Highlights of the Airbus A220 from a Pilot's Perspective

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Abstract

The Airbus A220 is one of the most modern passenger transport aircraft in the sky. The first flight in 2013 revealed the result of 26 years of development in comparison to the well-known Airbus A320. What has changed? What has been improved? The lecture takes the audience on a typical journey in the A220 formerly known as Bombardier CSeries 100/300 from a pilot's perspective. Throughout the various stages of a flight from preparation, take-off, climb and cruise until approach and landing a wide range of highlights and advantages of this aircraft are presented. Aspects such as Avionics / Flight Deck layout, Handling, Performance, Cabin, Engines and operational experience are covered. The single aisle Airbus A220 is a success already and the number of operators using it is growing. For passengers it provides a spacious cabin and for pilots a modern flight deck layout and efficient aircraft to operate. The presentation shows the differences between the new Airbus A220 to the better-known Airbus A320 family.

Table of Contents

Brief History

- Airbus A220 formerly Bombardier CSeries launched on July, 13th 2008
- Maiden flight of CS100 (A220-100) on September, 16th 2013
- Maiden flight of CS300 (A220-300) on February, 27th 2015
- July 2018 Airbus acquired a majority stake in the program and CSeries was rebranded as A220
- Currently 914 orders and 329 deliveries
- Major operators in Europe are AirBaltic and Swiss Airlines

Compare with Airbus A320:

- A320 launched March, 2nd 1984
- Maiden flight February, 22nd 1987

From Bombardier to Airbus

Two of the operators are:

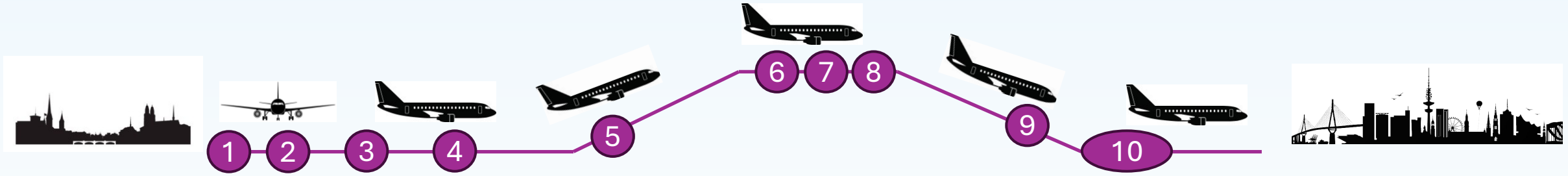
SWISS

airBaltic

Comparison of Aircraft Parameters

	A319 neo	A220-300	Difference
Seats	150	150	0%
Range	6850 km / 3700 NM	6297 km / 3400 NM	- 8.1%
MMO	0.82	0.82	0%
Max ramp weight	75.9 t	71.2 t	-6.2%
Max take-off weight	75.5 t	70.9 t	-6.1%
Max landing weight	63.9 t	61.0 t	-4.5%
Max zero fuel weight	60.3 t	58.0 t	-3.8%
Max fuel capacity	26 730 l	21 508 l	-19.5%

