Disclaimer

This summary contains information in a very condensed form. Its purpose is by no means to replace official airplane manuals or approved training or operational documentation. It is solely a private compilation of information and hints earned in different training, refresher and instruction situations, and flight duties. Please note that no distinction is made between information that is mandatory to adhere to, and other information that is more facultative and thus not compulsory to be followed.

Written initially to cover the EMB-145LR, it has been augmented with the EMB-135BJ Legacy variants and different operating procedures. It was finally completed to cover all ERJ 145 family members EMB-135/140/145(XR) and the EMB-135BJ Legacies 600/650. However, it can neither be guaranteed that all differences have been taken care of, nor that the information is up-to-date. - Note that the Embraer Legacies 450/500 (EMB-545/550) are not covered as they do not belong to the ERJ 145 family.

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TECHNICAL

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OPERATIONAL

Planning	**Airports RWY**	**T/O CLB**	**RVSM**	**Charts**
OFP M&B	**Dispatch**	**Normal Procedures**	**CRM**	**T/O CLB**
Pitch Thrust XWND	**Descent Holdings**	**APP**	**RNP APP**	**Expanded CL**

ABNORMAL

Abnormal Procedures	**Worksplit**	**QRH**	**Incapacitation**	**Fire Smoke**
T/O Abortion	**TCAS**	**ENG Failure**	**Pitch Trim**	**HYD Inop**
Unreliable A/S	**EGPWS**	**Upset**	**EMG Descent**	**Recall Items**

1. TECHNICAL

2-00 LIMITATIONS

Operation		Area of operation	60°S .. 80°N
		Extended overwater ops	**120**min

Masses

			135LR	140LR	**145LR**	145XR	**600**	**650**
MTOM	[kg]		20'000	21'100	22'000	24'100	22'500	24'300
MLM	[kg]		18'500	18'700	19'300	20'000	18'500	20'000
MZFM	[kg]		16'000	17'100	17'900	18'500	16'000	16'400
Pax			37	44	48-50	48-50	13-16	13-16
Range	[NM]		1'750	1'650	1'550	2'000	3'400	3'900
Max CGO	[kg]				1'200kg		454kg	
					≤ 400kg per section		≤ 390kg/m^2	
							tighten if ≥ 125kg/m^2	

Speeds	Min SPD OEI **incl. icing**	v_2	(T/O safety SPD)
	Final T/O segment, clean	v_{FS}	(SE best ROC)
	Final APP, LDG config	v_{APP}	
	Min SPD 50ft over threshold	v_{REF}	= **1.3v_{S0}**	= v_{APPCLB}
	OEI G/A, F9, gear up	**v_{APPCLB}**	= v_{REF}
	Gear retraction	v_{LOR}	200KIAS
	Gear extension	v_{LOE}	250KIAS	= v_{LE}
			max **3000ft in icing** conditions
	Flaps extension	$v_{FE\ 9/18/22/45}$	**250/200**/200/**145**KIAS
		$v_{FE\ 45}$	**160**KIAS (650)
		ALT$_{FE}$	max **20'000ft**
	Manoeuvring speed	v_A	**200**KIAS
	(full aileron and rudder deflection protected)		
	Best angle of climb	**v_X**	≈ **v_{FS}** (clean)
	Best rate of climb	**v_Y**	≈ **v_{FS} + 50** (clean)
	Clean speed	v_{Pclean}	**180 / 200** (ice) KIAS
	(30° bank protected;	v_{P9}	**160**KIAS
	flap manoeuvring speeds)	v_{P22}, v_{P45}	**140**KIAS
			(150 w/F22 after ice)
	Turbulent air speed	v_{RA}	**200**KIAS ≤ 10'000ft
			250KIAS > 10'000ft,
			then M **0.63** if lower
	Max operating speed	v_{MO}	**250**KIAS < 8'000ft
			300KIAS (650)
			320KIAS > 10'000ft
		M$_{MO}$	0.78 (145)
			0.80 (135BJ)
	A/S after T/O / during		
	climb without **retrimming**	max	**160**KIAS
	Windshield wiper operation	max	**170**KIAS
	Direct vision window remove	max	**140**KIAS

		Hydroplaning speed	T/O	113kts
		(typical)	LDG	97kts
		Taxi speed	recomm.	30kts dry straight
				10kts dry turns
				10kts wet/cont strght
				5kts wet/cont turns
		Min control speed	$v_{MCA/L/G}$	112 / 105 / 101KIAS

ALT	Max ALT	FL**370** (145), FL**410** (135BJ)
	YD disengaged	FL350 (> M 0.70)
	Max airport ALT	**8'500**ft

Temperature		Temp **above FL250** Limited to **-45°C TAT**
		FL410 · · · · · · · · · Min **-65°C SAT**
		Qualified maintenance inspection after **LDG below -40°C**
		No temp limitation for anti-icing system automatic operation

WND	**XWND**	**30**kts	**dry / wet RWY** recommended
		25kts	**compacted snow** or for **CAT II**
		20kts	**standing water / slush**
		15/11kts	CAT III (AEO/OEI)
		10kts	**ice (not melting)**
		"Critical engine"	On luv side (for XWND LDG)
	TWND	**10**kts	
		5kts	for steep APP (max. **5.5°**)
	HWND	**60**kts	
		23kts	CAT II
		25kts	CAT III
	Parking	If WND ≥ 65kts	Shelter in hangar

| RWY | | Paved; Slope | **-2% .. +2%** |

| Airframe contamination | | T/O: No frozen contamination on wing upper surface; |
| | | underwing max 3mm frost layer |

Structural	Pitch limitation	max ANU	**20°** up to 3000ft/MAA
	Load factor	Flaps 0	**-1**.0 .. **+2.51**g
		Any flaps	0.0 .. +2.0g

2-01 AIRPLANE DESCRIPTION
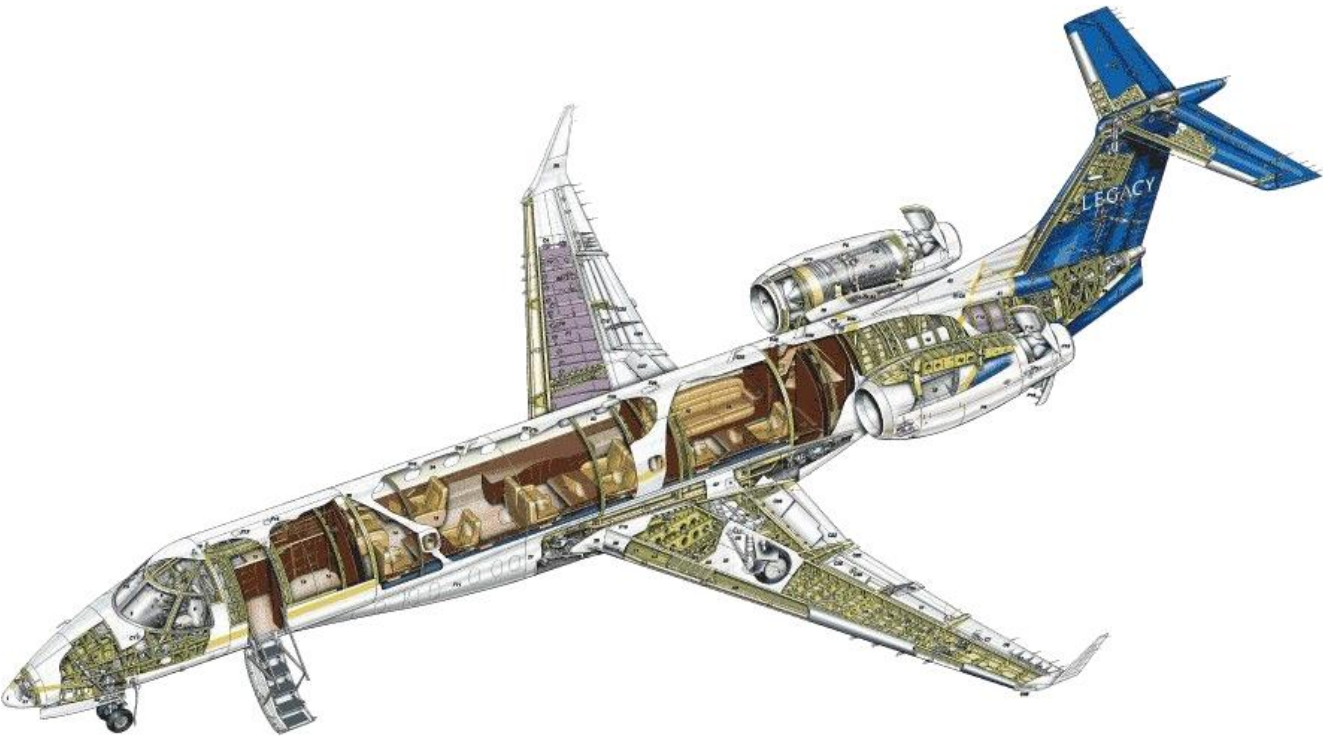
Dimensions		135	140	145	145XR	135BJ
	Wingspan	20.04m	20.04 m	20.04m	21.00m	21.17m
	Length	26.33 m	28.45m	29.87m	29.87m	26.33m
	Height	6.76m	6.76m	6.76m	6.76m	6.76m
	Turning width	18.54m	20.02m	21.21m	21.21m	18.54m
	Turning radius	14.94m	16.05m	17.01m	17.01m	14.94m

(nose covers wing tips)

Probes   Pitot/static **3**: For **ISIS** and **cabin** pressurization CPAM
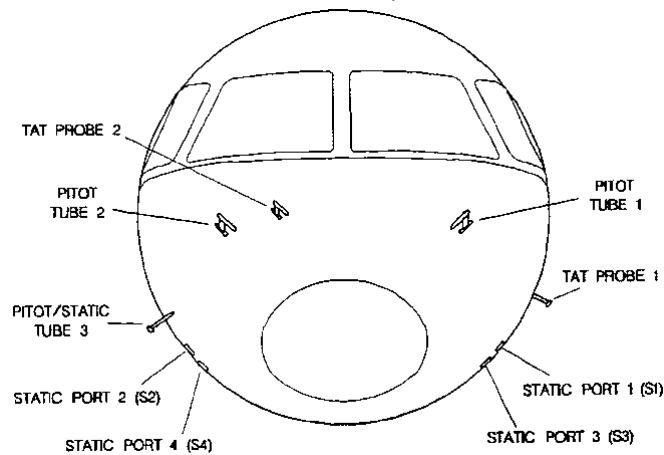
Antennas   ELT   RH ceiling panel of lavatory. Antenna: On top of fuselage
                             (auxiliary antenna on side of ELT when used as portable unit)
                       TCAS Directional antenna on top, omnidirectional at bottom

Cockpit   Circuit breaker panel, overhead panel, glareshield panel,
                       main instrument panel, consoles, control pedestal
                       2 cockpit windows, can be opened from inside and outside

Doors		Indications on MFD T/O page (and EICAS in case of MC/MW)
		2 overwing exits, can be opened from inside and outside (MC)
		Baggage door cannot be opened from inside
	135BJ	No service door, only one overwing exit (RH)
		Aft baggage compartment accessible via swing door (MC in cockpit)
Hatches		AOM 2-02-40
	Fwd	Cockpit underfloor access hatch door
	LH	**Battery** compartment
	RH	**Hydraulic** compartment
	Aft RH	Rear electronic compartment access hatch (rudder servo, cables)
Connections		AOM 1-12-05
	ELEC	LH fuselage nose
	LPU	RH of rear fuselage
	A/C	RH wind root

2-02 EQUIPMENT AND FURNISHINGS

Water   20l potable water
                               Heated drains
                               Cold WX   Drain water to prevent freezing

Toilet   135BJ   6l "blue water"   1-5

2-03 EMERGENCY EQUIPMENT

Operator specific.

2-04 CREW AWARENESS

EICAS		**DAU**s provide each 2 channels; select channel B via DAU button on reversionary panel on center pedestal
		DAU deliver messages to IC-1 and IC-2 and to the RMU
	DAU-1	Front part of A/C systems, ENG 1
	DAU-2	Rear part of A/C systems, ENG 2
	PFD "CAS MSG"	#messages disagree between IC-1/2
	Inhibition logic	T/O v_1-15kts until RA > 400ft or CAS < 60kts or after 1min
		LDG 200ft RA until on GND for ≥ 3sec or after 1min
	Backup display	on RMU if SG fail. Selections on the RMU can be done as before, but 20sec after last selection backup EICAS is displayed again
		TEST button on display controller with WOW and A/S < 50kts: EICAS invalid display

Stall protection	Components	SPC, AOA sensor, stick shacker, stick pusher
	Inputs	2 channels, from IRS, ADC, flaps, spoilers, LDG gear, ice detection, W/S detection, RA
	SPS	Light is on after power-up, remains on after unsuccessful test
	Stick shaker	May be activated at 1.0 .. 1.13 v_S
	Stick pusher	Is activated at or below 1.0 v_S
		Inhibited if: Quick **disconnect switch** pushed or cutout switch pushed, below 200ft RA, RA failure, until 10sec after T/O, below 0.5g, above 200KIAS, SPS advanced
		Activation needs agreement of **both** stall protection computers
		Servo motor on LSP side
	SPS advanced	AOA disagree, flaps/spoilers disagree, SPC/ADC/IRS fail
	Amber AOA	Loss of PLI indication due to an invalid stall protection computer signal

EGPWS

Includes windshear detection and escape guidance function

Updrafts **MC**, yellow WINDSHEAR on PFD, 1x "Caution windshear"
Downdrafts **MW**, red WINDSHEAR on PFD, 3x "Windshear"

Escape guidance mode by pressing **G/A buttons** (< 1500ft)
Windshear mode does not stop at ASEL ALT

Inputs IRS, ADC, SPS, **RA1**; DC-550 control panel   (no CAT II if RA1 failed)
Outputs Both IC600 (2 PFD, EICAS for WINDSHEAR INOP), AWU

'E': Terrain DB. Red: 30sec. Yellow: 60sec.

Mode I	Excessive descent rate		"sink rate", "pull up"
Mode II	Excessive terrain closure		"terrain", "pull up"
	IIa	Flaps not in LDG configuration	
	IIb	Flaps in LDG configuration	
Mode III	Baro ALT loss after T/O		"don't sink"
Mode IV	Min terrain clearance		"too low"
	IVa/b/c		"terrain", "gear", "flap"
Mode V	Excessive G/S dev (1.3 dots)		"glideslope"
Mode VI	VIa	10°/30ft .. 55°/ ≥ 2450ft	"Bank angle"
	VIb	DH	"minimum"
	VIc	APP	"500", "200", "100"

Enhanced GPWS Based on a terrain database
No warnings when landing 2NM short of the RWY
Inhibit terrain awareness alerting and display (TERRAIN SYS OVRD)
within **15NM** of T/O, APP or LDG when
    - no instrument APP procedure,
    - longest RWY < 1067m / 3500ft, or
    - A/P not in data base

Terrain awareness:

Solid yellow	60sec to impact
Solid red	30sec to impact
Red dots	2000ft above A/C
Yellow dots	1000..2000ft above A/C
Medium yellow dots	500ft below to 1000ft above A/C
Medium green dots	500..1000ft below A/C
Light green dots	1000..2000ft below A/C
Black	> 2000ft below A/C

TCAS II
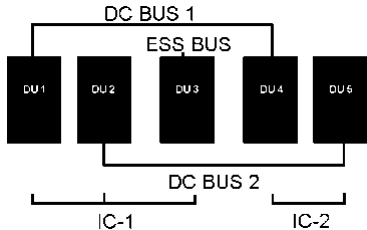
Range indication	Normal range -**27**..+**27**, above/below: ±**70**
	Climb: Above; Cruise: Normal; Descent: Below
Inner ring	2NM, removed if range above 20NM
TA	**Inform ATC**, do NOT perform an escape manoeuvre
RA	**Preventive** ("Monitor V/S") / **corrective** ("Climb, climb now")
	Has **priority** over instructions from ATC
RA inhibited	During descent 400ft/AGL During climb 600ft/AGL
RA DESC inhibited	During descent 1000ft/AGL During climb 1200ft/AGL
TA auto	TCAS automatically pops up in case of TA/RA
TA only	During abnormal situations (**OEI**, ...)
Test	RMU Cursor into ATC/TCAS, TST for 7sec

◊   Other traffic

♦   Proximate traffic (within **6.5NM**, **1200ft**)

●   **TA**   **35..45**sec   amber   "Traffic"

■   **RA**   **20..30**sec   red   "Monitor"   (preventive)
                                            "..."   (corrective)

Rate of intruder is only indicated if > 500FPM

Weather radar

	12" flat type antenna, tiltable **±15°**
	Avoid storm cells by 5..10NM (recommended: 25NM), divert to luv side
	Adjust tilt regularly (no GND echoes)
Limitations	300ft from refueling operations
	15ft from personnel or flammables
Tilt	T/O **8°**, manual tilt selection
	5000ft 5°, for each additional 5000ft subtract 1°
Operation	Do not switch on if large metallic objects within scan sector,
	(re)fueling within 100ft or GND personal too close to 270° sector
Colors	Magenta - red - yellow - green - white (turbulence)
TRB	Turbulence detection
STB	Antenna stabilization
	Exit **forced STBY mode** by pressing **4x STB** in 3sec
TGT	Display a 'T' (on PFD/MFD) if a red level is within ±7.5°
SECT	Select between ±120° and ±60°
GAIN	Calibrated (pushed) / variable (pulled)
RCT	Cyan where further compensation is not possible
FP	Flightplan mode. Radar STBY
ACT	Auto tilt based on barometric ALT, ±2°

