) HB-AZL (*06*/2021)	
	A/L, Steep APP, RNP AR certification expected in Q1/2020	
Brief Part 4	Brief **tail number**, system differences, limitations, procedures	

Systems

	OM-B 12	E1-A JVM-R	E1-B JVS	E1-B JVT	E1-C JVU	E1-C JVV	E2 AZA-B
Cockpit:							
Autoland		☑	☐(1)	☐(1)	☐(1)	☐(1)	☐(1)
Steep APP		☑	☐(2)	☐(2)	☐(2)	☐(2)	☐(2)
Autobrake		☑	☑	☑	☑	☑	
RAAS		☑	☐(3)	☐(3)	☐(3)	☐(3)	
HF		☑1x	☑1x	☑2x	☐	☐	
ADF		☑1x	☑1x	☑2x	☐	☐	
LSS		☑	☐	☐	☐	☐	
Cabin:							
Pax OXY sys		**22**min	**22**min	**12**min(4)	**12**min(4)	**12**min(4)	**12**min(4)
Potable water drain sys		☐	☑	☐	☐	☐	
Forward cargo vent sys		☑	☐(5)	☑	☑	☑	
2 zone aircond contr sys		☑	☑	☑	☐	☐	
Additional 1R J/S		☐	☑	☑	☐	☐	☑
Galley curtain		☑	☐	☐	☐	☐	
PAX **class divider**		☑	☐	☐	☐	☐	
PRA		☑	☐	☐	☐	☐	
Number of PAX seats		112	104(6)	104(6)	104(6)	104(6)	110

Aft ATTND panel: -A: above drop-down window; -B: above 2L J/S; -C: no TEMP ctrl knob

(1)	No **autoland**	→	CAT II only
(2)	No **steep APP**	→	No EGLC
(3)	No **RAAS**	→	CMD: "RWY ... identified"
(4)	Outlook: 22min for all A/C		
(5)	No fwd **CGO vent**	→	**No live animals**, **no dry ice**
(6)	No rows 12 and 28; more leg space, row letters A,C/D,F		

Misc	DVDR	Universal iso Honeywell
	Cabin	Adjustable headrest
	EMG Equipment	Different locations (refer to CSPM).

3G Hotspots	iPhone	Settings - Personal Hotspot
	Android	Swipe upwards, then downwards, 📶
	Pocket Hotspot	Press and hold button. Auto-standby

14-99 DIFFERENCES E2

14-01	Structural limits	MRM	54'200kg	
		MTOM	**54'000**kg	
		MLM	**49'050kg**	
		MZFM	**46'700**kg	

(smaller tail; CG is more aft. **No ALTN CG** for performance calculation)

	Dimensions	Wing span	**33.72**m	
		Length	36.33m	
		Height	10.72m	
		Min turning radius **20.72**m		(restricted by **wing tip**)

Doors indication   in cockpit: **Green** if door closed

Potable water   level indication on both fwd and aft FAP (↔ E1)

14-03	Automatic flight	Control via FCC	
		No movement of yoke/pedals (no servos); BOID fixing the yoke	
	Limitations MEH	**200**ft	
	MUH	**80**ft	ILS F5
		100ft	flaps full
		190ft	NPA

14-04	APU	PW APS2600E	
		Air inlet door	
	Consumption	90..100kg/h	
	Limitations	APU start, AC pwr	≤ **39'000**ft
		Bleed air	≤ **15'000**ft

14-05	ELEC System	IDG - ICC - SPDA - MAU
		No AC STBY bus/inverter (E1: for ENG IGN; E2: IGN on DC)
	IDG	**50**kVA

14-06	Engine	PW1919G high bypass geared turbofan
		N1 is geared, LP compressor linked to LP turbine

	Thrust ratings	T/O-1	**19800**lbf	**21700**lbf (OEI)
		T/O-2	17900lbf	19800lbf (OEI w/ATTCS)
		T/O-3	17100lbf	17900lbf (OEI w/ATTCS)
		CON	18900lbf	18900lbf (OEI)
		CLB-1	18900lbf	n/a
		CLB-2	17200lbf	n/a
		CRZ	18900lbf	18700lbf (OEI)

CLB-1 leads to higher thrust at lower FL (then it changes),
not recommended to change inflight

	Engine start	Duration 30..78sec; motoring at N2 8..11%
		IGN/FF at 18% N2
		WML or AES indication
		4min starter limit
		LSP: Check **oil level**
	Cool-down	3min after nosewheel TD before shutdown, 5min recomm (OAW: **5min**)
	Taxi-in	Single ENG: ENG 1 does not require HYD 1 ELEC pump to run (↔ E1)
	Limitations	Start, T/O, G/A **1054**°C
		Max CONT **1006**°C
		New ENG 1/2 LIMIT CL if limitation exceeded
		Min oil TEMP T/O **24**°C (otherwise: MC)

14-07	Fire protection	FWD/CTR/AFT EBAY smoke CL replacing RECIRC SMOKE CL
		Smoke detection: 3 in fwd CGO and 4 in aft CGO
		Halotron instead of Halon
		Only two OXY masks
	Lavatory fire ext	No pressure indication gauge

14-08	FBW	Full fly-by-wire (all axes)
		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
		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 envelope protection, direct function of column position, stability augmentation, trim directly controls horizontal stabilizer position
	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, 50kts 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: Controls horizontal stabilizer

Quick disc button Only for A/P

Best beta function Automatic rudder (app 70% of required rudder input) / target side slip (cyan) for best CLB performance, if
- ENG failure
- TLA>57
- F<5
- gear not locked down

Slip-skid indicator turns cyan

Flare behaviour Different than on E1 (less input required)

High lift system			
0	slat 0°	flap 0°	
1	slat 11°	flap 7°	
2	slat 17°	flap 13°	
3	slat 20°	flap 20°	
4	slat 25°	flap 25°	
5	slat 25°	flap 25°	
FULL	slat 25°	flap 35°	

14-09	Flight instruments	SA terrain	Max elevation ~40°/~40NM arc	Within circle (not on entire display) for SVS
		Traffic	►◄	Closure rate

Predictive WS 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

SVS Shall be on below FL100/MSA
Not to be used for primary navigation
Larger pitch scale compared to E1
White terrain range lines (distances)
RWY is track oriented; ZPRL HDG bug
Bottom of surrounding box is abeam TDZ

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

Advanced RAAS "RAAS checked", consider G/A
Unstable aural warnings (flaps, too high, too fast, unstable): **G/A**