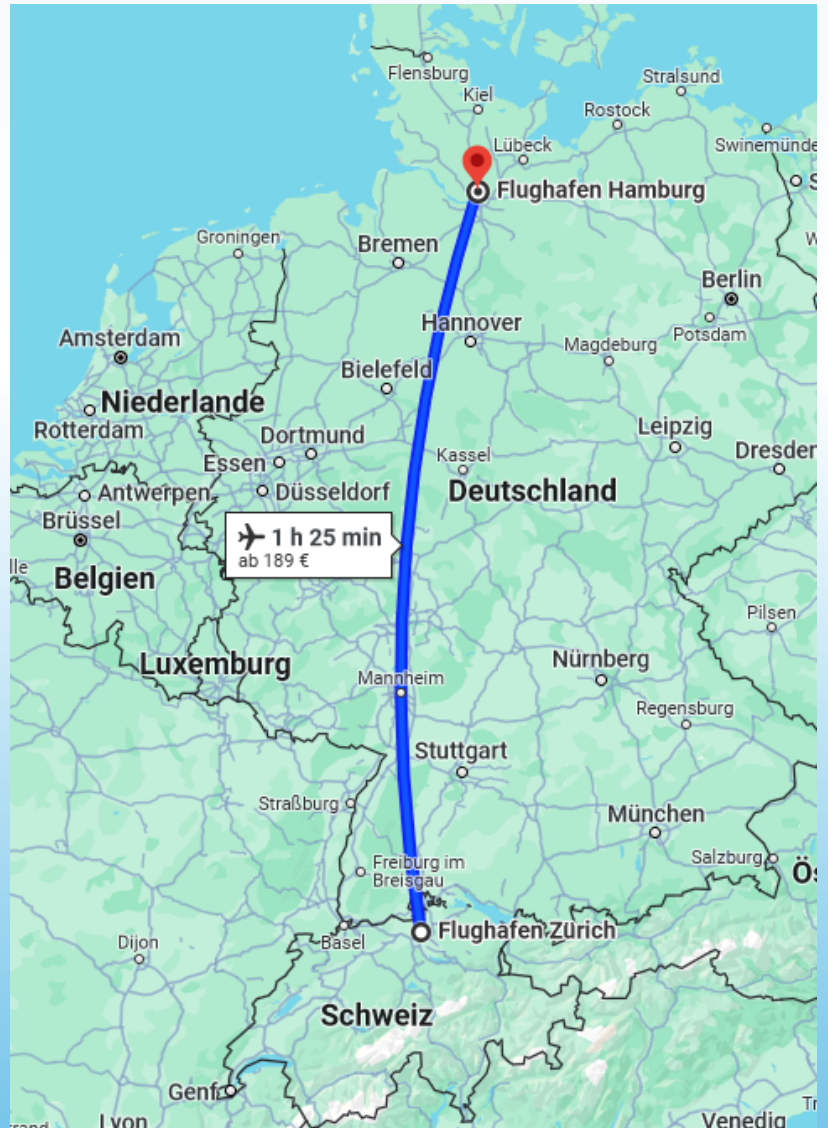
A220-300 weight variant offered in March 2021