2-05 ELECTRICAL

Batteries	**BATT 1/2**	2 NiCad 24VDC **44**Ah. Min **23.5V**. Disconnect if < -10°C
		MW if temp above **70°C** (**2** temp sensors, only one used for indication, but both for the MW). BATT must be switched off
		BATT **charging**: **1 GEN** required
		BATT are not charged with GPU online (even not by APU)
		BATT can only be **loaded if ≥ 19V** (if below: **exchange**)
		Connected to **hot buses 1/2**. Hot bus 1 powers backup buses
		ELEC EMG: Power supply via BATT 1/2 for **40**min (**ESS PWR**)
	Backup BATT	1 lead-acid 24VDC **5**Ah
		Stabilized power for hot bus 1 / backup ESS bus; for **GCUs**
		Charged if BACKUP button is in

Generators		**Primary ELEC source** inflight. **4 ENG GEN**, **1 APU Starter/GEN**
		Max load **400A**, except APU GEN above 30'000ft: **300**A
		28VDC. All brushless, except APU GEN
	ENG GEN	GEN **1**, **3**: **LH** ENG; GEN **2**, **4**: **RH** ENG
		Online when **N2** reaches **56.4**%
		GND: Cooled by a fan. Inflight: Via NACA air inlet.
		BEARING FAIL advisory: 20h on auxiliary bearings possible
	APU GEN	Starter/generator
		Supplies **DC BUS 2** via central DC bus, can also replace a DC BUS 1 GEN
		Online **7**sec after **95**% RPM
		GND: Air cooled. Inflight: Via NACA air inlet.
	GCU	GEN **control** (voltage regulation, line contactor control, parallel ops, current limiting to 400A [e.g. APU start]), system protection, BIT
		To reset GCU: Cycle GEN button

GPU		28VDC (**26..29V**). Isolated if > 32VDC (only if BATT 1 is installed)
		Does **not charge BATT**
		For APU start 1600A required, **300A** for maintenance/servicing
		Has **priority over BATT or GEN** (**cannot be in parallel to any GEN**)

Buses	**EDL**		Controls power contactors, fault protection and load shedding
			Left and right distribution systems (EDS 1/2)
		≥ 4 GEN	Normal operation, two independent networks left/right (DC bus 1; central and DC bus 2)
			BATT 1: DC bus 1, parallel to GEN 1/3
			BATT 2: Via central DC bus to DC bus 2, parallel to GEN 2/4
		≥ 3 GEN	All buses energized, networks connected via BTC
			On **GND** only: 1 GEN+**OVRD** to power shed buses
			Or: GPU to energize all buses
		< 3 GEN	**Load shedding**. Cabin: EMER PILOT illuminated
		0 GEN	ELEC EMG. Only "inner circle", no DC buses
	Central DC bus		To connect APU GEN or GPU to DC buses via BTCs, and to connect DC buses in case of asymmetrical configuration
	GND service bus		Energized if GPU connected but no BATT/GEN online
			Interior lights, dome, baggage compartment light
	Shed buses		SHED BUSES AUTO if GPU online
			SHED BUS OFF **MC** → Check **GPU**

AC power		**115VAC**, **400Hz** through a static inverter (LH nose section) powered by **DC BUS 1**
		INV does not work on BATT only. MC if < 108.5VAC
	Consumers	**TCAS**, **GPWS**, **W/S** detection

Failures	**Electrical EMG**	**Loss of all GENs, only on** (2) **BATT**
		Still powered: **ESS DC** buses, **central DC** bus (to start APU), **HOT BATT** buses, **backup EMG** bus, **backup HOT BATT** bus (inner circle)

→ **no DC BUS, no SHED BUS**
(no DME depending on A/C configuration),
no AC power

→ Max A/S 250kts (nose gear doors could open)

ESS PWR button	Overrides automatic transfer of the electrical system
	Connects **BATT directly to ESS buses**
ELEC EMERG ABNORM **MC**	EDS has transferred to ELEC EMG condition without needing to do so. Check ESS PWR switch is off (out), start APU
	If APU GEN u/s: **40min BATT power** to land
	Only "**inner circle**" of displays available: EICAS, RMUs, ISIS
ELEC ESS XFR FAIL **MW**	Loss of all 4 GENs but **no automatic transfer to ELEC EMG** condition (ESS interconnection contactor did not close)
	QRH: Press ESS PWR button
Display units	**PFD** and **EICAS** must always be displayed
	Reversion of PFD to MFD or EICAS possible via rotary knob
	Each DU: Two **fans** and two **sensors**

Durations	Flashlights	45min	6VDC NiCad. Switch off while in assembly
	ELT	**48**h	(121.5/243/406MHz)
			Right ceiling panel of lavatory, antenna on top of A/C.
			:00..:05 for testing
	ULB	30 days	(37.5kHz)
	EMG cabin lights	15min	

Electrical System Schematic

GEN 1 — GLC 1
GEN 3 — GLC 3
APU GEN — ASC / ALC
GEN 2 — GLC 2
GEN 4 — GLC 4

BTC 1 — **DC BUS 1** — **CENTRAL DC BUS** — BTC 2 — **DC BUS 2**

INVERTER 115 VAC — 115 VAC BUS — TCAS II, GPWS/WINDSHEAR
GPC 1 2 3

BC 1 — **HOT BUS 1** — **GND SERVICE BUS** — **HOT BUS 2** — BC 2

BATTERY 1 — BACKUP BATTERY — BATTERY 2

(BBC)

BBR 1 — **BACKUP ESSENTIAL BUS** — **BACKUP HOT BUS** — BBR 2

BACKUP BUS 1 — **BACKUP BUS 2**

EBC 1 / SBC 1 — **SHED DC BUS 1** — **ESSENTIAL DC BUS 1** — EIC — **ESSENTIAL DC BUS 2** — **SHED DC BUS 2** — EBC 2 / SBC 2

AVIONICS MASTER 1 2

DC BUS 1
AILERON CONTROL SYSTEM 1
AIR/GND POSITION SYSTEM A
AOA 1 SENSOR HEATING
BRAKES TEMPERATURE INDICATION OUTBD
CABIN LIGHTING 1
CENTRAL MAINTENANCE COMPUTER
CLEAR ICE DETECTION SYSTEM - CHANNEL 1
COCKPIT READING LIGHT
COURTESY/STAIR LIGHTS 2
CREW PEDAL ADJUSTMENT
CREW SEAT ADJUSTMENT 1
EICAS POWER (DAU 1B)
* ELECTRICAL FLIGHT IDLE STOP 1
ELECTRONIC BAY COOLING (EXHAUST 1)
ELECTRONIC BAY COOLING (RECIRC 2)
EMER/PARKING BRAKE
ENG 1 FUEL PUMPS 1C
ENG 1 THRUST REVERSER COMMAND
ENGINE 1 LIP ANTI-ICE
FLAP POWER/COMMAND 1
FLOOD/STORM LIGHTS
FUEL PRESSURE REFUELING 1/2
GROUND SPOILER OUTBD
* HEAD-UP GUIDANCE SYSTEM
HYDRAULIC ELECTRIC PUMP 2
HYDRAULIC GEN SYS 2 INDICATION
ICE DETECTOR 1
INVERTER
LANDING LIGHTS 1
LAVATORY FLUSH
LAVATORY LIGHTS
LAVATORY SMOKE DETECTOR
LAVATORY WATER DRAIN HEATER
LOGOTYPE LIGHTS
MAIN DOOR CONTROL 1
NAVIGATION LIGHTS
OVERHEAD PANEL LIGHTING
PACK VALVE 1
PASSENGER SIGNS
PITCH TRIM 1
PITOT 1 HEATING
PNEUMATIC HSV 1
PRESSURIZATION CONTROL
SPEED BRAKE
STATIC PORT HEATING 1
STROBE LIGHTS
TAT 1 SENSOR HEATING
* TCAS 2000
VENTRAL FUEL TRANSFER PUMP A (EMB-145 XR)
WINDSHIELD HEATING 1
WINDSHIELD WIPER SYSTEM 1 (IF INSTALLED)
WING ANTI-ICE SYSTEM
YAW TRIM SYSTEM

DC BUS 2
ADC 2 POWER/CONTROL
AHRS 2 POWER
AILERON CONTROL SYSTEM 2
AIR/GND POSITION SYSTEM C
AOA 2 SENSOR HEATING
AURAL WARNING SYSTEM 2
BAGGAGE SMOKE DETECTOR
BRAKES TEMP INDICATION INBD
CABIN RECIRCULATION
CLEAR ICE DETECTION SYSTEM - CHANNEL 2
COMPARTMENT LIGHTS
COPILOT'S CLOCK
CREW SEAT ADJUSTMENT 2
DEFUELING
DISPLAY PRCS/CONTROL POWER 2 (IC2)
EICAS POWER (DAU 2B)
* ELECTRICAL FLIGHT IDLE STOP 2
ELECTRONIC BAY COOLING (RECIRC 1)
ELECTRONIC BAY COOLING (EXHAUST 2)
ENG 2 FUEL PUMPS 2C
* ENG 2 THRUST REVERSER COMMAND
ENGINE 2 LIP ANTI-ICE
ENGINE VIBRATION SENSORS
FLAP POWER/COMMAND 2
GASPER FAN
* GUST LOCK (ELECTROMECHANICAL)
GROUND SPOILER INBD
HYDR ELECTRIC PUMP 1
HYDR GEN SYS 1 INDICATION
ICE DETECTOR 2
INSPECTION LIGHTS
* IRS POWER 2
LANDING GEAR DOOR COMMAND
LANDING LIGHTS
OBSERVER AUDIO (INTPH 3)
OVERHEAD PANEL LIGHTING
PACK VALVE 2
PASSENGER CABIN LIGHTS 1/2/3
PITOT 2 HEATING
PNEUMATIC HSV 2
RED BEACON LIGHTS
ROLL TRIM 2
SENSORS HEATING CONTROL
SPOILER INDICATION
SPS (SHAKER 2/CHANNEL 2)
SPS PUSHER
STABILIZER ANTI-ICE SYSTEM
STATIC PORT HEATING 2
STEERING SYSTEM
TAT 2 SENSOR HEATING
VENTRAL FUEL TRANSFER PUMP B (EMB-145 XR)
WINDSHIELD WIPER SYSTEM 2 (IF INSTALLED)

HOT BUS 1
EMERGENCY LOCATOR TRANSMITER (ELT)
ENG 1 FIRE EXTINGUISHING (BTL A1)
ENG 2 FIRE EXTINGUISHING (BTL A2)
FUEL PRESSURE REFUELING 3
FUEL SHUTOFF VALVE 1
HYDRAULIC SHUTOFF VALVE 1

HOT BUS 2
COURTESY/STAIR LIGHTS 1
ENG 1 FIRE EXTINGUISHING (BTL B 1)
ENG 2 FIRE EXTINGUISHING (BTL B 2)
FUEL SHUTOFF VALVES 2
HYDRAULIC SHUTOFF VALVE 2
MAIN DOOR CONTROL 2

BACKUP ESSENTIAL BUS
AHRS POWER 1
DATA ACQUISITION UNIT ½
DISPLAY PRCS/CONTROL POWER 1
EICAS POWER
* IRS POWER 1

BACKUP HOT BUS
APU GENERATION
DC DISTRIBUTION
DC GENERATION 1
DC GENERATION 2
DC GENERATION 3
DC GENERATION 4
ISIS (EMB-145 XR)

BACKUP BUS 1
NONE

BACKUP BUS 2
AHRS POWER 2
* IRS POWER 2

SHED DC BUS 1
COCKPIT RECIRCULATION
* GALLEY OVEN POWER
NOSE LANDING LIGHTS
* MUSIC
* PRE RECORD ANNOUNCEMENTS (PRA)
READING LIGHTS/ATTENDANT CALL 1
* SELCAL SYSTEM

SHED DC BUS 2
CABIN RECIRCULATION
FLASHLIGHT
* GALLEY
* GALLEY COFFEE MAKER POWER
READING LIGHTS/ATTENDANT CALL 2/3
WINDSHIELD HEATING 2

ESSENTIAL DC BUS 1
ADC 1 POWER/CONTROL
AHRS 1 POWER
AIR/GND POSITION SYSTEM B
APU BLEED
AURAL WARNING SYSTEM 1
BRAKE CONTROL UNIT (OUTBOARD SYSTEM)
COCKPIT DOME LIGHTS
DISPLAY PRCS/CONTROL POWER 1 (IC 1)
EICAS DISPLAY POWER
EICAS POWER (DAU 1A)
ENG 1 FIRE DETECTION 1
ENG 1 FUEL PUMPS 1A
ENG 2 FUEL PUMPS 2B
ENGINE 1 FADEC A POWER
ENGINE 2 FADEC A POWER
ENGINE 1 STARTING
ENGINES N2 SIGNALS 1A
ENGINES N2 SIGNALS 2A
FDR MANAGEMENT
FUEL QUANTITY INDICATION 1
LANDING GEAR CONTROL (DOWN OVRD)
LANDING GEAR NOSE INDICATION 1
* IRS POWER 1
PASSENGER OXYGEN SYSTEM 1
PILOT/COPILOT AUDIO SYSTEM (INTPH 1)
PILOT'S CLOCK
PILOT'S PANEL LIGHTING
PNEUMATIC 1 (EBV 1)
RAM AIR DISTRIBUTION
RMU 1 POWER/CONTROL
RUDDER CONTROL SYSTEM 2
SPS (SHAKER 1/CHANNEL 1)
VHF SYSTEM 1

ESSENTIAL DC BUS 2
AIR/GND POSITION SYSTEM D
APU CONTROL
APU FIRE DETECTION
APU FIRE EXTINGUISHING
APU FUEL FEED
BRAKE CONTROL UNIT (INBOARD SYSTEM)
COPILOT'S PANEL LIGHTING
CROSS BLEED
EICAS POWER (DAU 2A)
EMERGENCY LIGHTING CONTROL
ENG 2 FIRE DETECTION 2
ENG 1 FUEL PUMPS 1B
ENG 2 FUEL PUMPS 2A
ENGINE 1 FADEC B POWER
ENGINE 2 FADEC B POWER
ENGINE 2 STARTING
ENGINES N2 SIGNALS 1B
ENGINES N2 SIGNALS 2B
FUEL CROSS FEED
FUEL QUANTITY INDICATION 2
ISIS (ALL MODELS EXCEPT EMB-145 XR)
LANDING GEAR CONTROL
LANDING GEAR NOSE INDICATION 2
PASSENGER OXYGEN SYSTEM 2
PEDESTAL PANEL LIGHTING
PILOT/COPILOT AUDIO SYSTEM (INTPH 2)
PITCH TRIM 2
PITOT HEATING 3
PNEUMATIC 2 (EBV 2)
PUBLIC ADRESS
RMU 2 POWER/CONTROL
RUDDER CONTROL SYSTEM 1
STANDBY ALTIMETER
STANDBY ATTITUDE INDICATOR
VOICE RECORDER

AVIONIC SWITCHED DC BUS 1B
* CMU MARK III
* FLITEFONE
FMS SYSTEM 1 DATA LOADER
* FMS SYSTEM 1 COMPUTER
* FMS SYSTEM 1 CDU
RADAR SYSTEM
* TDR 1 POWER/CONTROL
* VHF SYSTEM 3

AVIONIC SWITCHED DC BUS 1A
AUTOPILOT 1
DME 1
MFD 2 POWER
* MLS 1 POWER/CONTROL
PFD 1 POWER
RADIO ALTIMETER 1

AVIONIC SWITCHED ESSENTIAL DC BUS 1
ADF 1
VOR/ILS/MB 1

AVIONIC SWITCHED ESSENTIAL DC BUS 2
NONE

AVIONIC SWITCHED DC BUS 2A
AUTOPILOT 2
DME 2
* FMS SYSTEM 2 DATA LOADER (#)
* FMS SYSTEM 2 COMPUTER (#)
* FMS SYSTEM 2 CDU (#)
MFD 1 POWER
* MLS 2 POWER/CONTROL
PFD 2 POWER
* RADIO ALTIMETER 2
TUNING BACKUP CONTROL HEAD
VHF SYSTEM 2

AVIONIC SWITCHED DC BUS 2B
* ADF 2
* GPS
* HF POWER/CONTROL
* OMEGA
TDR 2 POWER/CONTROL
VOR/ILS/MB 2

(subject to variant-specific changes)

2-06 LIGHTING

Main Lights	TAXI	2, LH on nose gear, wide and narrow angle (gear must be down and locked)	450W
	WING LDG	2. Wing leading edge, close to fuselage	450W
	NOSE LDG	1, RH on nose gear (gear must be down and locked)	600W
	NAV	3, main and standby lamps each NAV LT STBY switch on PIC side maintenance panel	
	INSP, LOGO	each side (fuselage / under vertical stabilizer)	150W
	ACL	Strobes (3), red beacon (2)	

Other Lights		Nose cone, cockpit underfloor compartment, fwd electronic compartment, refueling/defueling panel, baggage compartment, rear electronic compartment, tail cone
	Cockpit	2 dome lights (ESS DC bus 1 - available in ELEC EMG), 3 reading lights, 2 chart holder lights (7 lamps each), 3 floodlight assemblies (below glareshield) 6 dimmers, 9 potentiometers
	Cabin	PAX cabin lights (ceiling, sidewall), PAX warning signs, reading lights (PSU), ATTND call lights, courtesy/stair, lavatory, gallery
	FSTN BELTS/NO SMKG automatically on if > 14'000ft (mask deployment)	
	EMG cabin lights	4 dedicated batteries, recharged by essential bus, 6 static INV converting 6VDC → 130VAC, 450Hz Come on when ESS DC power is lost (15min) **MC** if not armed **F/A** may switch them on regardless of cockpit switch