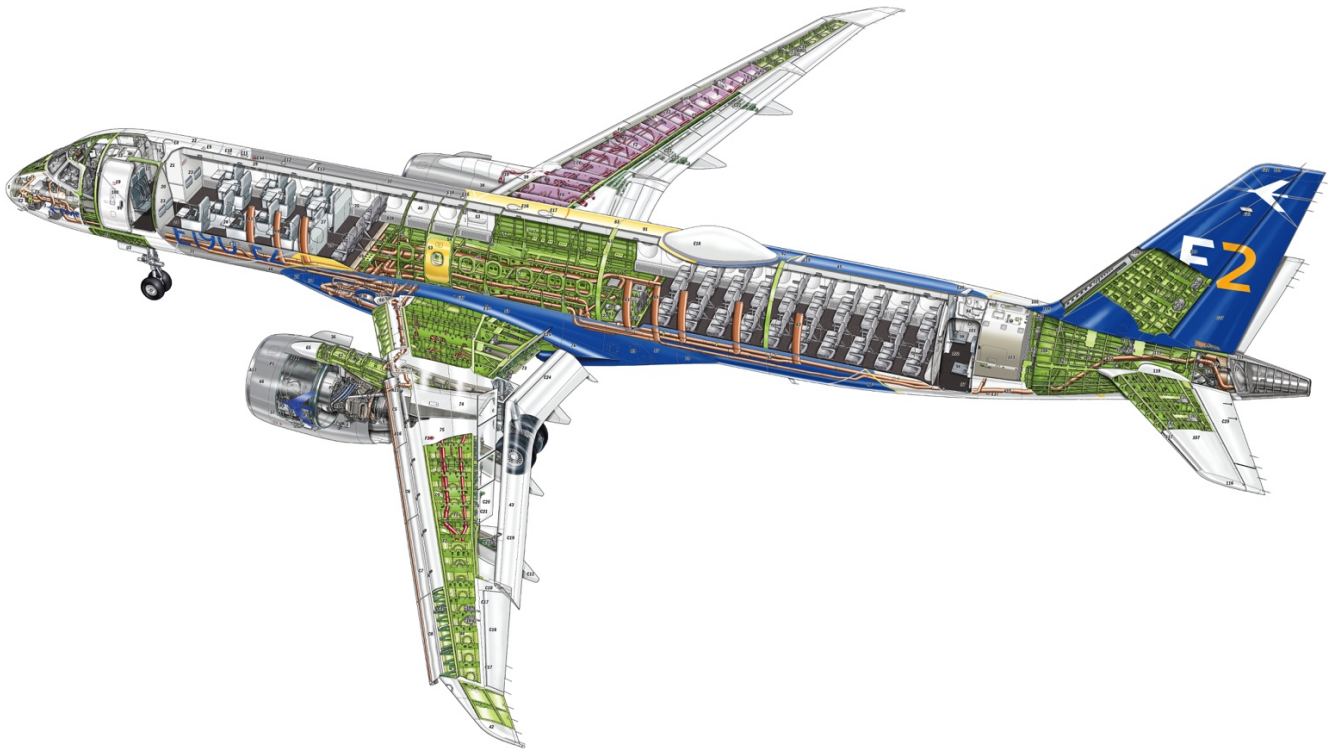|		
	ALT	Enter, then confirm (**push**) QNH
	ET	To reset: CCD top left, then side button
	EDS	**4 DU**, **2 CCD** (with **6 hot spots** [double tap]), 2 display controllers
		Power up / ELEC EMG: DU 1 and 4. Power up: MFD/EICAS
		Automatic reversion
	Controls	NAV iso V/L, LNAV iso NAV, **no YD button** (**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

14-10	Fuel capacity	Max usable: **13'690**kg (2 x **2'190**kg in wing tanks + **9'310**kg in center tank)
	Components	2 wing tanks, 1 center tank, **2 collector** tanks, **2 surge** tanks (outer end)
		2 AC pumps, 1 transfer valve, **1 DC** pump (for **APU** start)
		On-board inert gas generation (enriching air with N to min flammability)
	Way of fuel	Center tank (1 shut-off valve, 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
	Trapped fuel	PERF - NEXT - FUEL MGMT
		Only **range** value on PERF - CRUISE page is adjusted
	Cold soaked	Allowable **cold soaked fuel frost area** (no precipitation, no visible moisture, TEMP > 0°C, frost only inside marked area)

14-11	Hydraulic	Loss of HYD 1 or 2: A/P still functional (if HYD3 is available)

14-12	**Icing speeds**	OM-B 2.5.1.1
		Resettable if **no icing** conditions detected, **no ice accretion** and <u>**SAT**</u> ≥**5**°C
		May be performed by heart

14-13	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**
	Limitations	Gear retraction **220**KIAS v_{LOR}
		Gear extension **250**KIAS v_{LOE}

14-14	Lavatory OXY	Not chemically generated but stored in a bottle

2	Wind	XWND	**36**kts	T/O dry	(limited by ENG)
			35kts	LDG (incl gusts)	(limited by ENG)
		TWND	15kts	If ≥13kts: **N1 max 60% below 20kts GSPD**

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)

Operating policies **Screen settings** OM-B 2.0.2.9

PFD in ¾th layout, **PF** defines position of EICAS

	LSP				RSP			
	LH Display Units				RH Display Units			
	DU 1		DU 2		DU 3		DU 4	
Power-up	MFD Status Page	EICAS	X	X	X	X	EICAS	MFD Status Page
After Power-up default setting	FLT Info	¾ PFD (SVS on)	Synoptic Flight Controls	EICAS	Synoptic Status	MFD MAP Mode	¾ PFD (SVS on)	FLT Info
Flight-Preparation	FLT Info	¾ PFD (SVS on)	Synoptic Electrics / Plan for Prep.	Synoptic Flight Controls	EICAS	Synoptic Status / Plan for Prep.	¾ PFD (SVS on)	FLT Info
Flight e.g. LSP PF, EICAS option DU3	FLT Info	¾ PFD (SVS as required)	Full MFD MAP Mode		EICAS	MFD MAP Mode	¾ PFD (SVS as required)	FLT Info
Flight e.g. LSP PF, EICAS option DU2	FLT Info	¾ PFD (SVS as required)	MFD MAP Mode	EICAS	Full MFD MAP Mode		¾ PFD (SVS as required)	FLT Info
Before Engine Shutdown	FLT Info	¾ PFD (SVS on)	Synoptic Electrics	Synoptic Flight Controls	EICAS	Synoptic Status	¾ PFD (SVS on)	FLT Info

Use of SVS OM-B 2.0.2.10
Shall be on below MSA
Must not be used as primary NAV source

Use of INAV OM-B 2.0.2.11
Topography shall be selected **on below MSA**
TRAFFIC shall always be on

Call-outs OM-B 2.0.2.19

Predictive WS OM-B 3.13.5
Detects presence of WS up to 5NM, 10..60sec warning time
On < 1800ft/AGL, alerts ≤ 1200ft/AGL

MW	"WS ahead, WS ahead"	T/O	Consider reject
MW	"**G/A, WS ahead**"	Final APP/LDG	**G/A** (**no** WSHR manoeuvre)
MC	"Monitor radar display"		Consider deviate

FMS Preparation: Enter **CLB**1/2

TOLD OM-B 2.2.2.4 (T/O), 2.4.2.1 (LDG)
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 **±3kts**. If beyond: use ePerf SPDs

LPV NPA based on FMS as primary NAV source

CAT II	OM-B 1.4.10: **No manual CAT II** (FD) allowed

G/A sequence	**F5**	**F2** instead of F3
	Flaps full	F4 (as on E1)