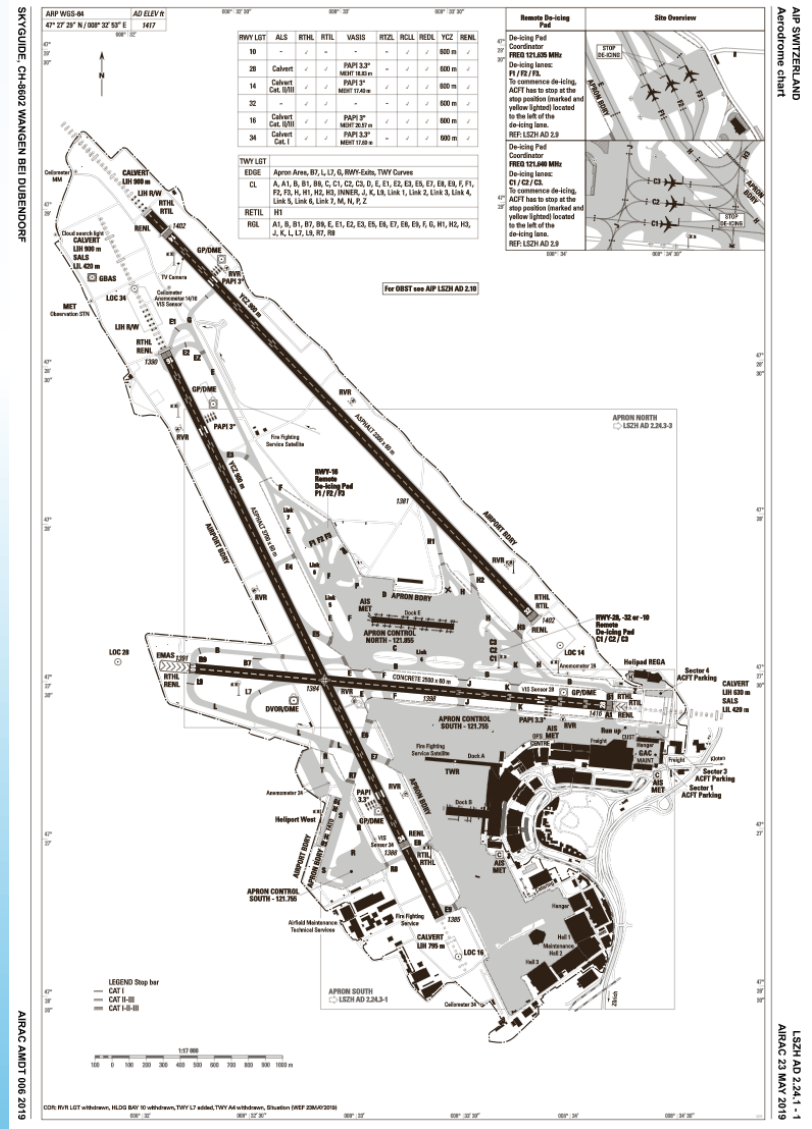


Presentation of the Airbus A220 on a Flight from Zürich to Hamburg

Zürich Airport (IATA: ZRH, ICAO: LSZH) is the largest international airport of Switzerland and the principal hub of Swiss International Air Lines. It serves Zürich, Switzerland's largest city, and, with its surface transport links, much of the rest of the country. The airport is located 13 km north of central Zürich, in the municipalities of Kloten.

Hamburg Airport (IATA: HAM, ICAO: EDDH), known in German as Flughafen Hamburg. Since November 2016 the airport has been named after the former German chancellor Helmut Schmidt. It is located 8.5 km north of the city center in the Fuhlsbüttel quarter and serves as a hub for Eurowings and focus city for Condor. It was formerly named Hamburg-Fuhlsbüttel Airport, a name still frequently used.