2-07 FIRE PROTECTION

Engines		2 single loop detectors (engine accessory region, pylon region) consisting of **16 thermocouples** each ENG, ESS DC bus 1/2 These tubes contain gas, its pressure increases with heat Fire extinguisher halon 1301 bottles (tail cone), hot bus 1/2
	Fire handles	**Fuel** shutoff **Hydraulic** shutoff **Bleed** air shutoff **ENG air inlet** (lip) **A/I** shutoff valves Arm the cartridges → **First rotate outboard**
	Test	Press at least for **2sec**. 3 MW, 2 MC, Bagg comp fan goes off (on GND, if pressed > 10sec, APU shuts down) To repeat: Wait ≥ 6sec If pressed ≤ 2sec: BAGG EXTG button may remain illuminated
APU		1 single loop detection, powered by ESS DC bus 2 **On GND** (only)**, APU shuts down automatically after 10sec, but no fire extinguisher is automatically activated**
	EXTG	APU stop, Fuel S/O close, discharge bottle (**not** automatically)
	TST	On GND, APU shuts down if pressed more than 10sec
Lavatory	Smoke detection	Lavatory ceiling: **Smoke sensor** (indicated on EICAS), DC bus 1 Test via smoke detection panel in fwd galley N/a on 135BJ
	Fire extinguisher	Fire extinguisher tubes tips (in the lavatory waste compartment) melt at **77°C** (no warning in cockpit), 9 cu inch 120g agent mass (auto discharge into waste compartment). **No indication for fire** in cockpit
	135BJ	Additional fire extinguisher of this type in galley
Baggage Compartment		2 smoke detectors + temperature sensor to trigger BAGG SMOKE MW Button remains illuminated as long as there is smoke **2 bottles** High rate and metering (re-ignition protection min **60**min / 75min on 135BJ) Powered by ESS DC BUS 1 **Fan** goes **off** (also if test switch is pressed)
	135BJ	Close baggage access swing door if smoke in baggage compartment before discharging baggage fire extinguisher bottle

2-08 FUEL

Tanks	[kg]	135ER 145ER	135LR 145LR	135XR 145XR	Legacy 600	Legacy 650
	Wing tank	2 x 2087	2 x 2594	2 x 2594	2 x 2587	2 x 2722
	Fwd aux tank	-	-	-	2 x 900	2 x 900
	Aft aux tank	-	-	-	2 x 670	2 x 670
	Ventral tank	-	-	845	-	821
	Total	4174	5188	6033	8314	9405

Auxiliary tanks		2 aux tank systems (fwd, aft); = 4 aux tanks
	Fwd	Front section of wing to fuselage fairing
	Aft	Inside rear area of fuselage, aft of baggage compartment (pressurized)

Ventral tank   Between main LDG gear (650 only)

System		Engines and APU are fed by the wing tanks only (APU by RH tank)
	Indication	**7** capacity-type sensors per tank
	Mechanical	3 measuring points each wing (first read outboard, if no indication read root, then stub. **Do not add** values)
	Ventilation	2 float valves, flame arrestor, NACA air inlet, vent tank
	135BJ	Wing, fwd aux and ventral tank vented by NACA air intake
		Aft aux tank vented by cabin air pressure
	Collector box	Flap valves to **keep pump inlets submerged**
		Transfer **ejector pump** keep fuel in box

Fuel pumps	**Wing**	**3** ELEC centrifugal pumps **per tank**; 1 req (2 for T/O / G/A)	
		Fuel pumps **A** on respective **essential** DC bus,	
		pumps **B** on **opposite essential** DC bus,	
		pumps **C** on respective **DC** bus	
		ELEC EMG	No pumps if **C** selected
		Failure	of 1 pump Remaining pumps alternate
			of 2 pumps MC FUEL LO PRESS
			of 3 pumps ABC steady indication
		ENG driven fuel pump: Suction feed, only up to 25'000ft	
		Avoid rapid TL movements and unusual A/C pitch	
	Auxiliary	Fwd	**2** pumps per tank (1 on stby; A/B selectable)
		Aft	**1** pump per tank plus **cabin air pressure** (automatically if > 20'000ft; "P" indication)
	Ventral		**2** pumps (1 on stby; A/B selectable)

Shut-off valves	ENG	28VDC brushless motor, controlled by fire handle
	APU	Closed by APU master switch, FUEL SHUTOFF or APU EXTG

Operation	Normal	ENG1 from LH wing tank, ENG2/APU from RH wing tank
	135BJ	Auxiliary tanks and ventral tank feed wing tanks
	XFEED	Wing imbalance max **363**kg, FUEL IMBALANCE MC disappears if < 45kg
		Start XFEED when imbalance ~100kg
		When QRH asks for **XBLEED**: Consider **XFEED**
		No T/O, LDG and G/A with XFEED

XFER (aux/ventr)   Transfer from auxiliary fuel tanks to wing tanks

2 independent fuel transfer systems:

	FUS 1	From lefthand fwd aux tank 1 to righthand wing tank and from lefthand aft aux tank 1 to lefthand wing tank
	FUS 2	From righthand fwd aux tank 2 to righthand wing tank and from righthand aft aux tank 2 to lefthand wing tank
	Operation	Wait 3sec when switching between FUS1/2

        1. Level off fwd and aft aux tanks (feed fwd into wings 1+2)

        2. **Fwd** aux tank into wing **2**,

          Aft aux tank into wing **1** ("clockwise")

FUS1/2 on   XFER starts if wing ≤ **1900**kg, stops if ≥ 2400kg

FUS1/2 off   EICAS FUEL XFER CHECK message 7sec after wing ≤ 1850kg

Aux **ventral** tank can be transferred to **both wing tanks simultaneously**

No T/O, LDG and G/A with XFER

	Refueling	Pressure **35**..**50**psi
		Drain fuel before refueling or if parked > 2h
		Procedure: BATT on if A/C not energized; WINGS, amount, connect, go, **wait** until valves closed, switch **OPEN**. Switch CLOSED
		~ **1**min / 100kg
		No APU start during refueling and **packs off** during refueling
	De-Fueling	Pressure ≤ 4psi. Open de-fuel SOV; XFEED LOW1 for left tank
		If no suction on fuel truck: Fuel pumps on
		~ **3**min / 100kg

Limitations	Density	0.785..0.811kg/l (1000l ≈ 800kg)
	Temperature	Measured in **LH tank only**
		-40°C .. +52°C (FUEL TANK LO TEMP)
		Use **TAT** if fuel temperature sensor U/S
		Fuel without icing inhibitor: Fuel leaving FCOC ≥ 5°C
	Freezing point	-40°C (JET-A), -47°C (JET-A1, JP8)
	Level	FUEL 1/2 LOW LEVEL MC: 210..400kg (**30**min), MW if below
		Unusable: **22**kg, any pump inoperative: **203**kg
		Usable fuel may be reduced by 2x50l if pressure refueled
	Pressure	**MC** if fuel press < **6.5**psi before FPMU inlet
		Two remaining pumps are energized
		Vent valve opens at 13psig fuel press

2-09 AUXILIARY POWER UNIT

APU		Sunstrand single stage centrifugal compressor, reverse flow annular combustion chamber, single stage radial turbine
		Constant SPD gas turbine
		Does not contact in parallel to GPU
		Fed by RH tank
		Do **not start** while **refueling**
		Packs off while **refueling**
		Leave on if trip time less than **30min** and **GPU not** included
	Fuel filter block	**Unfiltered** fuel flows through **bypass valve** to fuel pump

Starter / Generator		28VDC, 400A (**300A above 30'000ft**)
		On **DC bus 2** via **central bus**, but will replace any other GEN
		ELEC load: 100% up to 39'000ft

Start		With **GPU**, with **BATT 2**, or with BATT 2 **assisted** by GENs
		Starter power from BATT bus **2**, **BATT bus 1 is disconnected**, supplying the avionics. Start with GPU requires **1600A** (300A for maintenance/servicing). Consider no APU start out of GPU because there is no AMPs indication
		APU **bleed** must be **closed** prior APU start
		Packs on after **3min**
	ESU	Ignition at **0%** (inflight) / **3%** (on GND) RPM
		FF at 15% RPM
		Starter disengagement at 50%/70% (depending on APU model)
		Ignition exciter de-energize at **70**% RPM
		<u>**Online after 95% and 7sec**</u>

Stop		Via **STOP** button; ESU sends **overspeed** signal
		APU **bleed on while stopping** APU
		Switch **off** when ≤ **5%**
	Auto shutdown	GND only: Fire (**10**sec delay), overtemp, bleed valve opening, low oil press, high oil temp, oil press switch short, loss of EGT
		GND/inflight: over-/underspeed, failure to start/accelerate/light, loss of speed data, external short, loss of ESU signal, ESU failure

Limitations	Rotor speed	MW if > **108**% or ≤ **95**% (**auto shutdown**)	
		(green: 96..104, amber: 0..95/105..110, red if above)	
	EGT	Start EGT max **884**°C	(925°C for 10sec above 25'000ft)
		Continuous max **680**°C	(**717**°C for 5min)
		(732°C for 3sec for APU assisted inlight ENG start)	
	APU oil	MC if < 6psi or > **166**°C (APU OIL HI TEMP MC)	
	APU fuel	MC if < **6.5**psi (APU FUEL LO PRESS MC)	
	Start limitations	Min BATT **23.5**V and **-20**°C. No APU start when **fueling**	
		Max ALT 30'000ft (min -54°C up to FL250, then -30°C)	
		TWND 34kts	
	Starter	Max 15sec on	
		Between 3 attempts	1min off
		Between 2 series of 3 attempts	30min off
	Pneumatic	APU bleed on	after ≥ **3**min warm-up
		Max ALT for bleed air	37'000ft

2-10 POWERPLANT

Engine	Rolls Royce / Allison AE3007A1E (T406 engine core) 2 x 8169lbs T/O thrust High bypass, 2 spool axial flow turbofan, single stage fan driven by **3** stage **low** pressure turbine, **14** stage axial flow **high** pressure compressor gas generator (with inlet guide vanes and 5 variable-geometry stator stages) driven by 2 stage high pressure turbine Pneumatically started
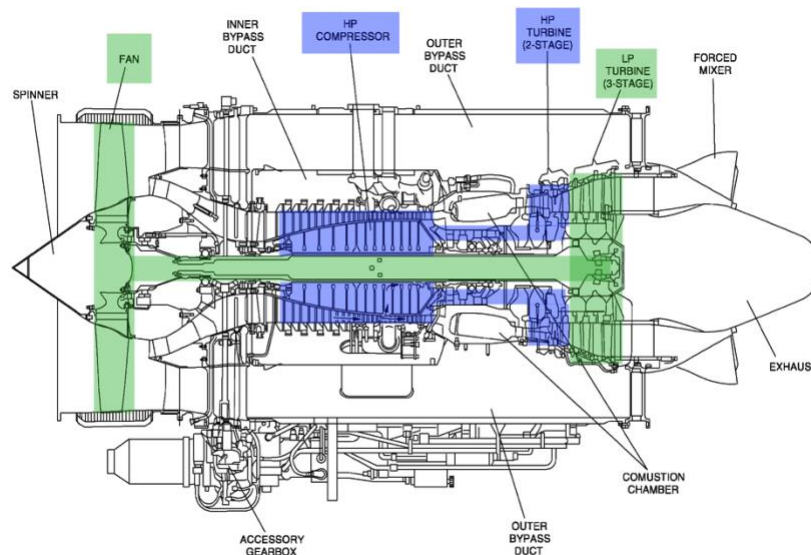
Green: Fan (N1)
1-stage low press compressor
3-stage low-press turbine

Blue: Compressor (N2)
14-stage high-press compressor
2-stage high-press turbine

Variants		135, 145	145LR, early 600	145XR, late 600	650
	Type	AE3007**A1A**	AE3007**A1P**	AE3007**A1E**	AE3007**A2**
	Thrust	3365kg	3705kg	3996kg	4208kg
	Modes	ALT-T/O-1	ALT-T/O-1	ALT-T/O-1	ALT T/O-1
		T/O-1	T/O	T/O	T/O
			T/O (RSV)	E-T/O	A2 TO
			ALT T/O-1	E T/O (RSV)	A2 TO (RSV)
			CON	T/O (RSV)	T/O (RSV)
			CLB	ALT T/O-1	ALT T/O-1
			CRZ	CON	CON
				(E) CLB	(A2) CLB
				CRZ	CRZ
	Fan blades	24 (A1) / 22 (A2)			

Fuel System		FPMU, FCOC, CVG actuators, FF meter and fuel nozzles
	Routing	Tank - Centrifugal pump (increases pressure) - FCOC - Filter assembly (with a bypass if blocked) - High pressure pump (with overpressure relief valve) - Fuel metering valve (constant 70psi, excess is returned to gear pump inlet; operated by dual coil torque motor) - Fuel flow meter - Fuel flow nozzles - Combustion liner

Oil System		For cooling (main purpose) and lubrication
	Components	Oil tank, lube and scavenge pump, oil filter, ACOC, FCOC, sumps
		In case of blockage: Oil filter **bypass valve** opens
	Quantity	**6**..14qts (green range; amber below)
	(MFD T/O page)	in oil tank
		Min dispatch 8qts
		Min ENR 6qts
	Temperature	**40°C .. 126°C** (at FCOC)
	(EICAS)	(green range: 21°C .. 126°C)
		-40°C min temp for start
		21°C min temp for T/O thrust
	Pressure	34..95psi if N2 < 88% (green range)
	(EICAS)	50..**95psi** if N2 ≥ 88%
		96..**155psi** for max **2min**
		95psi (red range) if oil temp < 21°C, only idle
	Quality	Impending bypass sensor;
		E1/2 OIL IMP BYP advisory message
ENG Components	AGB	Driven by **HP** spool (N2 shaft)
		Drives **FPMU** (centrifugal and gear pumps), **PMA**, **oil pumps**, **hydraulic pump**, electrical **generators**, **pneumatic starter** (6)
	CVG	To prevent engine stall at low speed conditions
		Driven by servo fuel pressure from FPMU, controlled by a dual coil torque motor (commanded by FADEC)
	PMA	Primary electrical source for engine control
		Supplies **FADEC** (> **50% N2**) and **igniter** (> **10% N2**)
		(two coil windings) (else: ESS DC)
	Ignition system	2 ignition exciters, 2 high tension igniter leads, 2 igniter plugs
		FADEC A Bottom igniter
		FADEC **B** Top igniter (prefer if wet)
		OFF No IGN, no FF (for motoring)
		Heavy turbulences: Switch ignition to ON (both IGN come on)
	ATS	Components: Air inlet assembly, impeller turbine, reduction gear set, clutch assembly, output shaft. Controlled by SCV
	Thrust reversers	3 locking systems to avoid inadvertent inflight deployment
		Electrically commanded/controlled,
		1, 2: hydraulically powered; 3: electrically powered
	FADEC	Dual lane FADEC (A, B), one in hot spare mode (stand-by)
		Initially powered by ESS DC bus, at 50% N2 by PMA
		FADEC controls FPMU (FF and CVG) and IGN
		Indication A/B (FADEC), IGN A/B (IGN exciter)
		RESET Reset the fault buffer
		ALTN Automatically prior ENG start to other FADEC, not the one that attempted last GND start
		Inflight restart FADEC in control will command own ignition
		ON and request other FADEC to command ignition ON too
		Fuel SOV is not connected to FADEC

Start		First start **RH** ENG. BAGG door must be closed	
	Sources	**APU** bleed, **ENG** bleed, **GND** source (hatch near RH ENG)	
	Sequence	N2 ($\rightarrow$ oil pressure) $\rightarrow$ IGN $\rightarrow$ FF $\rightarrow$ N1 $\rightarrow$ Light up	
		14% N2	IGN (if AUTO or ON)
		31.5% N2 / **12sec** after IGN	**FF, after max 10sec ITT↑**
		54..57% N2	IGN off
		Stabilized	N1 **2**4, ITT **4**xx, N2 **6**4
	Motoring	IGN OFF $\rightarrow$ No FF, no IGN exciter - dry **motoring** possible	
		After motoring, to STOP, then START again	
	X-bleed	First start **LH** ENG. Requires ~**80% N2**. Close ENG bleeds (SOPM 2-63)	
	LPU	SOPM 2-65	
	Airstart	Check if ENG is eligible to being restarted (not if **N1/N2 zero** or **no ENG oil** - N2 could read zero below 160KIAS)	
		Both IGN come on (FADEC requests other FADEC to ignite)	
	Abort start if	**No N1/N2** acceleration to stable idle speed (hung start)	
		N1 rotation is not confirmed or decreases	
		No N2 increase **within 5sec** after START	
		ITT rises rapidly towards or approaches **800**°C (hot start)	
		(new FADEC B8.0 will shut-down automatically)	
		Oil pressure stabilizes below minimum limit	
		Intermittent ELEC/pneum or starter malfunction before starter diseng	
		Abnormal noise, vibration, fire or smoke	
		$\rightarrow$ ABNORMAL ENGINE START checklist	
	Warm-up	Idle during ≥ **4min** for cold engines (off for > **90**min)	
		≥ **2min** for warm engines	
		N2 above 83% only if oil temp ≥ 40°C, or	
		run for 8min or complete a static run-up to 88% N2, oil pressure ≤ 83psi	
	Spool-up	From idle Up to 8sec	
	Cool-down	Before shutdown **1min** at idle	

Thrust ratings	**T/O-1**	Max **5min**
	ALT T/O-1	Max 5min. ATTCS armed for T/O-1 if OEI
	GO AROUND	= T/O-1, but different N1, max 5min
	CON	OEI, severe icing, ...
		FADEC selects T/O-1 if T/O mode button is pressed, TL above THRUST SET, FADEC power up or power interruption, T/O-1 mode T/O data selected, gear down and locked below 15'000ft, disagreement between thrust mode selection on each engine for > 350msec

Limitations		N1	Max 100%	Fan speed
		N2	Max **102.4**%	Core speed
		Starter	1min on $\rightarrow$ 1 min off, after 5th cycle 5min off	
		Motoring	5min on $\rightarrow$ 5min off,	
	ITT	Measured by 16 open-tip thermocouples in 1st stage (LP)		
		ITT	210°C (no motoring needed)	
		Start ITT	max **800**°C	
		T/O	**948**°C (**5min**)	(135BJ: **970**°C)
		CONT	**901**°C	(135BJ: **935**°C)
		Normal ops	790°C recommended. Accelerate to M 0.65 if higher	
	SE	**Max ALT**	**15'000ft**	
	Vibrations	HP indication	Turbine	max 1.1IPS
		LP indication	Top outer fan	max 1.8IPS
				< 2.5IPS Monitor ENG
				> 2.5IPS Reduce thrust
		Fan blade icing	ENG LP VIB; N1 max 60% 3..5sec	
		Vibrations on GND in icing conditions: Increase N1 to max. 75% N1		