After LDG seq   NO ELEC DEVICES off
TC for 5min cool-down time
Consider **APU off** until GPU on (ENG cool-down)

M&B   OM-B 6, 7
New: Seatrow trim and cargo sections for DCS LS
OM-B 6.6.2.3.5.1: Special Index/MAC diagram for **ferry flights**

EFB   WiFi hotspot from A/C on GND (*later*)

Initially   At the beginning, **no mixed fleet variant on the same day**
OM-A 5: No restrictions

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)
	Icing conditions	≤10°C and visible moisture (e.g. VIS < 1.5km)

T/O	**No T/O**	if **moderate or heavy freezing rain / drizzle** (OM-A 8.2.4.22)
	If no lights	MIN RVR **500**m (OM-A 8.1.3.3)
	LVTO	OM-A 8.4.4: If RVR < **400**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; 90 m 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<200m CAT IIIa / acc MEL) or performance restricted. T/O ALTN has to fulfill OEI MIN
		Max 1h M0.8/310KIAS OEI CRZ SPD @ ETA ±1h @ TOM (OM-A 8.1.2.2.5)

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: **370**NM
		Max 1h M0.8/310KIAS 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 IIIa **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 <800m, 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 have to be operational

	TEMP comp	Compensate MIN for TEMP. Enter MIN on last TEMP COMP page, then adjust selected MIN
		Step-down ALT: Use TEMP compensated values
	LDG ALTN	OM-A 8.1.5.3.5. Must be open for lower APP category:
		CAT II/III → Cat I → LOC → Incr **1000**m (RVR/CMV) / **200**ft (CEIL)

WX Inflight

		Req **VIS** at ETA (no ±1h margin), CEIL/VV not required
		ALTN must be open (no lower APP category 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 ≥ MIN; G/A otherwise
	MIN	CAT **I** — Required RVR is **550**m/125m/75m
		CAT **II** — Required RVR is **300**m/125m/75m, only **TDZ** RVR req
		CAT **IIIa** — Required RVR is **200**m/**125**m/75m, only **TDZ/MID** RVR req (down to safe taxi SPD, 1000m; OM-A 8.4.1.15)
		CAT II/IIIa — 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 8.3.2.32)
		For LOC, VOR, NDB, SRE/ASR, LNAV: DA = MDA + 50ft (E1) / 100ft (E2) (**all NPA except DA published or VNAV, LNAV/VNAV, LPV, circling MIN**)

Wind

		OM-A 8.1.6.2.1/2 (dry RWY only), OM-A 8.3.2.16, OM-A 8.3.2.40		
	General (planning) DEP/DEST	**50**kts	**X**WND **38**kts	**T**WND **15**kts
	ALTN	**40**kts	**X**WND **20**kts	**T**WND **10**kts
			OM-B - 10kts	OM-B - 5kts
	Specific — **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 **15**kts		
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
		Final reserve	**30**min holding at 1500ft / **800**kg (OM-A 8.1.7.3.5)

	Extra fuel		**4**min per **100**kg
			a) Block - Trip (consider taxi fuel as saved)
			b) ALTN + FR
			Delta = Extra
	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 betw 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	OM-B 2.1.19.1: **Uplift** Δ max **2%** of indicated + **110**kg
		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)

DOM/DOI tables	OM-0 9
Manual loadsheet	OM-B 6.4.2, APM - APM 4 Forms - Ground Operations - Manual Loadsheet
	Do not mistake **T/O fuel** with **block fuel** on manual loadsheet
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 **5 PAX and 300kg** payload/fuel and CG ±2% allowed
Manual loadsheet	**OM-0 9 22** (DOM, DOI); OM-B 2 Appendix 1 (QRH) (M&B tables)
Rough estimate	TOM = **28t** + 100kg x #PAX
	43t MLM + trip fuel - ZFM - 200kg reserve
Crew complement	2 cabin crew: Max **100** PAX (OM-A 8.2.2.1.1)
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	Tie-downs	OM-A 8.2.2.8
	Special loads	OM-A 8.2.2.9
	Live animals	AOM 8-80
		Fwd hold only, JVL-R only; min temp vs flight time

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
		MACTOW CG	≥**17**%: **ALTN CG** (<u>aft</u> 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 T/O segments	
	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%**; then brief OEI MAP
		Conversions	OM-C - Abbreviations and Conversions - Conversion Factors, or **% x GS ≈ FPM**

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		
		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** 1500m/**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/demonstr LDG dist)	
			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. **<2200m** or **contam**.)	
	No REV, max manual braking (but use full REV if req)	
	Resulting in MLM (considering depth of contamination)	
	Save screenshot in IFS	
	Cont RWY: **Inflight LDG performance may be lower**	
Operational LDG dist (**inflight**) = based on **RCC** (1-6; Snowtam/ATIS/ATS)		
	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	**Wet if ≥ 50% shiny** and water coverage < **3**mm	
	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	

Dispatch	Blue doc folder	OM-A 8.1.12.1
	ATL, **ACL**	OM-A 8.1.11
		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 and sign
		Sign entry in "Complaint" section
		Error entries shall be marked with "**canceled**" and signed off

	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)

CAMP   MEL E-Jet 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 on duty before performing a CAMP
ATL: Crew entry, ATA, defect details; MEL category,
crew deferred, due date, "defects deferred according
MEL ..., ...", limited pilot authorization
Send picture of ATL slip to LMC. Use new slip if station
copy already handed over to handling agent

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)

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 between **primary** altimeters, 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, turb, …)
"**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 ≥250ft 2D, MDA/H, non-precision
Type **B** MIN <250ft 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)
MAP: No TEMP correction

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**

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

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. **n/a** on OAW E190-E1

E190-E1

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

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 chapter 13
Supplementary two-way datalink system for non-urgent (non-time-critical)
strategic msg

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 - LOGON SEND

Messages "ATC" on PFD and in aux window. PM calls out msg content
Answer time limit **1**min (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

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
	Weapons	ACSP 10.2-5

Ops Notes	include current	List of category B+C aerodromes
	2017-16	**BRK** LH/RH **FAULT** momentarily displayed. BCM auto reset takes 1-4sec. Report and call LMC
	2018-08	**LG NO DISPATCH** 5min after LDG, when TEMP increase is <25°C Msg disappears after 10min, call LMC otherwise
	2019-01	**Bleed pressure** oscillations: Inform LMC if discomfort caused or beyond 8..50psi
	2019-14	**PACK 1 OFF** during first ENG start. No action required
	2019-23	WINDSHEAR FAIL considered as REACTIVE WSHEAR FAIL
	2019-40	Automatic fuel transfer system inhibition
	2019-41	FMS origin airport missing and AOC datalink issues
	2019-43	E1 LMC limits
	2020-02	DG, dry ice, NOTOC
	2020-07	**PERF-VNAV UNAVAIL** trouble shooting
	2020-14	Africa: IFBP, EQ, SLOP
	2020-16	Georgia: TBS/KUT decompression route
	2020-32	**E2**: After ENG 2 start, check T/O DATASET MENU 1/1
	2020-34	**E2**: Operation
	2020-35	MEL 34-61-02: No FANS 2-CPDLC with one MCDU inop