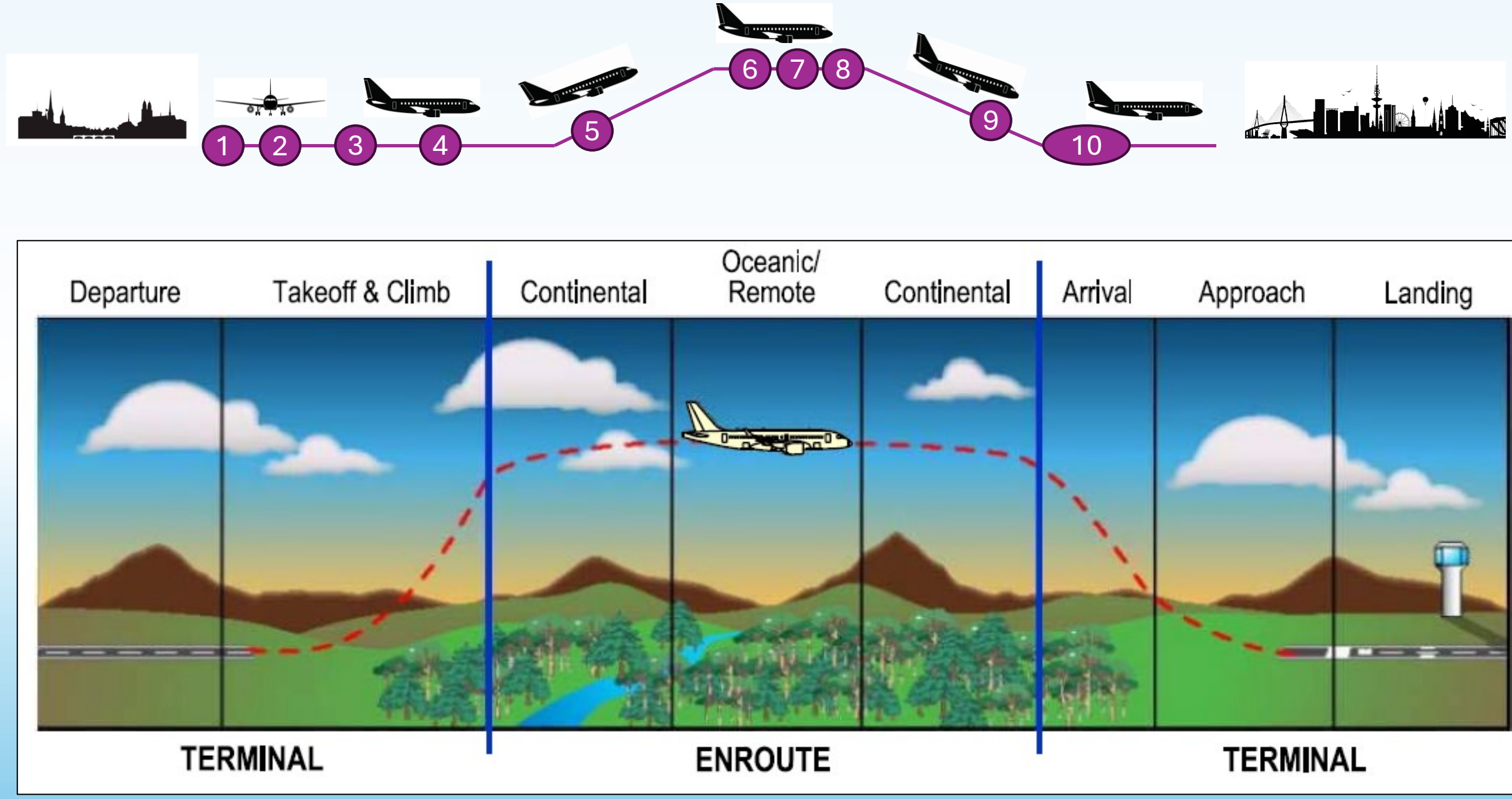




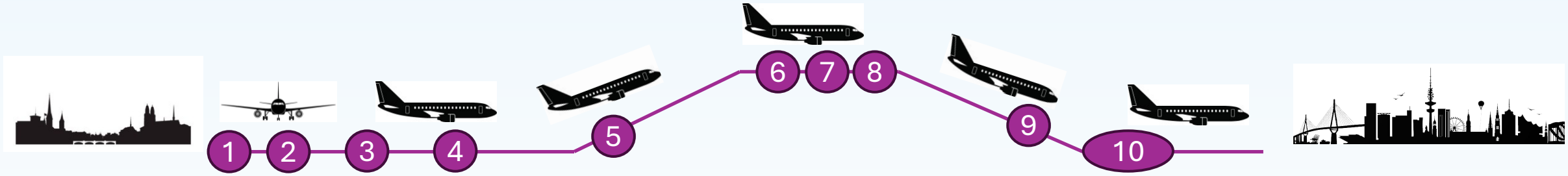
Flughafen Zürich

SFO Jens Rücker

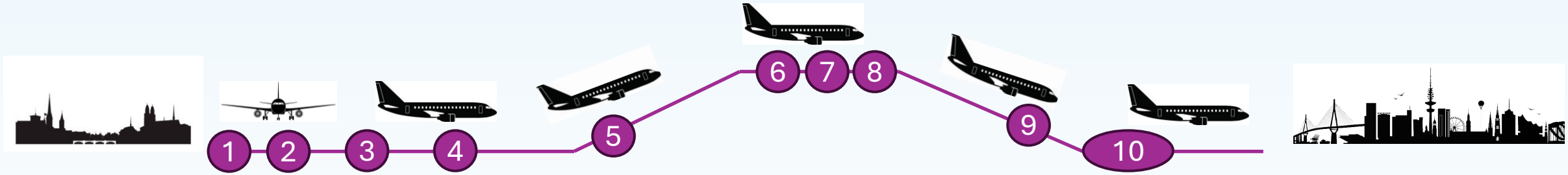
https://opennav.com/airport/LSZH



Bombardier, 2019: CS300 Flight Crew Operating Manual (FCOM) – Volume 1. Available from: https://perma.cc/54Y5-U77Q