2-11 HYDRAULIC

System	System **1**	**Gear**, **steering**, **door** (incl **accumulator**); IB spoilers, OB brakes (more critical system, more time req for gear operation, no steering on GND) **Priority valve** for flight controls (only minimum flow for gear retraction, which will operate through accumulator pressure) **if on EMDP only** and gear is operated and pressure difference below **2400psi** (e.g. ENG 1 fail after T/O and gear retraction in a turn) (lower EMDP flow)
	System **2**	EMG/park **brake accumulator** charging; OB spoilers, IB brakes

Components			Reservoir (pressurized by high-pressure HYD system fluid), EDP, EMDP, manifold, shut-off valve, filter
	EDP	**3000psi**	**9.2**GPM (100% N2)at engine AGB
			De-selectable; requires maintenance to re-engage
	EMDP (stby)	**2900psi**	**1.5**GPM intermittently (smaller HYD lines)
			0.7GPM continuously
		AUTO mode	EMDP on if < **1600** ±100psi or **N2 < 56.4%**; advisory msg
	Accumulators	Sys 1 LDG gear + main door	For **4** closure operations
			If blocked (closing line **remains pressurized** after door closing / solenoid valve failure; **BLOCKED** inscription illuminates on **entrance door panel**), actuate **altn opening valve** for **2min** clockwise
		Sys 2 EMG/prk brk	For **6 brake applications**, or min 24h parking
	HYD shut-off		Between reservoir and and EDP
			Closed by **buttons** on OVHD panel or by fire **handles**
			Used in case of overheat or a leak

Limitations	Temperature		Thermal switch in reservoir if > **90°C**
	Qty indication	**6l** reservoir	> **1l** Green
			≤ 1l Amber, advisory MSG
	Press indication	Amber if	< **1300**psi (HYD SYS FAIL MC) or > 3300psi

2-12 LANDING GEAR AND BRAKES

System		Hydraulically operated, electrically controlled, mechanically locked

System — Hydraulically operated, electrically controlled, mechanically locked

    Nose gear doors — Kept closed by HYD pressure **1**, LDG gear door command via DC bus 2

    Doors of main landing gears — Mechanically operated/linked to gear

    LG/LEVER DISAGREE MW after **20**sec

    2 WOW switches each main LDG gear, **1** on nose gear

    Nose gear switches for thrust reversers and nosewheel steering

Indications — On EICAS and RMU, ENG backup page 2

    "Gear" if — - Flaps below 22, RA < **1200ft**, 1 TL < 59°, 1 TL < 45° or OEI; or
- F22 or more

    If flaps < 22°: Voice message can be cancelled

Controls

    LG WRN CUTOUT — To cancel gear warning in case of RA loss

    DN LOCK REL — Mechanically releases gear handle down lock if the downlock solenoid fails (prevents raising the gear on GND). **Wait 10sec**, check LG AIR/GND FAIL, do not select gear up

Extension

    3 ways to extend

- LG **lever** — LGEU
- ELEC **override** — NORMAL — LGEU has control
  - DOORS — Open nose LDG gear doors
  - GEAR/DOORS — Extend LDG gear
- **Freefall** lever — Depressurizes LDG gear HYD line, releases gear uplocks

Steering — Hydraulically operated, electronically controlled

    ±71° with wheel, **±5°** with rudder → max ±76° deflection

    Radom is limiting in narrow turns if steering fully deflected

Brakes — Carbon brakes. Automatic gear retraction braking function

    Wear is mostly related to number of applications rather than the energy applied. Do not pump the brakes

    BCU

        TD protection — Permits braking only 3sec after TD or when wheel speed **50**kts

        Anti-skid — Triggered if Δspeed **30%**. Deactivated below **10**kts
Only relieves pressure (no increase)

        → **Reduce brake pedal pressure opposite** side of turn instead of applying pressure to the desired side

        Locked wheel — Protection above **30**kts

    Hydraulics — System **1 for OB** brakes, system **2 for IB** brakes

    Parking brake (=EMG brake) — First fully apply pedal brakes, keep it, then set parking brake (to prevent fluid transfer between systems)

    To release: As well first fully apply pedal brakes

    Accumulator for 24h brakes engagement

    Overrides TD protection / anti-skid / locked wheel protection

    (→ pull slowly, modulate manually, accumulator for 6 full applications)

    MC if accumulator pressure < 2200psi (max 3700psi)

2-13 FLIGHT CONTROLS

Elevator		Only elevator operates fully mechanically
	Elevator tabs	**Inner spring tabs**, opposite movement at high SPD, neutral at low SPD
		Outer servo tabs, two-channel HSCU with motors

Ailerons   Hydraulic. **Left:** Autopilot. **Right:** Roll trim, artificial feel unit

Rudder		Hydraulic via PCU
		Fwd/aft rudder, aft rudder deflected depending on fwd rudder
		System 1 shuts off above 135kts (**RUDDER OVERBOOST** MC else)
		If SYS 2 fails, SYS 1 takes over
		Yaw trim not available in mechanical reversion mode
	Hardover protect	Mechanical reversion in case of rudder runaway, if
		- rudder deflected > 5°±1°,
		- pedal force > 59kg (=excessive pedal inputs), and
		- both ENG > 56% N2 (**disabled if OEI**)

Trims		Trimming stops after **3**sec actuation
	Pitch trim	2 systems/motors. Triggers aural warning if > 3sec
		No priority between main and backup trims (first activation counts),
		Main LH trim has priority over main RH trim

Aileron/Rudder **Shutoff**   Manual reversion in case of HYD problems/runaway

Controls Disconnection   Reset of elevator/aileron disconnection requires **maintenance** action

Flaps		Double slotted fowlers, electrically driven by **2 ELEC motors**
	FLAP LOW SPEED	if FECU monitors that only one channel works
		Position indication shows every degree
		Consider early configuration and F22 LDG
	FLAP FAIL	if both failed
		Velocity sensors to detect flap panel asymmetry

Spoilers	GND spoilers	Deploy if > **25kts** & (TL < 30° or N2 < 56%), **both panels**
		(anticipate SPOILER FAIL MC if taxi speed around 25kts)
	Speed brakes	Deploy if TL < **50°**, **F0** or **F9**, **ob panels** only (because of ENG)
		Shall **not be used below 1000ft**/AGL
		Leave **hand at control while deployed** (as a reminder)
	Panels	Inboard 52° deflection
		Outboard 30° deflection

Gust Lock		Electromechanical
		Check elevator travel each time after release
		Wait ≥ 10sec after release

2-14 PNEUMATICS, AIR CONDITIONING AND PRESSURIZATION

System	Inputs	Engine **9**[th] and **14**[th] HP compressor stage (N2 > 56.4%), APU or GND bleed air source (GND: 40..45psi)	
		14th stage HSV: At low power settings, or with A/I on	
		ENG bleed air has **priority** over APU bleed air	
		- White stripe in APU bleed	Button is pressed (⇔ ENG bleeds)
		- OPEN inscription	APU bleed is actually open
		X-bleed AUTO	**CBV** opens if A/I on or XBLD start
selected			
	Outputs	Engine starting, air conditioning (ventilation, temperature, humidity reduction), pressurization, wing/horizontal stabilizer/air intake thermal A/I protection	
	Fans	RECIRC fan	Located at wing root
		GASPER fan	Located between cabin and cargo comp
	Pressurization	From forward to aft pressure bulkhead	
	PACK	Dual heat exchanger. Pneumatic air conditioning kit	
	Valves	High stage valve closes at 45.5 ±2.5psi	
	Press seq T/O	Thrust set (TL > 75°) → descent 450FPM to 0.2psi below, until A/C ALT is lower or until **15**min (so return is possible without having to change the LDG field elevation)	
	LDG	Cabin stays 300ft below (avoids pressure bumps), then climbs at 500..650FPM A/C rate of descent > 200FPM: Depressurization seq	
	More thrust T/O	Close ENG bleeds; use APU bleed for A/C	
Indications	Temperature	Bleed air temperature downstream of the precooler	
	MW	BLEED OVTMP	ENG BLD and XBLD valves close
	MC	PACK OVLD	if pack outl > 55psi or compressor outlet > 243°C
		PACK OVHT	if pack outl > 93°C or downstream condenser > 95°C
		ELEKBAY OVTEMP	Electronic compartment > 71°C
		MC if ventilation > 71°C	
	"**CABIN**"	if cabin ALT > **10'000ft**	
Controls	Temp control	Manual	3 .. 82°C
		Automatic	**18 .. 29**°C (default 24°C if knob failed)
	Press control	Pneumatic outflow valve (manual)	
		Electropneumatic outflow valve (automatic)	
		CAB ΔP **-0.3 .. +8.4**psi, overpressure max **8.6**psi, target **8.1**psi	
		(145 / 135BJ: slightly higher values)	
		Cabin ALT limiter at 14'000ft (valve closes)	
	Manual press ctrl	12 o'clock position	
	LDG ALT	If no LDG ALT is entered, the system takes 8'000ft	
	Dump	To open pneumatic outflow valve	
		AUTO mode	Press **DUMP**. **Stops at 14'500ft** Rate 2000FPM
		MAN mode	Select **full up** (full open) Rate 2500FPM
Connections	**A/C** SRC	RH wing root	Indication on A/C / pneumatics panel: GND CONN
	LPU SRC	Aft right side	
Limitations		Max **10'000ft for unpressurized flight**, unless MEA higher	
	Single bleed /	**Max ALT with one bleed or pack closed 25'000ft**	
	single pack	Exception: If bleed 1 u/s and APU bleed used for pack 1	
		Consider FF↑, use LRC tables in PIH	
		Max ALT for SE or single bleed in icing is 15'000ft	
		If both packs closed, ram air valve opens, providing ventilation	
	Left pack	Is automatically **closed if A/I on below 24'600ft**	
	Refueling	Packs must be off	

2-15 ICE AND RAIN PROTECTION

System	Input	Engine **14**th HP compressor stage
		APU bleed is **not** hot enough to provide inflight A/I
	Output	Horizontal stabilizer fed by left pneumatic system
		(no A/I for vertical stab)
	Temperature	**-40**°C .. **10**°C (SAT)
	Indications	ICE CONDITION, SPS ADVANCED, CROSS BLD OPEN

Operation	OVDERRIDE knob	ENG	< 25kts	ENG air inlet
			> 25kts	WING/STAB as well if ice detected
		ALL	≥ 25kts	ENG/WING/STAB; ENG only if < 25kts
	Operation	On GND	Switch to **ENG** if **visible moisture** (VIS < 1 mile) and **≤ 10°C**
	Icing conditions	FADEC reduces maximum available T/O thrust, and gives		
		minimum thrust setting (+20%) to ensure A/I as long as gear is up		
		→ **Do not extend gear > 3000ft/AGL in icing** (*not* applicable on 135BJ)		
	ENG AIR INLET	Valves open if	- ICE DETECTION TEST to 1/2, or	
			- ICE DETECTION OVERRIDE to AUTO and ice	
			detected (**any** of the 2 ice detectors), or	
			- ICE DETECTION OVERRIDE to ALL/ENG	
	WING/STAB	Valves open if	- ICE DETECTION TEST to 1/2, or	
			- A/C on **GND**, GSPD ≥ **25**kts and ICE DETECTION	
			OVERRIDE to AUTO (ice detected; **any** of the 2 ice	
			detectors) or ALL, or	
			- A/C inflight and ICE DETECTION OVERRIDE to AUTO	
			(ice detected; **any** of the 2 ice detectors) or ALL	
		Red MW ICE COND-A/I INOP if icing encountered below 25kts		
		(will disappear during T/O roll when ≥ 25kts)		

Test		SOPM 2-75 9ff, AOM 1-02-79 10ff
		TEST switch simulates icing conditions on the respective ice detector
		Must be carried out when icing conditions are prevailing/forecasted
		May be completed **on GND** (**A**) or **in 2 phases** (GND/AIR; **B**):
	A	**Prevailing icing conditions**: Test **on GND**, before T/O
		83% N2, ICE DET **OVRD ALL**, A/I buttons pressed, ICE DET TST 1 (10",
		< 15") then 2 (10", < 15"), chk OPEN inscr / ICE DET 1/2 FAIL / BLD 1/2
		LOW TEMP / ICE CONDITION, idle, OVRD ENG
	B	**No prevailing icing conditions**, not anticipated for T/O / CLB;
		once a day: Test in two phases
	-	**GND** before ENG start: Air cond packs open, APU/ENG bleeds close, A/I
		buttons press, ICE DET **OVRD AUTO**, ICE DET TST 1 (10", < 15") then 2
		(10", < 15"), check ICE DET 1/2 FAIL / BLD 1/2 LOW TEMP / ICE COND
	-	**CLB**: ENG bleeds open, 2000..23000ft, TAT < 10°C, before entering icing
		conditions, ICE DET OVRD ALL (20"), chk OPEN inscr., NO ICE-A/ICE ON

Ice Detection		Ice detection on **any** of the two sensors:
		Signal to activate A/I SYS, EICAS advisory message
	SPS/ICE Speeds	Advisory message; higher stall and approach speeds
		SPS will activate at **reduced AOA** for F9/18/22
	Reset	Can't be reset **inflight** (on **GND**: Stall protection test)

Windshield		2 circuits, 1 normal, 1 OVTMP, 1 spare sensor each
		On if icing cond or windshield fogging anticipated, and during descent
		MC at 55°C

De-icing		SOPM 2-75, AOM 1-02-79 (229)
		Trim settings: Full down during de-icing (acc CL)

2-16 OXYGEN

Systems	**Crew OXY**	Cylinder		Composite, high PRESS. RH side of A/C
				Delivers 300l/min if cylinder PRESS 200..1850psi
		3 Masks	NORM	OXY/air mixture (above 33'000ft: Pure OXY)
			100%	(center position)
			EMERG	Overpress; to clear the mask from smoke
			Observer	No vent-valve system, "blinker", on/off valve, test/shutoff slide
			MIC	Push BOOM/MASK button on DAP
				Consider MIC cold if mask to EMERG
		Smk goggle		Right of observer seat
	PAX OXY	145		36 chemical oxygen generators for passengers
				60 continuous-flow masks
				For **12**min
				Masks drop if **ESS buses** energized, PAX OXY **AUTO**, > **14'000**ft. FSTN BELTS and NO SMKG come on
				Masks are not suited in case of smoke as chemically generated OXY is mixed with ambient air
				(only for decompression; use a wet towel)
				2 tools near ATTND stations to open manually
		135BJ		1 or 2 oxygen cylinders for passengers
	Portable OXY	Cylinders		**5** cylinders **120l**. Min press **1'500psi**. 2 outlets:
			HI	**4 l/min** **30min** for 1st aid use
			LO	**2 l/min** **60min** for walk around
		PBE		**2** PBEs (15min/**20min**) in cabin, **1** in cockpit
Limitations	Crew OXY			Minimum pressure for dispatch **1100/1500psi** for 2/3 pilots at 21°C (normal: **1850**psi)
				OXY LO PRESS **MC** if oxygen press < **400**psi (**12**min for pilots+observer)
				Disc bursts if > 2700psi at 21°C
	PAX OXY (135BJ)			Min dispatch PRESS 1730psi
				PAX OXY LOW PRESS MC if < 750psi

2-17 FLIGHT INSTRUMENTS

General		Primus P-1000
	Inhibit aural	MC - Steer Diseng - MC

ADS		ADC 1 (from static ports 1 and 4) and ADC 2 (ports 2 and 3)
		Static ports 1 and 3 on LH A/C side, 2 and 4 on RH side

A/S indication   Red .. v_s .. amber .. **1.13**v_{S1g} .. white .. **1.23**v_{S1g}
Switches to M if > 0.45M

	Trend vector	Situation in **10**sec
	Speed bugs	Removed at v_2 + 42kts / 230KIAS
	Comparison	Amber IAS if difference 5KIAS
		$\rightarrow$ Use lower indication, or PLIs in pitch mode

ALT indication   **Trend vector**   Situation in **6**sec
Comparison Amber ALT if difference 200ft (RVSM requirement)
RA low ALT band below 550ft

PFD	**FMS** information	**Magenta**
	VHF NAV	**Green**
	On-side pointers	Blue
	Opposite side pointers	White
	CDI opposite	Yellow

PLIs   Shown if ≤ 10° between pitch and stick shaker activation

Limitations	PFD ALT indication	Δ max 50ft
	PFD ALT to ISIS ALT	Δ max 90ft
	HDG tolerance	6° (12° if bank > 6°)

RA		2 systems. 2 antennas each: Lower center and lower rear fuselage
		Connected to EFIS/IC-600, TCAS, GPWS, AWU, SPS
	Range	0..**2500**ft
		Brown awareness tape on ALT indicator if below 550ft
	DH	5..999ft
		Boxed in white if at or below 100ft above DH
		Amber if at or below DH

	Tests	**RA TST** button on display controller (**inflight**)
	First level test	Press for < 6sec (WoW, < 50kts)
	Second level test	Hold ~35sec until all green
	Inflight test	Displays 100 ±10ft

	RA1	Required by **GPWS** (therefore required for CAT II)
	Amber RA1	RA1 is source, RA2 has failed

IC-600s	Test	RA 920, **RA TST** (**on GND**)
	AWU	**2** channels, channel B activated automatically if A failed
		4 levels: Emergency, abnormal, advisory, information
	NAV	Consider calculation time for CRS homing after new NAV freq
		No DME in ELEC EMER
	IRS	3 ring laser gyros and 3 accelerometers

	Align	Insertion of position (via FMS) is required
		Flashing ALIGN: Wrong LAT/LON entered
		A/C must remain stationary during alignment, no power interruptions
		Max LAT for alignment **78.25°** N and S
		Remaining align time NAV, POS SENSORS, STATUS
	ATT	Quick Attitude/HDG restart (like a free gyro)
	TEST	Only in ALIGN/NAV. Below 20kts, ALIGN.
		After 24sec original state