Covid-19	2020-11	(De-)Boarding: **APU** / A/C on E2: FMS - PERF INIT 2/3 - **PASS** : **110**
	2020-17	CAB 2R during boarding: Aft galley door iso overwing exit
	2020-31	**C/I time 1:15**, min turnaround time 0:45 (delay code 65 otherwise) Brief **RTO** and **ENG failure** **QRH** procedures: Both PIL confirm any decision path *If crew not recent: XWND max 25kts, no W/S, no manual Cat II, no Cat C A/P, no FLR, required EQ: RTO, FD, TSA*
	2020-33	Cabin operations: **Masks** during security screening, in bus and on board

NORMAL PROCEDURES

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)

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

Awareness brief   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	
Cruise	AEO and OEI performance, decompression and engine out routing	adequate aerodrome and enroute	adequate aerodrome: fuel status, ATC, landing mass, runway condition	fatigue, stress, operational pressure
Approach	vertical and lateral situation including missed approach climb gradient	destination and alternate	aircraft technical status, aerodrome specials	

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

FMS   One head up all the time
FMS insertions below FL100 should be ordered (OM-A 8.3.2.4)

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 8.3.2.28: **QNH**, **FMS WPT**, **distance vs. ALT**

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, **cleared for T/O**, **cleared to land**

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
	Inflight	PF communicates with cabin
	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"
	Rejected T/O	"Cabin crew **at stations**" (**incident report**)
	Turbulence	"Cabin crew **seat belt sign is on**"
		"Cabin crew **take your seats**" (moderate turbulences)
	EMG descent	"Emergency descent"
	Post decompr	"Senior cabin attendant report to flight deck"
	Evacuation	"**Emergency, open seat belts, evacuate**"
		CSPM 4.2.3.3: Any crew member can may initiate EMG evacuation if A/C is on GND and severe structural damage / explosive fire / after ditching
	No evacuation	"Cabin crew and passengers **keep your seats**"
	Rapid disembark	"Cabin crew rapid disembarkation"
	Brace order	"Brace, brace" or flash FSTN BELTS or NO SMKG 1min prior T/D
		CSPM 2 App 1, 1.6.6
	Fueling w/PAX ob	OM-A 8.2.1.5
		Coordinate with red cap (local procedures), inform cabin
		"Cabin crew prepare for fueling with PAX onboard" - "Fuelling completed"

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

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

	STD - 63min	Flight documents
	STD - 60min	Flight crew briefing
	STD - 55min	Cabin crew briefing
	STD - 45min	Entering 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
	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
		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

EFB	OM-A 8.3.25, OM-B 2 Appendix 3 (EFB handling guidelines)

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

Leaving A/C unatt OM-B 2 appendix 1.7 / "OAW QRH"

Chocks, covers, check for leaks, check condition, all off, drain potable water tank (freezing conditions only), seals (if required)

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

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: Only in marked areas)

CL: Power-up   Read and do

     Before start   Do and verify, "+" items as read and do

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 do not cover heavy precipitation

One-step D/I: E.g. with frost. Two-step: HOT starts at beginning of step 2

Type I: orange (no thickener); II: white, III: yellow, IV: green

T/O prohibited   **Deposits on critical A/C parts, heavy snowfall, FRZ RA/DZ, BA poor**

Ice shedding taxi   **54**% N1 (**E2**: **60**%) for **30**sec → for **30**min ok

Ice shedding inflight TL idle then **70**% N1 10..30sec (AOM 3.75 E1, OM-B 2.3.5.6 E2)

Contamin RWY   **No flex for T/O. Use underline autobrake and full REV for LDG. Positive TD**

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

Take-off   **Low VIS**   RVR < **400**m (OAW: MIN **125**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 crosscheck, transition to high energy SPD

NADP

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

v_2+10 until 3000ft (acceleration ALT), then maintain positive rate

NADP-2   Noise protection for areas **distant** to the A/P (ICAO B)

VNAV/AP at **1000**ft

v_{FS}+10 from 1500ft / thrust reduction ALT, climb sequence, 3000ft: 250kts

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)

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	RANGE SCALE (NM)									LINE OF SIGHT (NM)
(ft)	0.5	1.0	2.5	5	10	25	50	100	200	
40000							-6	-3	-2	246
35000							-5	-2		230
30000							-4	-2		213
25000	(TILT LIMITED REGION)					-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	(LINE OF SIGHT LIMITED REGION)		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**	v_{APP} **Ffull**: Directly from F3, or via intermediate F4

APP Modes   **PREV**   Arms green mode (if within 30NM / 150NM post-mod load 27.1)
Arm APP only if HDG within 90° of final track (*n/a* for RNAV)
LOC   <u>**HDG**</u> - <u>**V/L**</u> - <u>**NAV**</u>. **Disarm ASEL** prior DESC
Other **NPA**   Via FMS
RNAV   APPR (no DGRAD) must be displayed **2NM before FAF**
Perform **predictive RAIM**. **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[7]	APP[5]	LOC	GS
	HDG	FMS[5]	YES[7]	APP[5]	LOC	GS
	HDG	V/L	NO	APP	LOC	GS
LOC	HDG	V/L	NO	NAV	LOC	FPA[4] V/S
BC	LNAV	FMS	YES[7]	APP	BC	FPA[4] V/S
	HDG	V/L	NO	NAV	BC	FPA[4] V/S
VOR	LNAV	FMS	YES[1]	APP[3]	LNAV	GP[3] FPA V/S
	HDG	FMS	YES[1]	NAV/APP[3][8]	LNAV	GP[3] FPA V/S
NDB	LNAV	FMS	NO	APP[3]	LNAV	GP[3] FPA V/S
	HDG	FMS	NO	APP[3]	LNAV	GP[3] FPA V/S
RNAV (GNSS)	LNAV	FMS	NO	APP[6]	LNAV	GP[6] FPA
	HDG	FMS	NO	APP[6]	LNAV	GP[6] FPA
RNAV (LPV)	LNAV	FMS	NO	APP[6]	LNAV	GP[6]
	HDG	FMS	NO	APP[6]	LNAV	GP[6]
RNAV (RNP)	LNAV	FMS	NO	APP[6]	LNAV	GP[6]
	HDG	FMS	NO	APP[6]	LNAV	GP[6]

(overlay notes on table: "No GP", "E2 only")

(1)   PREV can be used to monitor the course bar for the VOR while FMS
is the primary source. The VOR mode cannot be captured.
(2)   Arming n/a as LNAV is already the captured mode.
(3)   Preferred vertical mode is **VNAV GP**, but ok to use FPA or V/S.
(4)   Preferred vertical mode is **FPA** but ok to use V/S.
(5)   If cleared to intercept final, but not for the ILS, it is recommended to
use **LNAV** or alternatively display **V/L and arm** it by pressing NAV.
(6)   Preferred vertical mode is VNAV GP, but ok to use FPA.
(7)   Depending on certain conditions of LOC interception, such as
interception angle and speed, the FMS may inhibit LOC capture.
(8)   When the preview mode is active, pressing APP button does not
arm LNAV. It is necessary to arm using the NAV button.