ISIS		On ESS DC bus 2
		Air data from **pitot/static 3**
		MAG HDG and slip from **IRS 1**
Reversionary		To select offside ADC, ARS or SG (symbol generator)
	SG REV	Changes as well ADC and IRS, and AP changes CPL
Clock		On ESS DC bus 1 (clock 1) / DC bus 2 (clock 2)
		ET: Shows elapsed time
		Enter flight nr in lefthand clock (connected to CMC/CVR/FDR)
FDR		Stores **25**h of data, solid state
		On if red beacon is on or aircraft is airborne
		On ESS DC bus 1
		In rear electronic compartment
		With tri-axial accelerometer, de-energized if longitudinal acc > 5g
CVR		Stores **2**h
		Power cut at 5g
		Erasable on GND only with parking brake on

2-18 NAVIGATION AND COMMUNICATION

FMS Universal	*Nearest A/P*	*NAV DTO LIST [PLN LANG]*	
		XTK	*Will be canceled after each WPT*
		Extended centerline	*Via PVOR*

FMS Honeywell		Honeywell CD-810 / NZ2000	
	Tasks	Manage NAV sensors, high accuracy in NAV performance, position and guidance calculation	
	Functions	Navigation, flight planning, data base, lateral and vertical navigation, performance, NAV display on EFIS	
	Components	2 CDU (keyboard, CRT display, annunciators), 2 NAV computers (forward electronic compartment; for position computation and flight planning), 2 FMS configuration modules (forward electronic compartment), data loader (PIC side), FMS joystick	
	Databases	Navigation, custom, aircraft, maintenance	
	Dual FMS	4 modes (FMS Maintenance page):	
		- Dual mode	Autotransferring active FPL, perf, pilot defined WPT, stored FPL, offside rdo cmds
		- Initiated XFER	Active FPL and performance on command
		- Independent mode	Autotransferring offside radio commands
		- Single mode	No data XFER
	Priorities	for sources for position determination: GPS, DME/DME, VOR/DME, IRS	
	Messages	Alerting ("MSG" also on PFD) / Advisory (only on FMS panel)	
		Message is displayed on scratch pad	
		Clear with CLR (can**not** be recalled)	
MFD	Buttons	NAV-APT (NavAid / Airport), DATA (WPT identifier), JSTK, SKP (skip), RCL (recall, set designator at A/C position), ENT	
	Displays	Long range source, WPT data, wind vector, drift bug, WPT, lateral deviation, navaids, airport, designator bearing, range	
	Colours	Vertical navigation	Cyan
		Lateral navigation	**Green**
		From	Yellow
		To	Magenta
		Prompts, titles	White
		Flight plan names	Orange
		Atmospheric data	Cyan
	Range	WX	Via arrow keys on weather radar
		TERR	Via rotary knob (n/a on SPD bug page)

WX+**TERR** displayed simultaneously:

WX	MAP
TERR	PLAN

then push **1x MAP**, **1x WX**, **2x MAP**,

→
WX	MAP
TERR	PLAN

Initialization	Fast down alignment **1min**. NAV, ALIGN, insert POS, NAV
	DME must be out of hold
1h on GND or error > 2NM	Do a fast alignment (do not move A/C, (un)loading is ok).
	If A/C is moved during alignment (takes 5..10min), IRS restarts 30sec after motion stopped. If ATT is selected inadvertently, start a new align

FMS pages	NAV Tune	NAV-Tune. Auto Tune: Displayed in magenta
	NAV Ident	Default page. Active NDB (NAV DB)
		Possible to change on ground only
	POS Init	3 ways to initialize: Load last POS; define and load reference WPT; **load GPS POS**.
		Maintenance: FMS mode, list of failed sensors / history, TRUE or MAG mode
	Data Load	Up-/download. NDB: Update every 28 days
Sub	PERF	Performance calculations: 3 modes: Current GS/FF (with default G/S), pilot SPD/FF (pilot entered), **full performance** (based on pilots' selection and learned values). Certain pages are only available in last mode
		Fuel reserve: NBAA considering DEST to ALTN but min 200NM and 30min at 5000ft
		What-if and stored flight plan (to estimate fuel for next flight) functions
		Fuel management and single engine
		FF: PERF - NEXT - FUEL MGT - NEXT
		FMS is **not linked to FF meters**
		LDG mass: PERF - PERF DATA - NEXT
	NAV	FMS considers A/C inflight if G/S > 50kts or IAS > 80kts of WOW
		Following entries cannot be made: Temporary WPT, SID, Alternate FPL with DEST, another stored flight plan
		ATIS: NAV - DATALINK - ACARS - RETURN - ATS MENU - ARRIVAL/DEPART - REQUEST
		NAV - NEXT - CROSS PTS - PT **ABEAM**
	PROG	DIST/ETE/FUEL to DEST or WPT
		Page 1 EPU
		Page 3 Offset can be entered (L/R...)
		Navigation DB (VOR frequencies) on PROG page
		T/O time PROG - NEXT - FLT SUM
		Autotune PROG - DEL - TUNE
GPS STATUS	**RAIM**	Receiver autonomous integrity monitoring
		Predictive RAIM (yes/no at point/time)
		"/ETD" on FPL, NAV - **POS SENSORS** - NEXT - GPS STATUS - PRED RAIM - **DEST**
	FOM	Figure of Merit
	H/VDOP	Horizontal/vertical dilution of precision
Patterns		Hold H, Flyover F, Procedure Turn P
		Holdings over a fix To remove, DEL, then LSK
		Turn left L, turn right R
		1min over fix Exit Hold prompt appears
GND Operation		Check NDB date
	POS INIT	Reference WPT: Ramp WPT or A/P WPT within 3NM is chosen
		Otherwise enter Reference WPT. Positions are not transferred, so **both FMS have to be initialized**
	PERF	Initialize fuel reserve data, transition ALT and CRZ ALT, WND, Temp, speed restrictions, weights
		Climb 270 / 0.65
		Cruise 290 / 0.76
		Descent 290 / 0.76 / 3.0°
	FPL	Activate DEP RWY, SID, Transition
		Within 200NM of DEST: Arrival prompt appears. Within 25NM of DEST: Alternate prompt appears
		Before: Enter via NAV page
		Check **no discontinuity**, connect to **ALTN**
	After LDG	Flight summary page appears
		Can be cleared when prompt appears after 30sec

ENR Operation	Information about airports: NAV, DATA BASE	
Patterns	Press DIR / or NAV - NEXT - PATTERNS	
SLOP	PROG 3/3 - OFFSET	
Holdings	Insert latest 5NM before fix	
	Delete hold: DEL, LSK	
APP	During APP, MISSED APRCH prompt appears; will display MAP on MFD	
Sensor fail	IRS will be used as a reference (degraded mode)	
	De-select sensors: POS SENSORS page (DEL, LSK)	
Pt insertion	LAT/LON, P/B/D or P/B/P/B (place bearing distance)	
	Postfix "T" for true bearings	
	x NM prior to a point Pt // x	
	[First WPT "."] AWY name "." last WPT	
Diversion	On FPL, change DEST	
Horizontal	Restr bank on direct-to turns towards points that are not on the flight plan, but ≥ 30° off	
Vertical	FLx y NM before PtPt // y / x	
NDBs	xx**NB**	
	ADF standby frequency: First stby, then actual freq	
Edit	- PREV, then PREV/NEXT/CLR/DEL	
Del scratch	- DEL	
Default val	Press **DEL** and the desired LSK	
Tune	**Always tune COM from same FMS**	
Auto tune	NAV, TUNE, DEL, LSK (NAV 1/2)	
Space key	Press twice '/' (CD-820 would have a space key)	
Parallaxis	Type PX.	
Ext centerl	DIR, Pt, DIR, Intercept LSK, Pt, IB CRS, HDG SEL LSK, YES	
	Overlay APP: Both NAV SRC to FMS, RMU to NAV page	
ACARS	NAV - DATALINK - ACARS - PRE FLT - INITIALIZE (DEP, DEST)	
	Flight times: NAV - DATALINK - ACARS - NEXT - FLT TIMES	

HGS	DC bus 1. Fail-passive. BIT - built-in tests. Own built-in IRS.	
Data entry	Threshold ELEV APP chart **RWY ELEV**	
	RWY LEN 10-9 chart **Beyond threshold**	
Symbols	Refer to HGS manual appendix A	
PRI	Use **PRI** mode except **AIII** for CAT III APP or	
	IMC to monitor a CAT II APP (no APCH WARN)	
	FGS guidance source, except LVTO submode (when ILS freq is tuned)	
AIII	HGS guidance source. ILS must be captured, within limits for 5sec, diff magn track and detected CRS < 15°, RA > 500ft	
	RWY data is displayed for 5sec after AIII mode is selected or whenever values are changed	
NO AIII	APCH WARN if below **500ft**	
G/S	**-2.50° .. -3.00°** for AIII APP	
APP	Speed bug changes to v_{APP} when	
	- RA < **1300ft**, gear down, A/C in air, FD: T/O mode	
	- no WSHR / G/A ("SPD" symbol changes to "VAP")	

300ft RA	**RWY** symbol appears.
95ft AGL	AIII flare command symbol
Below 70ft	G/S deviation raw data no longer displayed
Below 60ft	No RWY edges displayed any more
45..55ft AGL	**Flare** maneuver
35ft	**IDLE** message
Rollout	RWY remaining from touchdown until < 20kts

DAP	Volume knobs	Unlatch to connect source to headphone/speaker
	BOOM/MASK	To select microphone. SPKR goes un if unlatched (MASK)
	ID/VOICE	ID (latched) for VOR/ADF identification
		VOICE (unlatched) to reduce the morse code signal
		(ADF audio unaffected)
	ST	Sidetone, to prevent undesirable feedback of speaker into microphone
		Unlatch to switch on SPKR
	MUTE	To control sensitivity, or push to temporarily mute the marker audio
	EMER	In case of power loss
		LSP is connected to COM1 / NAV1
		RSP is connected to COM2 / NAV2
		OBS is disconnected
		No intercom

RMU		On ESS DC bus 1/2
		Can store 12 COM and 6 NAV frequencies
		Dashes when the radio system fails to respond to commands
	PGE	NAV page source is always **NAV 1**
	Test	Cursor into subsystem, then press and hold TST

TBCH		Alternative mean of tuning COM **2** and NAV **2** if RMU 2 failed
		On DC bus 2
	EMRG	to take control: RMU2 cmds are ignored, AUX indication on RMU 2
		NAV AUDIO to identify NAV

MIC Switch		For intercom, both switches must be in HOT position
	on yoke	PTT – HOT – OFF
	connector panel	PTT – OFF – HOT

ICU	BACKUP INPH	If normal mode failed. Both CABIN and CAB EMER illuminate

Ramp Interphone Stations	2 (fwd lh, aft rh)

2-19 AUTOPILOT

System		Primus P-1000, autopilot and flight guidance, GC-550 control panel
		3-axes autoflight system and automatic pitch trim
		Incorporated in **IC-600 1**. **Fail-passive FD**
		Hold thumb overhead DISC button when ordering to engage
	Subsystems	2 FD, 1 autopilot (incl. YD), comparison monitor module
		(located in IC-600, can disengage the autopilot)
		Only IC-600 1 has an (enabled) autopilot (coupled to FD1 or FD1)
	Inputs	ATT, HDG, air data, RA, NAV, pilot inputs

Modes	Basic modes	**Roll and pitch**
		Entered when changing CPL, changing NAV src on VOR/LOC/ILS, pitch
		wheel or TURN knobs on autopilot controller, TOGA buttons, invalid
		sensor signals, changing SG or an armed mode is captured
	Roll	Engaged from HDG mode via TCS or TURN knob on center pedestal
		Canceled if bank < 6° (wings level)
		Use TURN knob to determine bank angle
	Pitch	Use PITCH wheel to determine pitch angle
	Half bank	**14**° instead of **27°**. **Only** available **in HDG** mode
		Used for OEI and for PAX comfort
		Automatically when climbing through **25'000**ft and cancelled when
		descending through 24'750ft
	ALT mode	Maintains barometric ALT at the time of selection
		Entered after ASEL capturing (25ft, < 5FPS)
	SPD mode	IAS below **25'000**ft, Mach number if above
		SPD bug is synchronized when engaged
		Does not cancel GS captured mode
	V/S mode	Descent: Brakes rate if approaching red line speed
		(as well valid for FLC in descent)
	FLC mode	Climb or descend depending on ASEL ALT

Climb or descend depending on ASEL ALT

Climb speed	FL100 and below	**240**KIAS
	FL120..FL170	**270**KIAS
	FL170 and above	M **0.56**
	145XR/600/650	290/M 0.6/M 0.65, different ALT (depending on EICAS version)
Descend rate	FL370..FL120	**-2000**FPM
	FL100 and below	**-1000** FPM

Max acceleration 0.1G, overspeed protected
Difference to SPD mode in climb: **FLC won't descend** to catch up speed

GS mode	canceled if GS signal is invalid for > 5sec		
	GS mode does not capture ASEL ALT		
Non-prec APP	VOR	APR mode	(higher gain, more accurate)
	LLZ	NAV mode	(prevent inadvertent GS capture)
	NDB	HDG mode	
	Once LLZ established, bank is limited to 8°..10°		
G/A	equals ROL-TO. Will level wings		
	Transitions to SPD hold if < 1.23v_S or 20sec after G/A and > 170KIAS		
G/A buttons	On GND, < 80kts, or < 400ft	Put FD into T/O submode (14° ANU)	
	During a windshear	Put FD into W/S mode, switch AP off	
	Otherwise	Put FD into G/A mode	

YD		Is engaged when AP is engaged
		Disengages when red QUICK DISC button is pressed

TCS — to manoeuvre the airplane without disengaging the autopilot
When TCS is released:
- **primary servos re-engage**
- new pitch attitude and vertical modes are synced (exc in APR mode)
- lateral control is returned to the previously selected mode

AP Failure	AP, YD FAIL MC	Pull IC-1 CB (3$\uparrow$, 3$\rightarrow$)
		BACKUP BATT off

Limitations

Min engagement height (**MEH**) **1000**ft
Min use height (**MUH**)　　　**160**ft, **80**ft if CAT II
　　　　　　　　　　　　　300ft for 2D APP

<u>Off</u> for <u>SE GA</u>, rudder manual reversion, yaw damper engagement with rudder in manual reversion, aileron manual reversion
APP mode selection during LLZ capture only when IB
G/A in basic modes allowed if wings LVL

2. OPERATIONAL

FLIGHT PLANNING

Planning on GND		**VIS** (not RVR) required at **ETA ±1h**; plus **ceiling for non-prec**
		METAR with NOSIG: VIS is valid for 2h, but RVR is **not**
		If both VIS+RVR is given with a NOSIG, then
		- RVR overrules VIS for current situation
		- VIS however is valid for 2h
		(trend appended to a METAR/SPECI overrules the TAF for that period)
		Snowtam: 2h prior A/D opening; MOTNE: With METAR
	WND	Only consider mean X/WND (w/o gusts)
	VIS APP / Circling	**600ft MDH, VIS 2400m (Cat C** A/C)
	CAT I and 2D	CRVR := 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
		(VIS: Prefix "V"; equal to RVR if no prefix)
		(**not for T/O, CAT II/III , circling**)
	Low VIS T/O	if RVR < **550**m (MIN **125**m, 90m visually [slant range])
		Consider **T/O-1 T/O**
		RVR < 150m: High-intensity RWY centerline lights spaced ≤15m apart, high-intensity edge lights spaced ≤60m apart; 90m visual segment from flight crew compartment at the start of the T/O run; required RVR value is achieved for all of the relevant RVR reportings
		Start T/O roll at threshold (in case of **displaced threshold**)
	LVP in force	Perform **monitored APP**
	T/O ALTN	If not possible to return, considering OEI
		Max 60min OEI CRZ SPD (270kts max CONT)
	No T/O	if moderate or heavy freezing rain
	Closed DEST	2nd ALTN required; calculate with the higher ALTN fuel
	ALTN	Must be open for lower APP category:
		CAT II/III → CAT I → Non-prec → Incr **200ft / 1000m RVR**
	No DEST ALTN	required if **two separate RWYs**,
		CEIL ≥ 2000ft / circling height + 500ft, whichever is higher at
		ETA ±1h and flight time **≤ 6h**
		Add 15min holding at 1500ft for 2nd APP
Max dist to adequate A/D: 2h @ 333kts (OEI CRZ SPD)		

Planning inflight		Req Wx **at ETA (no ±1h margin)**
		Ceiling/VV not required (only **VIS**). ALTN must be open
		(no lower APP category req as during planning on GND)
		APP may be started irrespective of RVR when there is a reasonable chance for a success
		APP may be startet, but **continue beyond OM / 1000ft only if latest RVR ≥ RM chart**
		CAT I: Required RVR is **550**m/**125**m/**75**m. CAT II: **300**m/150m
		If RVR drops after having passed OM: Look and see
	AP	ILS, DH 300ft / RVR/VIS ≥ 800m May be flown raw data
		ILS, DH 200ft / RVR ≥ 700m FD compulsory
		ILS, DH 200ft / RVR ≥ 550m/300m AP, RSP flies, LSP lands
	MDA	Must not be undershoot; **add 50ft**
	DA	Altitude at which the decision has to be taken (land / G/A)
	Contact	if at least **3 consecutive lights** in sight (one of which with a central row)

Airports	**Fire fighting**	For DEP/DEST	4	other sources: 6 (145/140) / 5 (135)
		For ALTN	3	
		XCHK with dispatch		
	Class B	Self-briefing airport		
	Class C	SAAA airport		

RWY	Factored LDG	**DEST**	unfactored x **1.67** for dry RWY
	distance (for		unfactored x **1.92** for wet RWY
	planning)	**ALTN**	unfactored x **1.67** for both dry and wet RWY
	Inflight	Use unfactored LDG distances (dry) / QRH tables/factor (wet)	
	WED	Slush	0.85
		Wet snow (loose)	0.40
		Dry snow (loose)	0.20
	T/O	Max **8**mm WED	
	LDG	Max **20**mm WED	
	Wet	**Wet if ≥ 50% shiny and water coverage < 3mm**	
	Grooved RWY	May be considered **dry**	
	Contaminated	**≥ 3mm** (but < 13mm)**; Plan at least with wet**	
		No ALT-T/O. IGN on	
	BA	**BA unreliable** does not imply a poor BA	

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 is covered with roll-resisting deposits
- Contaminated RWY: v_R/v_2 are increased for better climb

Unbalanced T/O — Only if **not RWY limited** (2..2.5km)

T/O Segment		Ground roll	v_1 - v_R - v_{LOF}
		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 cont power, up to 1500ft

CLB Gradient — Indicated on APP chart only if > **2.5%**; then brief OEI MAP

RVSM — FL**290** to FL**410** (both inclusive; six additional FL)
Operator, crew and aircraft must be approved
Check blue documents booklet and ATC FPLN (10/equip '**W**')

MEL 2 independent primary ALT, 1 AP 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. **XCHK and log prior entering** A/S / **every**
  60min (ATC interferes latest at 300ft)

ALT changes Do not over-/undershoot by more than **150**ft,
  Reduce to max 1500FPM the last 1000ft

"**Affirm**/negative RVSM" / "**Unable** RVSM **due to EQ / turb**" /
"Ready to resume RVSM"

| Non-RVSM | **odd** | FL290 FL330 FL370 |
| Non-RVSM | **even** | FL310 FL350 |

Jeppesen Charts	MSA	Clearance by 1000ft within **25**NM
	MOCA ("T")	Min obstruction clearance ALT. Radio NAV signal coverage only within 22NM from the VOR ($\Leftrightarrow$ MEA)
	MORA ("a")	Min off-route ALT (grid/route). Obstacle clearance left/right 10NM by 1000ft (< 7000ft/MSL) or 2000ft respectively
	JeppView PLN	24.WOOD1B HELEN HELE1A.27

| SWC | | WND speeds ≥ 120 kts: ALT of WND is being indicated |
| | | 80kts isotachs (from LVL / to LVL) |

OFP	Fuel	Trip fuel	3.5kg / NM air
			3.2kg / NM air for longer flights
		Rule of thumb	# kg / 20 = # minutes
			1st hour **1500kg** trip
			2nd hours and ff **1200kg**
		Contingency fuel	5%, or 3% with fuel ALTN
		Diversion fuel	Dest ALTN fuel + company fuel + final res
			= fuel from MAP to dest ALTN + final res
		Final reserve	15min holding at 1500ft
			Calculate **+20%** for 180KIAS instead of v_{Hold}
		Target: Arrive w/**2000kg fuel** onboard	
		Fuel checks at least once an hour	
	Icing conditions	Climb fuel	Increase by **10%** (ISA or below)
			Increase by **20%** (above ISA)
		Holding fuel	Increase by **20%** (ISA)
	CRZ LVL	Optimum	1.4 x trip NM
		Fastest	Around **FL258**; where v_{MO} meets M_{MO}
		Lower LVL	Add **3%** to trip fuel for **each 1000ft**

Loadsheet	**Min fuel**	18'500 - 16'000 = 2500
		Burnoff + 2500 with full house
		Taxi/APU **70**kg
		Trip fuel DEST with burn-off correction
		a) ZFM + ramp fuel - taxi/APU
		b) MTOM/RTOM
		c) MLM/RLM + trip fuel
		Underload Lowest of a/b/c - actual TOM

| Dangerous Goods | | Articles/substances capable of posing significant risks to health, safety, environment, property |
| | | "No Carry Operator" if no approval |

Dispatch	MEL	Minimum Equipment List, for A/C systems, on GND as long as A/C is not operating under own power
		If a system is not listed, then it has to be ok
		(O): specific operations procedure, (M): specific maintenance proc
		Rectifying intervals: A (specific), B (3 days), C (10 days), D (120 days)
		After off-blocks **QRH** applicable, not MEL any more
	CDL	Configuration Deviation List, outside parts of A/C
		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)

Blue Booklet

EASA Regulation (EU) 965/2012 on air operations, CAT.GEN.MPA.180; customs regulations, OFCOM
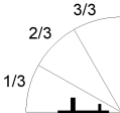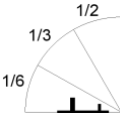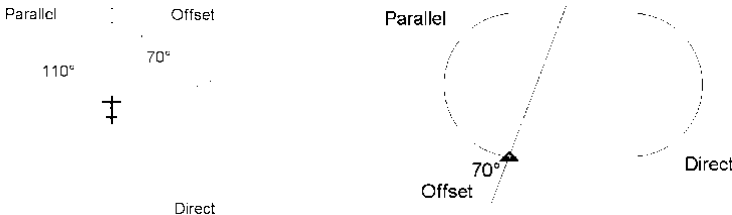
Originals of:
- Aircraft flight manual (AFM)
- Certificate of registration
- Certificate of airworthiness
- Noise certificate
- Air operator certificate (AOC)
- Operations specifications
- Aircraft radio station operating licence
- Third party liability insurance certificate
- Journey log
- Technical log
- ATS flight plan, charts
- Procedures and visual signals information for interceptions (ICAO Annex 2)
- Information concerning search and rescue (AIP)
- Operations manual (relevant parts)
- MEL
- OFPNOTAMs, briefing documentation, MET
- Passenger/cargo manifests
- M&B

NORMAL PROCEDURES

Manuals	AFM	Certified document, must be strictly applied
	AOM	Additional details of applicable procedures
	SOPM	Proposed actions/CRM in order to best cope with a situation

| **Priorities** | | **Stall warning** → **EGPWS** → **TCAS** |
| | FGS | **Always follow FD**, except TCAS RA, EGPWS hard warnings, or when in doubt about correctness - switch **off** otherwise |

CRM	MCDU	**Below FL100, PF orders all MCDU entries**. PM enters, PF confirms	
	FGS	If flying **manually** or **OEI** (even if AP is engaged): **Order** all settings	
	Closed loop	Simplified	PF executes and calls out, PM: "Checked"
		Extended	PF orders, PM executes silently, PF checks silently
	AP	Below 1500ft/AGL Always one hand at yoke	
	Call-outs	"On/Off" or	Change of system status
		"Engage/Disengage"	
		"**Select**"	Including mode change
		"**Set**"	Change of a value, but same mode
			"NAV1 … active, CRS …, preset …"
		"Insert"	FMS; PM: "Inserted" - PF: "Checked"
		"Select FL ..."	PM: "**FL ... armed**"
		"Gear" / "Flaps"	Only silent check
		"LLZ / G/S **alive**"	But no capture call-out
		Deviations	Call out "guidance", "speed" (+10/-5), "sink" (-900FPM), "pitch", "thrust", "LLZ" - PF: "Checked"
		Guarded switches	Always need confirmation
	ALT	"CLD FL/ALT ..., STD/QNH, passing FL/ALT ...",	
		"CHKD, ±...ft, STBY ±...ft"	
		"FL100"	
	Handover	*"Ready for handover?",* "Ready"	
		Call out actual modes, "Checked"	
		"Your controls", "My controls"	
		*"**NAV source** to **FMS**" on (new) PF DCP,*	
		CPL AP, *"AP on your side"*	
		Re-engage and call out modes, "Checked"	
		*"**NAV source** to **NAV**" on PM DCP*	
		TCAS *page on PF side,* **FUEL** *page on PM side*	
	Cabin	**T** - ime available	**N** - ature of problem
		E - mergency type or	**I** - ntentions
		S - ignals to be used	**T** - ime
		T - ransmit additional instructions	**S** - pecials

Areas of Responsibility	LSP	Glareshield panel incl. middle part, control pedestal
	RSP	Overhead panel, RH RMU, RH CDU
	PF	Spoilers
	PM	Gear, Flaps

| Shoulder Harness | | May be removed between TOC and TOD |
| | | Lock in case of turbulence, expected crash, pilot incapacitation |

| **FD** | | Always follow, except for TCAS RA, EGPWS hard warnings, or if in doubt |
| | | VIS APP: FD OFF |

Lights	NAVIGATION	Whenever A/C is energized
	LOGO	Sunset to sunrise and during low VIS operations
	RED BEACON	When engine(s) running or when A/C is moved
	TAXI (nose)	On GND when moving (together with **parking brake**)
	STROBE	When on active RWYs
	LDG	During T/O / LDG, after **clearance** received, < FL100/in congested areas
	INSP	For visual wing surfaces inspection

RTF Phraseology	Readback	Readback QNH and RWY
	Acknowledge	"[Roger], C/S"
		"Wilco" only to confirm a reporting instruction
	HDG	All headings should be expressed in single digits
	SPD	All speeds should be expressed in single digits
	ALT	Specify ".. FEET" and "FLIGHT LEVEL ..."
		10'000ft can be expressed as "one zero thousand feet"
		FL can be expressed in hundreds
	Request	"Request FL360" (not: "any chance" / "is available")
	Yes	Affirm
	No	Negative
	Clearance	"C/S, information hotel, stand E43, request clearance to..."
	Cleared	The word "cleared" shall only be used in connection with an ATC clearance at the gate, a T/O, an APP or a LDG clearance, but not for crossing or L/U. "RWY 28 cleared for T/O"
	Conditional	"BEHIND landing traffic, line-up RWY 28 and wait BEHIND"
	H/O	Only repeat the frequency, not the station for the hand-over

ENG Start-Up		BATT min 24V	
	LPU	Low press unit	SOPM 2-65, AOM 1-02-81 1 01 (273), 1-12-05 2 **40..45**psi
	XBLEED	Cross start	SOPM 2-63, AOM 1-02-81 3 01 (275)
		Bleeds closed (non-operating ENG) and open (other ENG)	
		N2 > 80%	

T/O	LSP	Hand on TL until v_1	
	Low VIS	Use **T/O-1**	
		Start T/O on **green line** (taxi forward if displaced threshold)	
	Profiles	v_2+15, when outbound HDG established consider v_{FS}. Acc ALT: 210kts	
		NADP-1 / ICAO A	v_2+10 until 800ft (NADP-1) / 1500ft (ICAO A), then CLB thrust, maintain v_2+10 until 3000ft, then v_{FS}
		NADP-2 / ICAO B	v_2+10 until 800ft (NADP-2) / 1000ft (ICAO B), then CLB thrust, v_{FS} until 3000ft

Climb		Do not use V/S mode for climb (much shorter time until stall after engine failure than with **pitch mode**)
		Good climb performance at **4°..5° ANU**
		When CAB ΔP reaches 7.8psi, select max 1500FPM
	Approaching	**Max 1000FPM** 1000ft before cleared ALT/LVL
	Endurance	**240**KIAS to FL100, **270**KIAS to FL174, then M **0.56 (FLC)**
		(high TWND ENR or climb fast through turbulences)
	High speed	240KIAS to FL100, **290**KIAS to FL216, then M **0.65**
	Climb gradient	e.g. 383FPM: Multiply by [GS]
	Intermediate LVL	Max **240**KIAS ≤ FL100, **300**KIAS > FL100
		Maintain CLB thrust mode
	Cruising LVL select	**CRZ mode** when speed exceeds M **0.70**

Pitch - Thrust	ISA, 18t, CG 25%	T/O		F9	v_{F0}	14°	T/O thrust
		LVL		clean	180KIAS	5°	59%
		LVL		clean	210KIAS	4°	62%
		LVL		clean	240KIAS	4°	70%
		LVL	30° bank	clean	210KIAS	4°	64%
		LVL	45° bank	clean	210KIAS	5°	68%
		LVL		F9	160KIAS	5°	59%
		LVL		F9	180KIAS	3°	61%
		LVL		F22, gear down	160KIAS	3°	71%
		LVL		F45, gear down	140KIAS	3°	80%
		3° G/S		F9, gear down	180KIAS	1°	64%
		3° G/S		F22, gear down	160KIAS	0°	57%
		3° G/S		F22, gear down	140KIAS	3°	52%
		3° G/S		F45, gear down	140KIAS	0°	67%
	OEI	*LVL*		*clean*	*180KIAS*	*5°*	*75%*
		LVL		*F9*	*160KIAS*	*5°*	*76%*
		3° G/S		*F22, gear down*	*160KIAS*	*0°*	*73%*
		3° G/S		*F22, gear down*	*140KIAS*	*3°*	*70%*

XWND	T/O	SOPM 3-15-05 4	Positive rudder, small control wheel inputs
	LDG	SOPM 3-40 7f	4 Methods (sideslip, crab, de-crab, crab and sideslip)
	WCA	[kts]	

XWND = × WND **WCA** = × WND
= ½ XWND

for 120KIAS. At 150KIAS, decrease corrections by 30%, at 90KIAS, increase corrections by 30%

	Conversion	m/s → kts	Multiply by 2

Timed Turns

Bank = $^{TAS}/_{10}$ + 7 for a rate-one turn. 10sec for 30°
(TAS = ½ FLT LVL + KIAS = 6 × Mach Number)

Turn Radius

$^{GS}/_{100}$ = Turn radius [NM]

Course Intercepts

90°/45° intercept if **QDM more than 20°**
30° intercept otherwise

Descent Planning	Normal	**3NM each 1000ft + 10NM** margin (or: FL × 3)
	Eco	4NM each 1000ft, 3000FPM, until FL110, idle
	WND	TOD **2NM** earlier **per 10kts** TWND
		TOD 2NM later per 10kts HWND
	A/I	FADEC ensures min 55% N1 → Shallower descent
	Procedure	Until FL130 **Maintain 310KIAS**

The lower the ALT, the more thrust necessary to maintain constant M, the less thrust necessary to maintain constant IAS

	At **FL130**	**FLC**, thrust↑ to maintain **V/S of 5×GS**
	At FL100	250KIAS
	At FL80	240KIAS
	At 4000ft	200KIAS
	LLZ intercept	180KIAS
	Corrections	**5% N1 ≈ 1000FPM**
	Idle descent	Glide angle 1:18

Mach		Angle of descend x Mach number x 1000 = Desc rate [FPM]	
		10 x Mach number = #NM per minute	
Rates	Recommended	Within last 2000ft ASEL max rate 1500FPM	
	Within TMA	V/S ≤ 1000FPM within last 1000ft,	
		V/S ≤ 1500FPM within last 1500ft	

Holdings Standard RT Entries:

Parallel   Offset
110°   70°

‡
(end of OBS needle)

Parallel   Direct
70°
Offset

(Offset = Teardrop, 30° for 1min)

Outbound leg 1min if ≤ 14'000ft/MSL, 1½min if above

ILS

LLZ signal	± 35° to 10NM	
	± 10° to 18NM	
	Full deflection 2.5° (VOR: 10°)	
G/S	1000ft after threshold	
	3° → 50ft/ARTE	
DME	Carefully check DME identification with chart	

CAT II

AEO only. Requires 2 ILS set to frequency, F22, RA set to MIN, **RA test**
Both DU on RSP side must be working, **GPWS** (+RA1) must be working
RSP flies down to MIN, "CTC / LDG" → H/O; G/A otherwise
Use **F22 ice speeds**
AP MUH **80**ft

Callouts	1000 ("**stabilized**") - 500 ("**CAT II green**") - approaching MIN - MIN
Malfunctions	Any malfunction requiring crew action
	> 1'000ft/AFE G/A if not completed prior 1'000ft/AFE
	< 1'000ft/AFE G/A
	500..1'000ft/AFE Downgrade (new MIN)

CAT III

OEI possible. PF: LSP, PM: RSP
Use **F22 ice speeds**
Arm AIII
No troubleshooting / system downgrading below 1000ft/AGL
APPR warning before T/D: G/A

Setup	PF "AIII armed", PM: "Checked"
500ft	PM "500", PF: "AIII checked"
	PM "Flare/Idle"

2D APP

General	Use **FMS overlay**	
RNAV	GPS only	**No overlay** required
Required **VIS**	**DH x 6**	= VIS [m] required to see RWY
Required V/S	**5 x G/S**	= V/S [FPM] for 3° descent, max 1500FPM
VDP	**DH / 300ft**	= Dist [NM] for 3° descent
Timed VDP	**DH / 10**	= time [sec] from VDP to RWY
		Deduct from given time from FAF to RWY

RNP APP		AOM 1-02-80 9ff
		LNAV, LNAV/VNAV, LP, LPV (SW6.1+). RNP is a type of PBN
	Required eq	1 FMS, 1 GPS, 1 DME*, 1 VOR/LOC*, 1 ADF*, **4 DU**s**, 1 FD, 1 MCDU
		(* for conventional NAV backup; ** PFD-DUs must be working)
	LP/LPV	SBAS required
	LPV	2D, angular, not subject to low TEMP corrections
		Gets linear when approaching the RWY threshold
	Indications	Linear instead of angular
		RNP value equals 2 dots deviation horizontally,
		indicated number equals 2 dots deviation vertically
		Amber/blinking if deviation of ≥1 dot
	Procedure	Check NAV DB validity
		Initialize PERF
		Perform predictive **RAIM** (not req for LPV, consider for downgradings)
		Check **TEMP** limitation for LNAV/VNAV APP (or compensate TEMP)
		FMS PROG 1/3 FMS NAV mode GPS, LRN MIN 3
		FMS ACTIVE FPLN APP WPT, CRS DIST, ALT constraints, final APP angle
		2NM before FAF Check **APP** annunciation
	3D	**Arm NAV, then arm APR**
	Temp corrections	Only for 2D approaches, only from FAP/FAF to RWY
		(delete corrections for other WPTs on FMS, incl missed approach)
		Manual correction: 4% / 10°C ISA deviation for ALT AGL
	EPU	MCDU - PROGRESS PAGE 1