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"

| **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 section "CRM - APP briefing"
CAT II / A/L: Perform **QRH NP CL**

Downgradings   allowed down to **500**ft (incl. A/T fail)
Downgrading CAT III → CAT II: G/A in order to perform QRH NP CL
Troubleshooting must be finished down to 1000ft
RA fail: **RA test** req

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)
LDG roll: Call out "**60**" kts

	CAT IIIa	CAT II
Mode	**A/L**	**APPR 2** or **A/L**
MIN	50ft ≤ .. < 100ft	100ft ≤ .. < 200ft
	Set RA < **80**ft	Set RA < **1500**ft
RVR	TDZ/MID	TDZ
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

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 (for details: refer to page **1-13**)

RA test   MCDU MENU - MISC - TEST - NEXT
ePerf   Calculate with **A/L SPDs**
Setup   MCDU - MENU - MISC - OPERATOR CONFIG - AUTOLAND
Usage of **autobrake** recommended (OM-A 8.4.6.3)
Inhibited   TCS, SRC, NAV, APP, BANK, HDG, VNAV, FLC, ALT, FPA, V/S
A/L wording "APPR | **A/L 1 armed**" - "Checked"
"APPR | **A/L 1 engaged**" - "Checked" (800ft latest)
500ft: LSP **and** RSP: "**Checked**" (incapacitation check)
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
Failures   IRS 1 fail → Change of SRC → basic modes → press TOGA **twice**
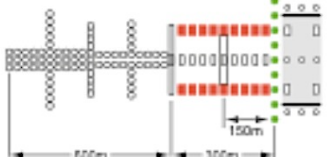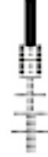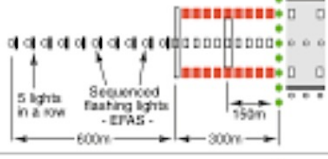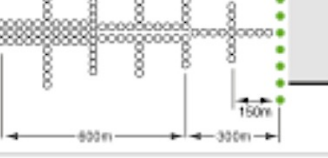
Simulated A/L   MIN **2000m/500ft** required (OM-A 8.4.6.6.4)
Perform A/L on FFD on Mondays (if required: refer to IFS - Latest Flights)
or **6 months before SIM check** (one A/L)
Criteriae: Within TDZ, centerline ±20m

APP Lights

Aerochart code letter	Description		Aerochart Symbol
A	Precision approach CAT II / III lighting system		
B	Precision approach CAT II / III lighting system	5 lights in a row / Sequenced flashing lights - EFAS -	
C	Precision approach CAT I lighting system (Calvert)		
D	Precision approach CAT I lighting system (Barette centre line)	5 lights in a row / Sequenced flashing lights - EFAS -	
E	Simple approach lighting system. Single row with roll guidance bars. / Simple approach lighting system. Single row without roll guidance bars.		
F	Simple approach lighting system. Parallel row.		

MIN	CAT IIIa 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 8.3.2.36.4, SOPM 3-35-10 p. 19ff
- **Circling**   See below
- **One minute**   AOM / OM-B
- **Briefed**   If circling and one minute not possible
    Brief ALT, SPD, configuration schedule
    Mid base target ALT 1500ft
    Aim established at 4NM

Circling APP		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*** *__160KIAS__*	
	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°/30**sec or 30°/45sec, set **MAP ALT**	
	Ab LDG threshold	TC, **20**sec (for 600ft/AFE; **extend** if higher)	
	Base	*Gear down, flaps **3**, 150KIAS,* LDG **flaps** (AEO)	
	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/full, 140/130kts, before LDG CL
	60sec	Start turn
	Mid base	Descend, set v_{APP}
	F0 LDG	210kts until base, final: $v_{RefFull}$ + 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
		Flaps full, AEO only, CAT I only, prohibited on contaminated RWY
		Stabilized at 1000ft/AFE or 3NM, whichever is earlier; A/P MUH 167ft

Stabilized APP		OM-A 8.3.2.30.1, 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 / one minute visual : 500ft/AAE
	Criteriae	Max **half scale** deflection (NDB: ±5°; RNAV/RNP: XTK, VDEV), bank **<10°**
		NPA **+100/-100ft**
		SPD **+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
	30ft	Idle
	20ft	Flare. Consider SPD and increments (WND, ice, malfunctions)

Go-Around		**Flaps retraction** only when ≥ v_{FS}
		Gear up → **SPD up** to v_{REF}+20 / v_{APPCLB}
		CLB until reaching missed APP ALT (no rate reduction/acceleration)
	Discontinued APP	**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**"
		"**Check <u>thrust</u>, check <u>performance</u>**" (if required)
		"**Your analysis, your CL** (QAC/QRH), **my ATC**"
	Structure	**<u>PPAA</u>** (+fly) → **<u>CL</u>** → **<u>FORD</u>**

```
            (worksplit)
                 |
             R  A  A  R
             |           \
       ┌───────────┐   ┌───────────┐
       │ P  P  A  A│   │ F  O  R  D│  –  A  C  P  C
       └───────────┘   └───────────┘      | /
                        /   \            N  I  T  S
                     W  T  F  N
```
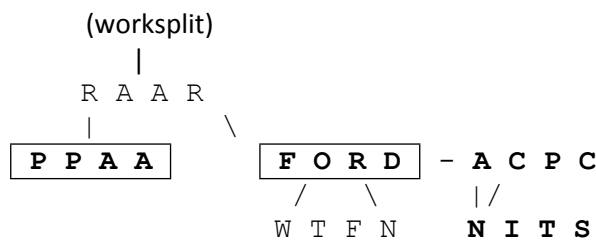
RAAR	**R**ecognition	**A**nalysis	**A**ction (worksplit)	**R**eassessment (update LSP/RSP)
PPAA	**P**ower	**P**erf (thrust, gear, flaps, SPD BRK)	**A**nalysis (initial) (e.g. "ENG fail")	**A**ction (initial)
FORD	**F**acts	**O**ptions	**R**isk/Benefit	**D**ecision
WTFN	**W**eather	**T**errain	**F**uel	**N**AV aids / **N**OTAMs
ACPC	**A**TC	**C**abin	**P**assengers	**C**ompany
NITS	**N**ature	**I**ntent	**T**iming	**S**pecials
	Explicitly mention the term "NITS"			
	Timing with **<u>absolute</u>** 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**, <u>START</u>/**STOP**, fire **handles**/extinguishers, fuel **pumps**, **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** (>)