Circuits	400ft	SPD 180, CLB Thrust, F0
	1500ft	Start turn, After T/O CL
	Begin downwind	F9, APP Briefing (T/G / Full Stop), Config
	ABM THR	TC, Gear down, F22, SPD 160
	45sec	Start turn, descent, SPD 140 (or: **3 x ALT / 100** = time [sec])
	T/G	Instructor: F9, Pitch Trim 8, "Go"

Steep APP		GS of **4.5° or more** (135BJ: **max. 5.5°**)
		Max TWND **5**kts

Stabilized APP		SPD (-0/+20), flight path, sink rate (max 1000FPM exc. steep
		APP), thrust stabilized
	In VMC	500ft/AFE
	In IMC	1000ft/AFE
	Exceeding v_{REF}	10% increase in v_{REF}: 20% increase in LDG distance
	G/A	**if deviation > 1 dot**

High SPD APP		Mind: Not stabilized at 500ft (F45)
	Final	**F9**, **240**KIAS
	1500ft	TL idle, gear down (mind "GEAR" warning at 1200ft)
	200KIAS	F22
	145KIAS	F45, set 62% N1

ABNORMAL PROCEDURES

Always   **Check CBs first**, reset if at all after 3min cooling period
                        Never reset CBs of fuel pumps / quantity indication systems
            MW Requires immediate crew action
            MC Requires immediate crew awareness

Worksplit   PM Acquisition: "MC/MW, …"
                    PF "Cancel warning/caution"
                        Aviate, **navigate**, **communicate**
        < 400ft/AGL "**Check thrust, check performance**" (gear, flaps, spoilers, *trims*)
                        (non-major EICAS MSG are inhibited v_1-15 .. 400ft)
                        (only MC/MW cancel and flight ctrls disconnect if stuck/trim runaway)
                        (**no BHI < 400ft/AGL or after 4NM final**)
        ≥ 400ft/AGL **Analyze**, action: "**BHI**", "BHI complete"
        > 1500ft/AGL "Worksplit: I fly, my ATC, your **ACL/ECL**. **Check CBs**."
                        (*e.g. request delaying vectors*)
                        If on APP: G/A if below, except blocked controls / trim runaway
        Wording   *PM: "**TL confirm**"*, PF: "Number 1/2 confirmed" etc.
                        (hand on respective ctrl to have it confirmed, don't make suggestion)
                        QRH: Read, then action: "**Pumps off, off**"
                        Status reports after checklist work

QRH   Smoke   Baggage smoke, lavatory smoke;
                            smoke evacuation, **smoke/fire/fumes** (non-annunciated)
        Non-annunciated No EICAS annunciation:
                        (all items are as well listed in the TOCs of the system-specific chapters)
                        aileron runaway, APU overtemperature, ditching, dual engine failure,
                        emergency descent, emergency evacuation, engine fire / severe
                        damage or separation, engine oil low pressure, forced landing, fuel
                        leak, inadvertent spoiler open, jammed aileron, jammed elevator,
                        jammed rudder, pitch trim inoperative, pitch trim runaway, rapid cabin
                        depressurization, roll trim runaway, smoke evacuation, smoke/fire/
                        fumes; abnormal engine start, abnormal landing gear extension, ADS-B
                        out fail or degraded, aileron artificial feel inoperative, approach
                        warning, asymmetric rudder operation, cabin depressurization, cabin
                        rate abnormal fluctuations, CAS message miscomparison, CDU data bus
                        fail FMS annunciation, cracked windshield, display failure,
                        emergency/parking brake handle disagree, engine abnormal vibration,
                        engine airstart, engine control failure, engine failure/shutdown, engine
                        high oil pressure, engine high oil temperature, engine low oil level,
                        engine oil low pressure, engine overtemperature, engine tailpipe fire,
                        erroneous stall protection actuation, gear lever cannot move up after
                        takeoff, gust lock failure, IC bus failure, IC failure, impaired or cracked
                        windshield, IRS/MSU failure annunciation, loss of engine indications,
                        loss of pressurization indication, main door blocked, NAV/flight
                        instruments failure, one engine inoperative approach and landing,
                        overweight landing, oxygen leakage, partial or gear up landing,
                        pressurization automatic system failure, radio altimeter fail, rudder
                        artificial feel inoperative, rudder runaway, single engine bleed
                        operation in icing conditions, steering system inoperative, stiffened
                        elevator, structural damage, transponder fail, uncommanded aileron
                        disconnection, uncommanded elevator disconnection, uncommanded
                        swerving on ground, unreliable airspeed, volcanic ash, yaw trim
                        runaway

	Message Index	Warning - Caution - Advisory

	Performance	Wind, pitch trim, flap speeds, unreliable airspeed, T/O / APP / reference / holding speeds, drift-down tables, LDG distances
	Appendix	Emergency evacuation

ENG Failure
SOPM 3-15-10

1. **Maintain wings LVL with ailerons,**
2. **add rudder gently until yoke is neutral,**
3. **trim** (remember 3sec trim cutout), use **ISIS** slip indicator

Initial CLB	**1**dot
CLB/CRZ	**¼**dot
APP/LDG	**½**dot

Add 10% N1, pitch remains same
F22 for OEI LDG
Always **start APU**, always start **XFEED**
Leave rudder trim during LDG

PF	Handles TL
PM	Handles Start/Stop selectors
After v_1	Pilots tend to pull yoke. Make sure that elevator remains down
At 14° ANU	Pitch down to **10° ANU**
Dual ENG out	Maintain v_{FS} (≈ v_{DD}); ~**1200FPM** ↓. Check HYD page if pumps on Use F22/F45 for G/S adjustments. **APU** start limit: **FL300**
ENG fail **on final**	< 4NM: *Consider* continuation and **retract to F22**, add 10kts SPD incr In general: **G/A**
CL	After bird strike, vibrations, bang/noise, **N1 or N2 zero**, ...: "**ENG Severe Damage CL**". **BHI only for fire, severe damage, separation**

Fire / Smoke
SOPM 3-10 18f

On GND	In case of any fire, even if extinguished: **EMG EVACUATION**
LSP	START/STOP selector to **STOP**
RSP	Fire ext handles **pull**; ENG fire, sever damage, separation **CL**
On final	Continue, land, EMG EVACUATION
Smoke in cabin	**Always put on mask** (even if not visible in cockpit)

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

Beyond 80kts	High energy, only abort with **ENG failure**, **fire**, **unflyable condition** (flap retraction, spoilers extension) or **pilot incapacitation** Do not vacate RWY, except on high speed TWY Try to turn A/C into WND. Set parking brake
	PM Watch spoilers, **"TWR, ... aborted T/O RWY ... request fire brigade"**
	CMD **"Cabin crew and PAX, keep your seats"**
"GO minded"	Short RWY, low VIS
Cabin call	**Always abort T/O**

Windshear Recovery / **EGPWS**
SOPM 2-83 1, 3-15-05 10f, 3-40 11f

Any "G/S" or "W/S" callout: "**Windshear**" (any pilot), **G/A**
AP off, <u>**TL max**</u>, <u>**G/A button**</u>, PF: "**Max**", wings LVL, pitch up:
Follow FD (announced) / **20° or PLI** (unannounced)
(remain between FD [stable] and PLI [nervous])
<u>**Do not change config**</u> (only once terrain cleared and
above 1500ft/AGL or after WDSHEAR label disappears)
(reasons: Safer with LDG gear down when **touching GND**;
flaps retraction could lead to a **stall**)
PM monitors V/S and calls out if A/C is descending, **FSTN BELTS** on
In W/S mode: **No ASEL** ALT will be captured

MC	"Positive" W/S. Pilot's decision to continue or to G/A
MW	"Negative" W/S; downdrafts

TCAS
SOPM 3-05-10 3ff

TA	PF	Look out; hands on yoke
PM		All external lights on, FSTN BELTS on
RA	PF	**AP off**, set thrust. Call out position of intruder
		If in a turn: <u>**Wings LVL**</u>
	PM	"**TCAS RA**", "**Clear of conflict**, **returning to** ..." / "... **resumed**"
		Contradicting instructions: "**Unable, TCAS RA**"
		File report
SOPM 3-05-10 4		Cases with insufficient performance to follow TCAS commands

Turbulences
SOPM 2-80 1, 3-25 5f

Pitch and roll AP modes (disengage actual modes)
During climb: Maintain thrust, climb faster

Upset Recovery
SOPM 3-25 18ff

Pitch values beyond -10 .. +25°, bank > 45° / any undesired A/C state

PF		"**Upset**, I have control", disconnect AP/FD
First		**Unload the wings** (for aileron effectiveness) (even with AND)
Stall	PF	"**Stall**". <u>**Nose down**</u>, <u>**wings LVL**</u>, <u>**TL max**</u>
		No trimming below top of white speed arc (1.23v$_S$)
		Approaching v$_{MCA}$ Reduce thrust, lower nose, increase thrust
ANU		Push to unload. Then, first adjust **pitch**, then **thrust**, then **wings LVL**
		(simultaneous elevator/aileron inputs could induce a dutch roll)
		If pitch is too high: Bank to 45..60° until pitch is lower
AND		Push to unload. Then, first **wings LVL**, then **throttle idle**, adjust pitch
High SPD buffeting		Thrust idle. **Do not use speed brakes**
Dutch Roll		Use YD. Use **ailerons**. **Do not use rudders**

Unreliable Airspeed
SOPM 3-25 17, QRH NAP-36

PF	**Disengage AP**, switch off FD, do **not use SPD brakes**
	Refer to Pitch-Thrust values. Consider GPS GND SPD and ALT
	Annoying **high SPD aural warning** (instead of pulling AWU CBs):
	Consider pulling ADC CB and use ADC reversion

Pitch Trim Runaway

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

Both hydraulic Systems inoperative

Use **half bank**, use asymmetric thrust, use **rudder**

Final APP	Copilot is "verbal autothrottle"
Braking	Use parking brake smoothly;
	do not taxi to stand (request push-back)

Driftdown *SOPM 3-25 6ff*	after ENG failure	$v_{FS} \approx v_{DD}$. NAV reception is not guaranteed **ALT hold, max <u>cont thrust</u>, at v_{DD} engage SPD**

EMG Descent *SOPM 3-25 13ff*	after rapid depr	**BHI**. Fly 5..10NM parallel (**turn 30° off to leave AWY**) ASEL to FL100 / MEA, initiate descent with TCS Inform ATC (declare **EMG**) Squawk 7700, turn on exterior lights "Attention crew, EMG descent" ALT callouts every 10'000ft, "2000ft", "1000ft" 2000ft before target FL FLC At target FL Retract gear (v_{LOR} **200**KIAS) "Attention crew, we have reached safe ALT"
	PACK fail	Immediately EMG descent
	Press problems	Immediately stop climb

Decompression
- Slow   > 1min   Whistling sound, may feel ear problems
- Rapid   Explosive noise, fog, flying objects,
- Explosive   < 1sec   dizziness, pain

TUC		
	FL300	**1min**
	FL350	**30sec**
	FL400	**15sec**

LDG Gear Malfunctions   During gear cycle: Consider leaving gear↓ if down and locked;
no retraction

Overweight LDG   ROD max 300FPM
SOPM 3-40 17f

Ditching   Refer to QRH (non-annunciated). Squawk 7700, cabin signs on, ELT on
SOPM 3-40 21ff   PACKs / BLEEDs out, max available flaps, gear up, reduce onboard fuel
Land parallel to waves

EMG Evacuation   Switch off ENG first
SOPM 3-10 20ff   "Crew at station" / "EMG evacuation" not via ICU but via **PA**
Rapid deboarding Using stairways. SOPM 3-05-01 7

COMM Failure	VMC	Squawk 7600, maintain VMC, land asap
	IMC	Squawk 7600, maintain assigned SPD/LVL for **7min**, then resume FLP

Pilot Incapacitation   = Failure to respond to a **second request**, or e.g. impairment by
SOPM 3-05-10 11f   gastrointestinal illness or laser strikes. Is always an **emergency**
1. Fly, "I have control", best use of equipment
2. Restrain (assisted by cabin crew). Removing from seat: difficult
3. ATC: "**Mayday** x 3, pilot incapacitation" + request **medical assistance**
4. Consider cabin crew to assist in CL reading
5. APP briefing (verbal), consider two-loop briefing with ATC
With increasing stress level, hearing/attentiveness is impaired
→ Start a normal dialogue, touch other pilot

RECALL ITEMS

Smoke / Fire / Fumes,	Crew oxygen **masks**	Don, 100% (center pos)
Smoke Evacuation	Smoke goggles	Don
	Crew **communication**	Establish, **also with ATC**
135BJ	*Recirculation fan*	*Push out*
APU Fire	APU **fuel SOV**	Push in
	APU **MASTER**	OFF, (**TC**)
Baggage Smoke *135BJ*	*BAGG ACCESS OPN MC*	*Not displayed on EICAS*
	Fire Extg Bagg Button	Push in

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Abnormal ENG Start To abort	Associated TL	**IDLE**	
	START/STOP selector	**STOP**	
ATTCS Failure	Thrust levers	Max	
ENG Fire, severe Damage, Separation	Associated TL	**IDLE**	
(no BHI for ENG failure)	START/STOP selector	**STOP**	(LSP)
(e.g. after bird strike, vibrations, ...)	Fire ext handle	**Pull** (do not rotate)	(RSP)
Legacy 600	*Fuel Fus Tk XFER*	*OFF*	
Legacy 650	*Fuel XFER master knob*	*OFF*	
	Fuel XFER OVRD button	*Pushed in (off)*	
Dual Engine Failure	Oxygen masks	As required	
	Fuel Pump Power Tank 1+2	On	
	Fuel Pump Sel 1+2	A or B	
	APU	START (max FL300)	
	A/S for windmilling	Above 10'000ft	MIN 250KIAS
		Below 10'000ft	220..250KIAS

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Battery Overtemperature	Affected **battery**	**OFF**
ELEC ESS XFR FAIL MW	**ESSENTIAL POWER**	**Push in**

Steering System inoperative / uncommanded Swerving on GND		Steering handwheel	Do not use	
		Steering disengage button	Press	
		Use differential brakes / rudder		
Pitch Trim Runaway		Quick **DISC button**	Press and hold	
Aileron / Rudder Trim Runaway		Quick **DISC button**	Press and hold	
		AILERON/RUDDER SHUTOFF 1+2 Push out		
		Control attitude manually with control wheels and rudder		
Jammed Aileron / Elevator		Aileron / elevator **DISC** handle	Press and pull (after confirmation)	
Inadvertent Spoiler Open		SPEED BRAKE	CLOSE	
Erroneous Stall Protection Actuation		Quick DISC button	Press	
		Stall Protection Cutout 1+2	Push out	
		Quick DISC button	Release	
Stick Pusher Failure		Control column	Toward neutral	
135BJ: Stall Protection inoperative		*Affected Stall Prot. Cutout*	*Push out*	
135BJ: Airplane Overspeed		*Airspeed*	*Max v_{MO}/M_{MO}*	

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Rapid Cabin **Depressurization**		Crew oxygen **masks**	Don, 100% (center pos)	
		Crew **communication**	Establish, **also with ATC**	
Emergency Descent		Cabin Crew	**"Attention crew, EMG descent"**	
		FSTN BELTS / NO SMKG	On	
		Thrust Levers	**Idle**	
		Speed Brakes	Open, check	
		A/S	MAX 250KIAS (v_{LOE})	
		LDG Gear	Down, check	
		Descent	Initiate	
	135BJ	*Transponder*	*7700*	
		ALT	**MEA of 10'000ft** if higher	
			"Attention crew, we've reached safe altitude"	
Emergency Evacuation	LSP	Parking **Brake**	Apply	
		ENG	Idle, STOP	
		Cabin Crew	**"Attention crew, wait for instr"**	
	RSP	(**1**) Cabin	**Depressurize**	
		(**3**) Top OVHD row	Fire Extinguishing **Handles**	Pull
			APU Fuel Shutoff Valve	Push
			ENG/APU Fire Ext **Bottles**	**Disch** (if req)
		(**2**) Med OVHD row	Fuel **Pumps** Pwr 1 and 2	Off
			HYD ELEC **Pumps** 1 and 2	Off
		(**1**) Bottom OVHD row	**EMERG LT**	ON
		(**1**) PTT	ATC	Notify
	LSP	Evacuation	**"EMG, open seat belt, evac"**, EVAC CL	

EXPANDED CHECKLIST

INTERNAL SAFETY INSPECTION

		Every crew's FFD on a particular A/C
		Performed by RSP according CL
	CBs	Also behind seats
	Electrical	All ON/AUTO except GPU, BATTs, ESS PWR, AVIONICS
	A/C	RECIRC/GASPER in, PACKs/BLEEDs out (closed)
	EMG/PKG brake	Push pedals while applying/releasing to avoid fluid transfer
	ALTN gear ext	NORMAL

POWER UP

		Every crew's FFD on a particular A/C or after SHUTDOWN
		Performed by RSP according CL
	Electrical	BATTs AUTO, "Aural unit ok"
		Min temp -20°C. Replace BATT if < **19**V
		BATT Voltage for APU start: **23.5**V
		If recharging, BATT 1 off before APU start, AUTO after 3min
		Min recharching time 30min
	GPU	**26**..**29**V
	Fire detection	2x pushed out.
		TEST for ≥ **2se**c: **3 MW**, **2 MC**, BAGG COMP **FAN** OFF
		(to repeat: wait ≥ 6sec)
	APU	Do not start APU before 30sec after energizing airplane (IRS)
		Do not start APU while refueling
		Fuel pump 2. Wait **3sec on ON**. **TC** (**3**min for APU bleed)
		SHED BUS OVRD (for galley power)
	Avionics master	Release BACKUP BATT momentarily, check ISIS
		→ **IRS**: To NAV asap