Priorities	Multiple messages	MW → MC → ADV
		Potential **root cause message** is highlighted by a yellow **chevron** (>)
	ELEC	**Warnings** → **AC cautions** → **DC cautions** → **MAU**/AVNX → **SPDA** adv
	Manuals	OM-B → OM-A → AFM → AOM → SOPM

| | Performance | **SPDs and unfact LDG DIST from QRH** (PD30-2ff, PD35-2ff) (**not** from ePerf) |
| | | Conservative value $\quad$ 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	STOP
		(motor if FF has been observed)	
	Jammed ELEV	Elev Disc Handle	PULL
	Jammed AIL	Aileron Disc Handle	PULL
	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); req equipment for special ops (RVSM, category II, autoland, baro VNAV, RNAV, RNP, FANS/CPDLC, ADS-B)
	S	Smoke	CRG, LAV, SMK evacuation, **SMK/fire/fumes**, RECIRC SMK
	NAP	**Non-annunciated procedures**	
		Emergency	CGO comp fire, ditching, dual ENG fail, EMG descent, EMG evac, ENG abnormal start, ENG fire/severe damage/separation, forced LDG, fuel **leak**, jammed elevator/aileron/rudder, pitch/roll/yaw/steering trim runaway
		Abnormal	Abnormal LDG gear extension, "A/P" aural cannot be canceled, blank DU w/o auto reversion, EICAS msg miscomparison, ENG abnormal VIB, ENG airstart / envelope, ENG ITT/oil overtemp/PRESS abnormal indication, ENG shutdown, ENG **tailpipe fire**, gear lever cannot be moved up, IESS ATT oscillation with RAT deployed, impaired/cracked windshield, "**LDG gear**" **aural cannot be canceled**, loss of APU indications, loss of COMM, loss of HYD systems, loss of PRESS indication, non-annunciated loss of all trims and A/P, OEI APP and LDG, OXY leakage, partial/gear up LDG, structural damage, unreliable A/S, volcanic ash
	EAP	EMG / abnormal procedures	
			1 Airplane general (CGO / doors / lighting), **2** AMS (pneumatic / A/C / pressurization), **3** Autoflight, **4** APU, **5** ELEC, **6** ENG, **7** Fire protection, **8** Flight controls, **9** FMS / NAV / COMM / flight instruments, **10** Fuel, **11** HYD, **12** Ice and rain protection, **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

Engine Failure		SOPM 3-15-10

Always use **MAN SPD**
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
QRH: "RELIGHTS" ≡ ENG starts
Always **start XFEED**
Always **start APU**

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

Types of failures
ENG failure **QRH**
Severe damage **QAC** (fire, bang, vibrations, 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 DMG OR SEP**"

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
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	Y	Y			Y		R	R	R	R	
Severe Damage	R	Y		R		R	Y	Y	Y	Y	Y
Surge / Stall	R		Y			Y	Y	Y			
FOD / Bird Ingestion	Y	Y		R			R	R			Y
Seizure							R	R	R	R	
Flameout							R	R	R	R	Y
Fire		R	Y							Y	Y
Tailpipe Fire			R			Y					
Hot Start						R					
Inadvertant Reverser Deploy				R	R						
Fuel Leak							R		R	R	

R	Symptoms very likely
Y	**Symptoms possible**

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

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

RSP: Chk spoilers, "60kts", "**TWR, ... aborted T/O** RWY ..., request **fire brigade**", F5 (for possible evacuation) (refer to page 2-25)

"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

Terrain		**A/P off**, **TL max** ($\rightarrow$ A/T off), **G/A button**, **PLI** / max **20°** 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

MC | "Positive" WS | "Caution windshear" MC. Consider
MW | "Negative" WS | 3x "Windshear" MW. Action required:

	w/o EGPWS wng	**A/P, A/T off** **TL max**, **TOGA**	**PLI** / max **20°** ANU
	w/EGPWS wng	**TL max**, **TOGA** + "**CHK thrust**"	**follow escape guidance cue**

PF: "**WS**", small inputs, keep wings LVL, anticipate SPD chng w/trend vect
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 **v$_{FS}$** or higher
		FLCH, **A/T**, **HDG** (sync HDG), **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		Additionally:
	PF	**A/P off**, **A/T off**, guide FPA symbol to fly-to zone (**green rectangle**), If in a turn: **Wings LVL**
	PM	"... **TCAS RA**" to ATC
		When "Clear of conflict": "Resuming cleared FL/ALT ...", 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 controls, no trim)
	First	E.g. "**Upset, I have control**", <u>**disengage A/P and A/T**</u>
		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**", nose down, wings LVL, apply **thrust if required** (do not chase ALT)
		(underwing engines), retract SPD BRK
	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 <u>**unreliable A/S tables**</u>

Pitch Trim Runaway		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

Electrical Failures		**ELEC EMG** MW: Go into that CL even if **RAT** deployed / no MW any more
		(preparation for **F3 LDG**)

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**	Compare sensed fuel (EICAS) to calculated (FMS - FLT SUM)	
	Low on fuel	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 **7min**, then resume FLP

Driftdown		SOPM 3-25 10ff

Driftdown SOPM 3-25 10ff
A/T off, **CON** thrust, **TL TOGA**
Set ALT (FL**250** ok for OEI), 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				
Slow	≥1min	TUC	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, live vest (if req), via 1R
SEN/1L	Flashlight, first aid kit, EMG medical kit, live vest (if req)
E190/2: 1R	Flashlighgt, 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
Situation clarification (what happens), **T**ell concerns/precautions,
Opposition (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

Hijack   ACSP 13.6
Squawk 7500

Bomb Threat   ACSP 13.7; CL in forms folder
Squawk 7700
LRBL: Aft of A/C, however, do not move

EXPANDED CHECKLIST

| **EXT. INSPECTION** | PM | LG | Uplock hooks unlocked, GND locking pins removed, BRK wear indicators (no less than flush) |
| | | OXY | Discharge indicator green disc |

INT. INSPECTION (read and do)	CMD	Blue doc folder	Check (FFD)
	PF	Entering	Check flaps/slat position; check CBs
		Maint status	Check w/LSP. Daily check valid for 48h
		Cockpit EMG EQ	PBE, fire ext, crash axe, life vests, esc ropes, flashlights
		Overhead panel	AUTO/in exc (**5**) <u>**GPU**</u>, <u>**BATTs**</u>, <u>**EMER LT**</u>, HYD <u>**3A**</u>, <u>**ATTND**</u> guarded switches out

POWER UP (read and do)	PF	BATTs	4 screens. **≥ 22**V
			Wait for 4 msg / GPS time before GPU
			Do not move A/C during ELEC PBIT
		Fire ext panel	**10** lights, **5** msg
		APU	**≥ -20°C** for APU start
		EMER LT	ON, then ARM
		APU ctrl panel	EMER STOP out; FADEC ready when no amber dashes
		HYD panel	If HYD fluid **≤ -18°C**: QRH NP16
		CB	Left MCDU on CB page
		DVDR ctrl panel	TEST for **3**sec (fwd only)
		Cockpit door panel	Close door, press and hold **TEST**, lock, from outside: press 3sec; wait 3 signals, then open
	Handover of A/C	DVDR, annunciator test, EMER LT, FIRE	

BEFORE START	Flow LSP	**OXY**	MIC cold, flow indicator, SPKR, 100%, check PRESS
		Lights/display ctrl	Set **QNH**, **FMS**, reversionary panel
		Flight instruments	No flags, **ALT** select (SID / MSA x900), **HDG**, **couple** le/ri
		MFD - Map/plan	All exc EO SID. **TCAS**; PF **WX**; PM **Terr**, **2.5**, **5°**, WPT cntr
		MFD - Status	ENG **oil level**, **BRK EMER accumulator**
		MFD - <u>**ELEC** page</u>	Select page
		Autobrake	Select **RTO**
		Check	GND PROX TERR, EICAS, FLIGHT CONTROL MODE, STALL WRN, IGN AUTO, EICAS FULL, SPD BRK, TL, **ACP** (VHF1/2, INPH, HDPH, PA, RAMP)
		Trim panel	ELEC **PBIT done**: Check **main/backup** 3sec, set **2up**
	Flow RSP	Manuals	Techlog, AOM, QRH; airworthy, M&B, radio sta, NAV kit
		J/S OXY, ACP	MIC cold, flow indicator, SPKR, 100%; set **ACP**
		OVHP	(**5**) <u>annunciator</u> **test**, <u>**EMER LT**</u> **on** (lights/2 msg) / **arm**, **NO** <u>SMKG</u> on; <u>NAV</u> light on, <u>**LOGO**</u> (night, low VIS), HYD pump **3A off**
		OXY	MIC cold, flow indicator, SPKR, 100%, check PRESS
		Lights/display ctrl	Set <u>**QNH**</u>, **FMS**, **reset clock**
		Check	Reversionary panel
		Flight instruments	No flags, <u>**ALT**</u> select (SID / MSA x900), <u>**HDG**</u>, <u>**couple**</u> le/ri
		MFD	**WX** (ACT, TURB), **TCAS** (EX), **MAP** (all exc EO SID; PF <u>**WX**</u>; PM **Terr**), **PLAN** (all exc EO SID, WPT cnt); **2.5**, **5°**
		MFD - <u>**Status** page</u>	ENG **oil level**, **BRK EMER accumulator**, remain on page
		Clock	**GPS**, **reset** ET
		Check	GND PROX G/S / LG WRN / FLAP OVRD, **ACP** (VHF1/2, INPH, HDPH, PA, RAMP)

	Trim panel Check	ELEC **PBIT done**: Check **main trim** 3sec, set **2up** **DISC** HANDLES, **ALTN gear** extension
	Turnaround	OXY, FMS, ALT, MFD, SRC, **reset clock**, FMS, RTO
Flow PF	MCDU	**NAV - NAV IDENT** - check NDB (new NDB activates at 0900Z) NEXT - POS INIT - load GPS 1 > **RTE** 6R - DEST / ALTN / FLIGHT ID (C/S), ACTIVATE, SEND, DLK FPL, APPLY ACTIVE, ACTIVATE (or: enter AWY LH, WPT RH / FMS FPL ID D...) > **PERF** 6R - PERF INIT - **RES** ..., **TO/LDG** 200, **ALTN** ...

> **DEP LIMIT**

	NADP-**1**	NADP-**2**
SPD LIMIT	160 / v_2+10	210 / v_{FS}+10
AFE LIMIT	3000	3000
VNAV CAP AFE	1500	1000
VNAV CAP EO	1000 / ePerf	1000 / ePerf

		(old load: PERF INIT; DEP/APP SPD - DEP 160/210, 3000/15 - APP 3000/1, FIRST APP WPT NO) **DLK** - PRE FLT - INIT (2 3LC, **FLT NO** [**not** C/S], SKED, AUTO INIT) [call sign 2L, flight ID OWA] **RADIO** - NAV setting, manual/automatic tuning NAV - **FIX INFO** (acc ENG fail procedure) ZFM + MACTOW **TRS** 6R TO DATASET, FMS TAKEOFF *6R TAKEOFF INIT -6R-> TAKE OFF -6R-> DEP LIMIT -6R-> ACT FLIGHT PLAN*
	Turnaround	OXY, FMS, ALT, MFD, SRC, RTO, FMS
LSP		"<u>BEFORE START CHECKLIST **to the line**</u>"
DEP briefing	CMD (lead)	Threats - **TWO-P** (**T**errain, **W**X, **O**ps, **P**ilot condition) (Ops: A/C variant, limitations, procedures)
	PF	**What-if** (dct, WSHR, ...), **SID** (acc **MCDU**), **manual flying**
	PM	Verify SID acc chart
T/O briefing	CMD	T/O rejection (until v_1) (first route sector only)
	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
ePerf completed	CG	**CG** <**17**%: STD. ≥17%: ALT
	RSP	Insert <u>**ZFM**</u>, PERF - TO - 2/2 - <u>**flaps**</u>, PERF INIT 3/3 - <u>T/O **SPDs**</u>, **TRS** - T/O data set, set **trims** REF A/I: **Icing cond** up to 1700ft / wet RWY <**5°**C: ALL, ≤**10°**C: ENG Check <u>**N1 target**</u> (ePerf value **+0.5%/-0.1**% (A/I ALL with FLEX: after ENG start) (SOPM 2-25, 3-31)
	LSP	Check pitch, **TOGA**, **SPD FMS**, **NAV**, **APU** on, DEP/APP **SPDs** (v_2**+10**/160 NADP1 / v_{FS}**+10**/210 NADP2), SID, ALT, XPDR

	S/U received	RSP	RED **BCN on**, HYD PUMP **3A on**, XPDR **TA/RA** on
		LSP	"Cabin crew, **arm the slides**", FSTN BELTS on, check doors closed + "all slides armed", **LOCK** door, **STEER** OFF (pushback: ask for green light) "BEFORE START CHECKLIST **below the line**" ("Fuel qty", "Fuel ob ...kg", "Fuel req ...kg", "checked") **Start** ENG 1, then 2 (START for ≥2sec; max **740**°C) TC START - 50% N2 (**90**sec starter limit), "**normal start**"

AFTER START — LSP

STERILE on, remove **GND EQ**, nose gear/RAT pins
"Set **flaps**..., **flight control check**", STEER OFF, FltCtrl pg
(push-pull-left-right; RSP: Follow LSP on rudder check)
"**APU off**, **AFTER START** CHECKLIST", select **MAP**
"Ready for pushback, brakes released/set",
"Remove towbar" if not yet ready

	Lights	LSP	TAXI (w/PKG BRK)
		RSP	**STROBE** when entering or crossing RWY "Left / right clear, **clear signal** received"

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**"
STROBE on, BRK TEMP green, check EICAS,
select **T/O CONFIG**, **checklist**, select **MAP**

CLR received — **LDG/taxi side** lights on, **nose** light off, FSTN **BELTS cycle**

PF — **Arm AT** when aligned, check EICAS, fuel, HDG

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

Take-off

PF	**PM**
"Cleared for T/O", TL to 40% (2nd dash), BRK release, TL to 60% / AT (**TWND** >10kts: AT on at 60% N1)	
"Check thrust"	"Thrust checked". "80kts"
"Checked"	"v$_1$, rotate, positive rate"
Rotate **3°/sec** to 18° ANU, then FD, "Gear up"	