BEFORE START

		Performed by LSP/RSP according areas of responsibility
	OVHD	EMER LT	ON, then ARM
		PB LT	TEST
		FIRE panel	2x pushed out
		APU FUEL SHUTOFF	Pushed out
		POWERPLANT	Store T/O data (local temperature)
		FLIGHT CONTROLS	4x pushed in
		HYDRAULIC	SHUTOFFs pushed out
			Pumps AUTO, then OFF
			Check 2900±200psi and fluid level
			(do not test if on BATT only)
		PASS SIGNS	FSTN BELTS on after refueling
		ICE PROTECTION	All in/AUTO, except W/S as req (defog)
		A/C	As req, APU BLEED on if available
	Oxy masks	Oxygen mask, regulators, mic (MASK/BOOM),
		1100/1500psi (crew of 2/3), 1150psi (pax)
	Glareshield	WX RADAR	TEST (WX on MFD), then STBY
	AP	Release gust lock, AP, check AP/YD, DISC, set gust lock
		Modes: **ROL - TO**, CPL to PF
	Clock LSP	Enter flight number, enter date according GMT
	Instruments	Flag free, set ASEL (cleared ALT - 100ft / MSA), x-check ALT, set
		NAV/CRS/HDG bug (ISIS: A/C must not be moved 90sec after power-up)
	MFD	Select **WX**, **NAV**, **APT**
	SYS	ENG **OIL LEVEL**	Check
	PF	**TCAS** page
	PM	**FUEL** page
	RMU	TCAS	Press TEST for **5**..7sec
		XPDR	Insert call sign

Control pedestal	When **IRS aligned**	Release gust lock, SPS TEST (ICE/SPS ADV msg)
	Trims	Check 3sec protection
	TBCH	Normal, copying RMU 2
	Pressurization	DEST A/P ELEV, DUMP/AUTO out, manual full down
	FMS	Check NAV DB expiry date
		Load GPS POS. PF sets route

		PERF INIT	CRZ WINDS, ISA DEC,
			INIT CRZ ALT = AT ALT
		M&B	BOM, block fuel, cargo 0, #PAX
		PF	**PROG** page
		PM	**FPL** page

| | RSP | "**Before start CL complete down to the line**" |

SPD bugs

V1	VR	V2	AP	Bug
v_1	v_R	v_2	v_{AP} ($v_{REF45}+5$)	**v_2+20** (max)

Briefing	LSP	Any failure before v_1, you call it out or point at it.
		I decide whether to reject, TL to idle, reverse.
		Up to 80kts	We stop for any failure
		Beyond **80kts**	High speed T/O abortion only for **ENG failure**, **fire**, pilot **incapacitation** or **unflyable** condition
		When we stop, you inform the **ATC**. I decide on **evacuation**
	PF	After v_1, we fly SID, **accelerate** at ..., (A/P elevation + 3000ft; climb to MSA), power reductions, WX, terrain/MSA, noise abatement, low VIS, inoperative airplane components, RWY in use / condition, return ALTN A/P, NOTAM, ops procedures
	RSP	**Pumps**, **red beacon**, safety pins on board
		"**Before start CL complete**"

	LSP	"**Starting ENG** 2 (1)", **RUN for 1..3sec**
	LSP	TC **START**	Check **10sec N2↑**, **12sec FF**, oil pressure
	RSP	TC **FF**	Check (5 -) **10sec ITT↑**
	LSP	"**Normal start**", "**Set F9**, **flight control check**, **after start CL**"

AFTER START	RSP	**SHED BUS**	AUTO
		APU	OFF
		FADEC	RESET/ALTN **650**: Confirm ALTN
			Check N1 target remains within ±0.2%
		HYDRAULIC	**ELEC HYD PUMPS** AUTO
		ICE DET OVRD	**ENG** (icing conditions only; VIS **< 1 mile**, **≤ 10°C** TAT)
		A/C ALT T/O	**ENG** bleed ~~APU bleed~~ X-bleed AUTO
		(E) T/O-1	~~ENG bleed~~ **APU** bleed X-bleed OPEN
		(E) T/O-1, ice	**ENG** bleed ~~APU bleed~~ X-bleed AUTO
	RSP	"**After start CL completed**"

	LSP	"**Left side clear**"
	RSP	"Right side clear"
	LSP	Ailerons into wind. **TAXI** LT on, check brakes, check FD

Single engine taxi: Use ENG1 (higher TLA available with gust lock set; steering is on HYD SYS 1)

Ice detection test: 83% N2, OVERRIDE to ALL, TEST to 1, then 2 (min 10sec / max 15sec), check 4 inscriptions, BLD LOW TEMP MC

BEFORE T/O		RSP	Advise **cabin** crew, **lights** on, check **brake temp**, MFD 2x**TCAS** page, EICAS, TCAS/**XPDR** TA/RA, gust lock, **T/O config**
		LSP	During line-up: "**Before T/O CL**" STROBE LT on, RADAR on (4xSTAB), center HDG bug LDG LT on (with T/O clearance)
		MFD	**WX** and **TERRAIN**

T/O			**40%** N1, brakes release, thrust set
		PF	"**Check thrust**" - PM: "Thrust checked"
		PM	"**80kts**" - PF: "**Checked**"
		PM	"v_1, **rotate**, **positive rate**"
		PF	"**Gear up**", **trim down** to **14° ANU** before 160 KIAS use **TCS** if SPD < v_2+10 Fly **v_2+20** (noise abatement)
	Any failure	LSP	*"**Reject**" / "**Go**"*
	Abortion	LSP	*Idle, reversers*
		RSP	*"60kts", to ATC: "Stopping" [, "Fire"]*
		LSP	*Decide on further proceeding, inform cabin "Attention crew, wait for instructions"*

AFTER T/O	**400**ft	PF	"Select **NAV**"
	1000ft	PF	"Engage **AP**"
	1500ft	PF	"Select **CLB thrust**"
		PM	Check packs
	3000ft	PF	"**CLB sequence**"
		PM	v_{FS}. At v_{F0} (**v_2+15**): F0, "**Flaps 0**" (F18 T/O: v_2+10 F9, v_2+30 F0)
		PF	"**After T/O CL**"
		PM	Do CL silently; APU as required, "**After T/O CL completed**"
	Trans ALT	PM	"**Transition ALT**". ALT set and x-check
	FL100 PM		External lights, cabin signs

ENG Failure after v_1 *(loss of thrust)*		*Any*	*"**ENG ... failure**"*
		PF	*"**Check thrust**, check performance" - PM: "Thrust checked"*
		PF	*Climb at v_2 (**10° ANU**) (use **TCS**) Yaw trim until system automatically stops after 3sec (¾dot)*
	400ft	PF	*"Select **SPD v_2, HDG, BNK**" In case of **fire**: "Check recall items"*
	1000ft	PF	*"Select **ALT** hold, engage **AP**"*
	v_{F0} (v_2+15)	PF	*"**F0**" - PM: "**F0, v_{FS}**" (SE best ROC clean)*
	v_{FS}	PF	*"Select **SPD** (v_{FS}), **BNK** off, **CON** thrust, **recall items**, applicable abnormal CL, **after T/O CL**" (full bank protection if ≥ v_2+10)*

Climb		PF	Max 240kts / 300kts (above FL100) Reduce ROC (≤ 1500FPM) if cabin Δp reaches 8.1psi

Cruise		PF	CRZ thrust when reaching 300kts / M0.7

| **DESCENT** | | PF | FLC mode. Maintain 310kts with TL. FL110: Idle |
| | | PM | Windshield heating on |

| | Briefing | PF | **NAV setting**, **charts**, **SPD bugs**, **FMS**, **fuel** |
| | | | (inoperative airplane components, WX, fuel/delays, RWY condition, low VIS, terrain/MSA, descent profile, MAP, taxi in) |

SPD bugs

AEO			OEI		
$\boxed{V1}$	$\boxed{VR}$	=	$\boxed{V2}$	$\boxed{AP}$	=	$\boxed{Bug}$
v_{FS}	v_{REF}		v_{APPCLB}	v_{APP}		v_{APP}
($\approx v_{DD}$)						

$$v_{APP} = v_{REF} + \tfrac{1}{2}HWND + Gust\Delta$$

SPD increment:	F45	5 .. 15kts
	F22	5 .. 20kts
	Ice/OEI	0 .. 15kts
		(HWND ≤ 10kts incl)

OEI: F22, $v_{REF} = v_{REF45} + 10$

| | | PM | Set LDG data, pressurization |
| | | PF | "**Descent CL**" |

	FL100	PM	"**10'000**" - PF: "10'000 checked"
		PM	External lights on, cabin signs on
			"Attention crew, prepare for LDG"

| **APPROACH** | Trans LVL | PM | "**Transition LVL**". ALT set and x-check |
| | | PF | "**Approach CL**" |

3D APP	RA		Set **RA DH to 0** (CAT I) / **DH** (CAT II/III)
	Intercept HDG		**APR** mode, "**F9**", 210KIAS
		PM	"LLZ alive", "G/S alive"
	1dot G/S	PF	"**LDG gear down, F22**"
	FAP		"**Set G/A HDG and ALT**"
			"**F45, before landing CL**" (latest at 500ft/AGL)
			TL **64%** N1
	1000ft	PM	"1000" - PF: "Checked"
			CAT II/III: Check "CAT II green" / "AIII engaged"
	500ft	PF	"500" - PF: "Checked"
	OM		"OM check", ALT / MIN / G/A ALT, "OM check completed"
	100ft/MIN	PM	"Approaching minimums", "Minimums"
		PF	"Landing / G/A"

2D APP			Set **RA DH to 0**
		PM	"CDI alive" - PF: "Checked"
	0.3NM	PF	"LDG gear down, F22"
			Select **V/S 0**, **disarm ASEL** (see below)
	FAF	PM	"FAF"
		PF	"**Set G/A ALT and HDG** " for CDFA
			(else: ASEL to MDA; SOPM 3-35-10 7f)
			V/S **-700**FPM (max 1500FPM),
			(MDA = VDP = MAPt)
		PM	Call-out ALT at every NM
		PF	"Landing / G/A"
			ASEL to G/A ALT as soon as visual

Circling APP	Final		LDG **gear down**, **F22** *(as well for OEI)*
	MIN	PF	"Select **HDG** and **ALT hold**"
			Break off: **45°** for **30sec** (protected area: 4.2NM; do not break off before)
	Abm LDG thresh		TC, **20sec**, AP off, descend
	Base	PF	"**F45**, before LDG CL". Completed latest at 500ft/AFE
	G/A		Initial climbing turn towards landing RWY and overhead A/D
			Intercept published MAP for **APP** RWY
Steep APP			**Fully configured** before capturing glide
	After F45		Push **steep APP button**, "**Steep APP green**" (inhibits EGPWS warnings)
			$v_{APP} = v_{REF}$
			AP off latest at 200ft/AGL (or earlier)
	LCY		Land within first 300m (lamps), G/A otherwise
G/A		PF	"**G/A**, **F9**" (if above v_{REF}), **G/A button**, TL MAX, **10°** ANU
		PM	"**Positive rate**", check thrust (silently)
		PF	"**Gear up**"
		PM	**Select SPD $\underline{v_{FS}}$** and advice ATC
		PF	"**NAV SRC FMS, select NAV**" / "Select HDG"
	v_{FS}-**5**		"CLB sequence"
		PM	F0, CLB thrust, SPD (210 or FLC), "F0"
		PF	"After T/O CL"
	OEI G/A		*AP off, CLB with $\underline{v_{APPCLB}}$ (= v_{REF}) to **G/A ALT** (SOPM: ACC ALT)*
			*"Select **SPD, HDG, BNK**", "**ALT** hold"*
	v_{FS}-**5**		**F0**, *"Select SPD (v_{FS}), **CON** thrust, BNK off"*
	CAT II		Prefer **AP off** (late G/A rotation with AP on)
BEFORE LDG	*OEI LDG*		*Anticipate yaw with rudder*
			Autopilot and XFEED must be off
			ENG failure on final: Retract to F22, re-brief speeds
	AP off		Silent item; press TCS to cancel warning
	Flare		Increase pitch by 2°..3°
			Do not apply brakes prior nose gear touchdown
			F22: If RWY wet, do not flare, positive T/D, brake early
	60kts		Min reversers
	30kts		Close reversers
AFTER LDG	Vacating		**WX radar STBY**
		LSP	"**After landing sequence**"
			LDG and STROBE LIGHTS off
		RSP	**APU**, WINDSHIELDS, **RADAR** stby, **XPDR** ATC,
			F0, **TRIM** 7, gust lock
SHUTDOWN			*Performed by LSP/RSP according areas of responsibility*
		LSP	TAXI LIGHT off
			PRK brake: Check **brake temp**
			If amber: Chocks, release PRK brake soon
			ENG BLEEDs close prior engine stop
			ENG min **1min idle** before shutdown
			RED BCN off, FSTN BELTS off
			APU bleed and packs on while APU shutdown
			APU master off when **below 5%**
LEAVING THE AIRPLANE			*Performed by LSP/RSP according areas of responsibility*
		IRS	Off
		A/C	All out except RECIRC/GASPER

3. ABBREVIATIONS

A/C	Airconditioning		EPU	Estimated Position Uncertainty
A/C	Aircraft		ESU	Electronic Sequence Unit
A/D	Aerodrome		FADEC	Full Authority Digital Engine Control
A/P	Airport		FCOC	Fuel Cooled Oil Cooler
A/S	Airspeed		FD	Flight Director
ACL	Abnormal Checklist		FDC	Flight Data Computer
ACOC	Air Cooled Oil Cooler		FDR	Flight Data Recorder
ACT	Altitude Compensation Tilt		FFD	First Flight of the Day
ADC	Air Data Computer		FGS	Flight Guidance System
ADS	Air Data System		FLC	Flight Level Change
AFE	Above Field Elevation		FLP	Filed Flight Plan
AFM	Airplane Flight Manual		FMS	Flight Management System
AGL	Above Ground Level		FPM	Feet Per Minute
ALC	APU Line Contactor		FPMU	Fuel Pump and Metering Unit
AND	Attitude Nose Down		G/A	Go-Around
ANU	Attitude Nose Up		GCU	Generator Control Unit
AOM	Airplane Operations Manual		GLC	Generator Line Contactor
AP	Autopilot		GMT	Greenwich Mean Time
APP	Approach		GPC	Ground Power Contactor
APU	Auxiliary Power Unit		GPU	Ground Power Unit
AR	Authorization Required		GPWS	Ground Proximity Warning System
ASC	APU Starting Contactor		HGS	Head-up Guidance System
ASD	Accelerate-Stop Distance		HIL	Hold Item List
ATS	Air Turbine Starter		HSCU	Horizontal Stabilizer Control Unit
AWU	Aural Warning Unit		IC	Integrated Computer
BBC	Backup Battery Contactor		ICU	Integrated Communication Unit
BBR	Backup Bus Relay		ICU	Intercommunication Control Unit
BC	Battery Contactor		INU	Integrated Navigation Unit
BCU	Brake Control Unit		ISIS	Integrated Standby Instrument System
BHI	By-Heart Item (Memory Item)		L/U	Line-Up
BIT	Built-In Test		LGEU	Landing Gear Electronic Unit
BTC	Bus Tie Contactor		LH	Lefthand
C/S	Callsign		LPU	Low Pressure Unit
CAS	Calibrated Airspeed		LRN	Long Range Navigation
CB	Circuit Breaker		LSP	Left Seat Pilot
CDFA	Continuous Descent Final Approach		LVP	Low Visibility Procedures
CGO	Cargo		LVTO	Low Visibility Take-Off (< 550m)
CL	Checklist		MC	Master Caution
CMC	Central Maintenance Computer		MCDU	Multifunction Control Display Unit (FMS)
CPAM	Cabin Pressure Acquisition Module		MDA	Minimum Descent Altitude
CRS	Course		MFD	Multi-Function Display
CVG	Compressor Variable Geometry		MIC	Microphone
CVR	Cockpit Voice Recorder		MUH	Minimum Use Height
DA	Decision Altitude		MW	Master Warning
DAP	Digital Audio Panel		NAP	Non-Annunciated Procedures
DAU	Data Acquisition Unit		NAV	Navigation
DB	Database		OEI	One Engine Inoperative
DMA	Daily Meal Allowance		OVHD	Overhead
DU	Display Unit		PAX	Passenger
EAD	Emergency / Abnormal Procedures		PBE	Protective Breathing Equipment
EBC	Essential Bus Contactor		PBN	Performance Based Navigation
ECL	Emergency Checklist		PCU	Power Control Unit
EDL	Electrical Distribution Logic		PF	Pilot Flying
EDS	Electrical Distribution System		PFD	Primary Flight Display
EFIS	Electronic Flight Instrument System		PLI	Pitch Limit Indicator
EGPWS	Enhanced Ground Proximity Warning System		PM	Pilot Monitoring
EIC	Essential Interconnection Contactor		PMA	Permanent Magnet Alternator
EICAS	Engine Indication and Crew Alerting System		POB	Persons On Board
ELT	Emergency Locator Transmitter		PSU	Passenger Service Unit

QRH	Quick Reference Handbook
RA	Radio Altimeter
RA	Resolution Advisory
RAIM	Receiver Autonomous Integrity Monitor
RCT	Rain Echo Attenuation Compensation
RH	Righthand
RMU	Radio Management Unit
RNP	Required Navigation Performance
RSP	Right Seat Pilot
RTF	Radiotelephony
SBC	Shed Bus Contactor
SCV	Starter Control Valve
SOPM	Standard Operating Procedures Manual
SOV	Shut-Off Valve
SPC	Stall Protection Computer
SPD	Speed
SPS	Stall Protection System
SSFDR	Solid-State Flight Data Recorder
TA	Traffic Advisory
TBCH	Tuning Backup Control Head
TCAS	Traffic Collision Avoidance System
TCS	Touch Control Steering
TL	Thrust Lever
TOC	Table Of Contents
TUC	Time of Useful Consciousness
UFN	Until Further Notice
ULB	Underwater Locator Beacon
V/S	Vertical Speed
VTA	Vertical Track Alert
VV	Vertical Visibility
W/S	Windshear
WED	Water Equivalent Depth
WOW	Weight On Wheels
WPT	Waypoint
WX	Weather
XPDR	Transponder