1000/**1500**	"Select **VNAV**. 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**"	Gear, flaps; "After T/O CL completed" **A**PU, **A**ir cond, **P**ress
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)*
	RSP	*Monitor deceleration, verify REV, cancel warning, "**60**kts", **ATC**: "... stopping", set **F5** for possible EVAC*

		OEI Take-off	**PF**	**PM**

	OEI Take-off	**PF**	**PM**
			"ENG failure"
		"*Check thrust*"; **no** firewall	"Thrust checked, rotate, positive rate"
		"Gear up", v_2 .. v_2+10 (**10° ANU**)	
	400	"*Select **HDG**, [**BANK**]*"	
	1000 (acc)	"*Select **FLCH**, select **v_{FS}**, engage **A/P***"	**Select MAN SPD / v_{FS}**
		"*Flaps...*" at flap retraction SPDs	
	v_{FS}	**Continuous, [BANK off]**	
		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

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, "<u>FSTN BELTS? STERILE?</u>"
		IFS: Block / T/O times, delay codes, ETOs, fuel checks
	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
		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)	Threats - **TWO-P**
	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),
		<u>fuel</u> (700kg = 1/2 h), stabilization criteriae, ALTN/WX, **perf**; **config**,
		autobrake, **NAV**, **REV**
		What-if (WSHR, short LDG/vacate, discontinued APP), **RAIM**, manual
		flying, A/C variant (limitations, procedures)
	Abbr. brief	Chart number, revision date, MIN, MAP (initial actions), FRAMS
	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}	= **v_{REF}** + **½HWND** + gusts Increment **5..20**kts
		Ice / low VIS / A/L 0..20kts
		Flaps full: cover icing SPDs

| **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 ..." ←	"... identified, CRS ..."	
		Extend **flaps** > **green dot SPD**	"**FL100** / 10'000ft"	
		"Checked"	**LDG / LOGO / STERILE** on	
	Cleared to ALT	"<u>...ft set</u>"	"<u>Checked</u>"	
		"<u>Set altimeter QNH ....</u>"	"<u>Set</u>"	
		"**Reading** ...ft **now**"	"<u>Compared</u>"	
	<FL100	"**APPROACH checklist**"	"PAX sign panel - set, ALT?" (**use CL**)	
		"**Set**"	"**Cross-checked**, APP checklist completed"	
	15min LDG		**FSTN BELTS** on / cycle	
	FAP			(210kts)
	Base/12NM	"Flaps 1"	"LOC|CDI alive"	(180kts)
	Bef intcpt	"Flaps 2"	"G/S alive" (prec APP only)	(160kts)
	1 dot|2NM	"LDG gear down, flaps 3"		(150kts)
	On G/S|FAF	"**Set MAP ALT and HDG**"	"HDG ..., ...ft set, **FAP**/F **check completed**"	
			(**ALT** vs DIST, **MIN**, FMS **WPT**)	
	Cleared to land		TAXI **SIDE** on	

BEFORE LANDING		"**Flaps 5 / full**" (consider via **F4** if green dot > 155kts)		(140kts)
		Set APP SPD, "**Before LDG CL**"	"**Landing gear**?" (may be by heart)	
		"Down"	"**Slat/flap**?"	
		"5 / full **set**"	"5 / full set, BEFORE LANDING CL compl"	
	Before LDG	*Fuel <u>XFEED</u> off, rudder <u>trim</u> neutral*		
	1000		"**1000** <u>stabilized</u>, (or "not stabilized, **G/A**")	
			RWY/APP lights in sight"	
		"**Verified**"		
	"500"	"Checked"	"Checked"	
	"MIN"	"Continue"	"Checked"	
	Touchdown	Open REV	Check spoilers, REV	
		60kts: MIN REV (no call-out)		
		TC (E2)		

Discontinued APP			**At or near MAP ALT, not fully configured**	
		PF	"**Discontinued APP**", press **ALT**, "Select **FMS** and	
			NAV/HDG", check ASEL, push **FMS MAP prompt**	
			(available after IAF), select FPA/VS/**FLCH**, clean-up	

Go-Around			*OEI:* *Initial* **pitch 10°**, *monitor* **SPD**	
			No intermediate acceleration phase;	
			directly climb to missed APP ALT	
		PF	"**G/A, flaps 3/4**" (≥v$_{FS}$), **TOGA**, TL to TOGA *OEI: Flaps 3*	
		PM	Check G/A thrust, "**Positive rate**"	
		PF	"**Gear up**, **SPD up**", check **FMA** GA/TRACK/GA + **SPD up**	
		<u>PM</u>	**Select v$_{FS}$**, advice ATC	
	400ft	*PF*	*"Select HDG [, BANK]"*	
	MAP ALT	PF	"**Select VNAV, 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*	*"<u>Select NAV</u>"*	

After landing sequence	LSP	**TC** (E2)
		"**AFTER LANDING** sequence, **APU** on/off"
		Icing conditions: Consider **A/I ENG**
	RSP	**STROBE** off, **TAXI** nose/side on, **LDG** off
		flaps 0, **trim** 2up, **status** page
		APU start if required (consider **bleed off**)
Single ENG taxi-in		E1: Cooling ENG **2min** 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 (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)
		TL idle, STOP, HYD pump **3A off**, RED **BCN** off,
		STERILE off, "Cabin crew, **disarm slides**",
		"**SHUTDOWN** checklist"
		4 red door indications + "all slides disarmed":
		FSTN **BELTS** off
	EFB	Post Reporting
LEAVING THE AIRPLANE	RSP	All lights/signs/**EMER LT** off
		9/28/1 msg + **TERR FAIL**: **BATT**s off

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

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 Inform CCO. 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)

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
ADDE	Additional Fuel Enroute
ADDISO	Additional Fuel Isolated Airport
ADDNAR	Additional Fuel No Alternate Required
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
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
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
ELT	Emergency Locator Transmitter
EMB	Embraer
EMG	Emergency
ENG	Engine
ENR	En-Route
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, Flight Duty Regulations

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
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
ELT	Emergency Locator Transmitter
EMB	Embraer
EMG	Emergency
ENG	Engine
ENR	En-Route
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, 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
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
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
HW	Hardware
HWND	Headwind
HYD	Hydraulic
IALS	Intermediate Approach Light System
IB	Inboard
ICC	Integrated Control Center
IDG	Integrated Drive Generator
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
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 (<400m)
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	Non-Directional Beacon, Navigation Database
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
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
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
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 Tranformer
RWY	Runway
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
SPD	Speed
SPDA	Secondary Power Distribution Assembly
SPKR	Speaker
SPS	Stall Protection System
SR	Sunrise
SRC	Source
SS	Sandstorm
SS	Sunset
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
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
WTFN	Weather - Terrain - Fuel - Navigation aids
WX	Weather
XBLD	Cross Bleed
XFEED	Cross-Feed
XPDR	Transponder
WSHR	Windshear
WTFN	Weather - Terrain - Fuel - Navigation Aids / NOTAMs
XWND	Crosswind
YD	Yaw Damper
ZPRL	Zero Pitch Reference Line