Flight Phase	Highlight	ATA Chapter	Comment
(1) Flight Preparation	Fuel consumption		
(2) Cockpit Preparation	Cockpit layout	22 Auto Flight 23 Communications 27 Flight Controls	Screens, Trackball, etc
(3) Engine Start	Engines	72 Engine	PW1100G
(4) Taxi	Navigation	34 Navigation	Ground charts
(5) Take-Off	Thrust levers	76 Engine Controls	Movable thrust levers
(6) Cruise	Cruising Alt & EDM & Cabin		
(9) Approach	GPS, RNAV & RNP	34 Navigation	
(10) Landing	FPV	34 Navigation	



(1) Flight Preparation – Fuel Decision

(2) Cockpit Preparation – Modern Avionic

(3) Engine Start – Geared Turbofans / Thrust Lever

(4) Taxi – Detailed Ground Charts on big screens

(5) Take-Off – Video

(6) Cruise – High Cruise Level / Low Cabin Altitude

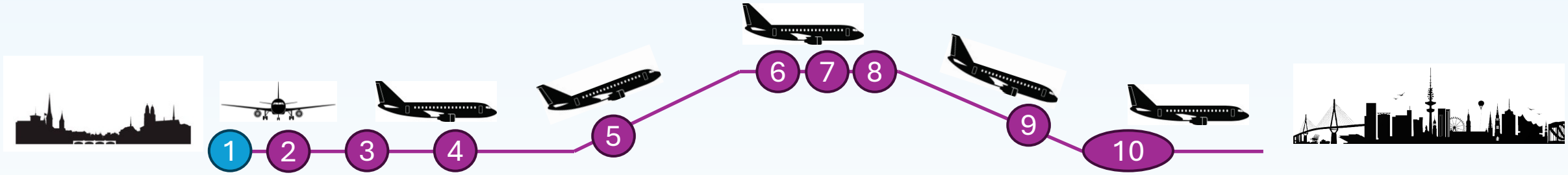
(7) Cruise – Cabin Layout

(8) Cruise – Emergency Descent Mode (EDM)

(9) Approach – Designed for GPS/RNAV/RNP

(10) Landing – Flight Path Vector (FPV), Video

airBaltic



(1) Flight Preparation – Fuel Decision

Pre-flight Preparation

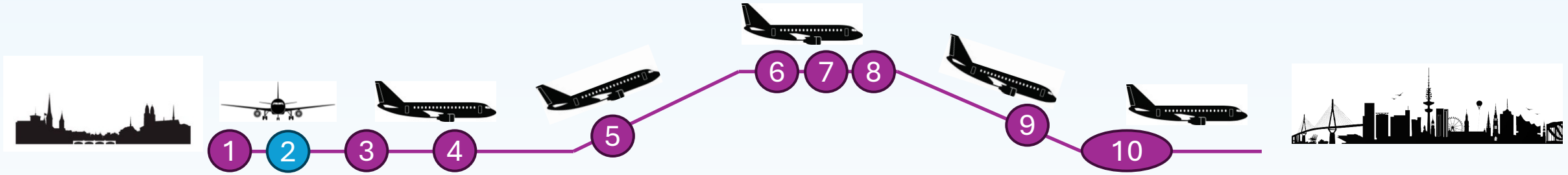
- Weather Forecast
- Fuel - Flight Planning
- Flight Plan (FPL)
- Cabin Crew Briefing
- Cockpit Preparation
- Flight Crew Pre-Flight External Check

*in kg	A320 ceo	A220-300
Trip Fuel	2670	2140
Contingency Fuel	190	120
Alternate Fuel (HAJ)	1250	1000
Final Reserve	1120	790
Taxi Fuel	150	100
Block Fuel	**5380**	**4150**

Old versus new and large versus small. This is not a fair comparison. Just for illustration.

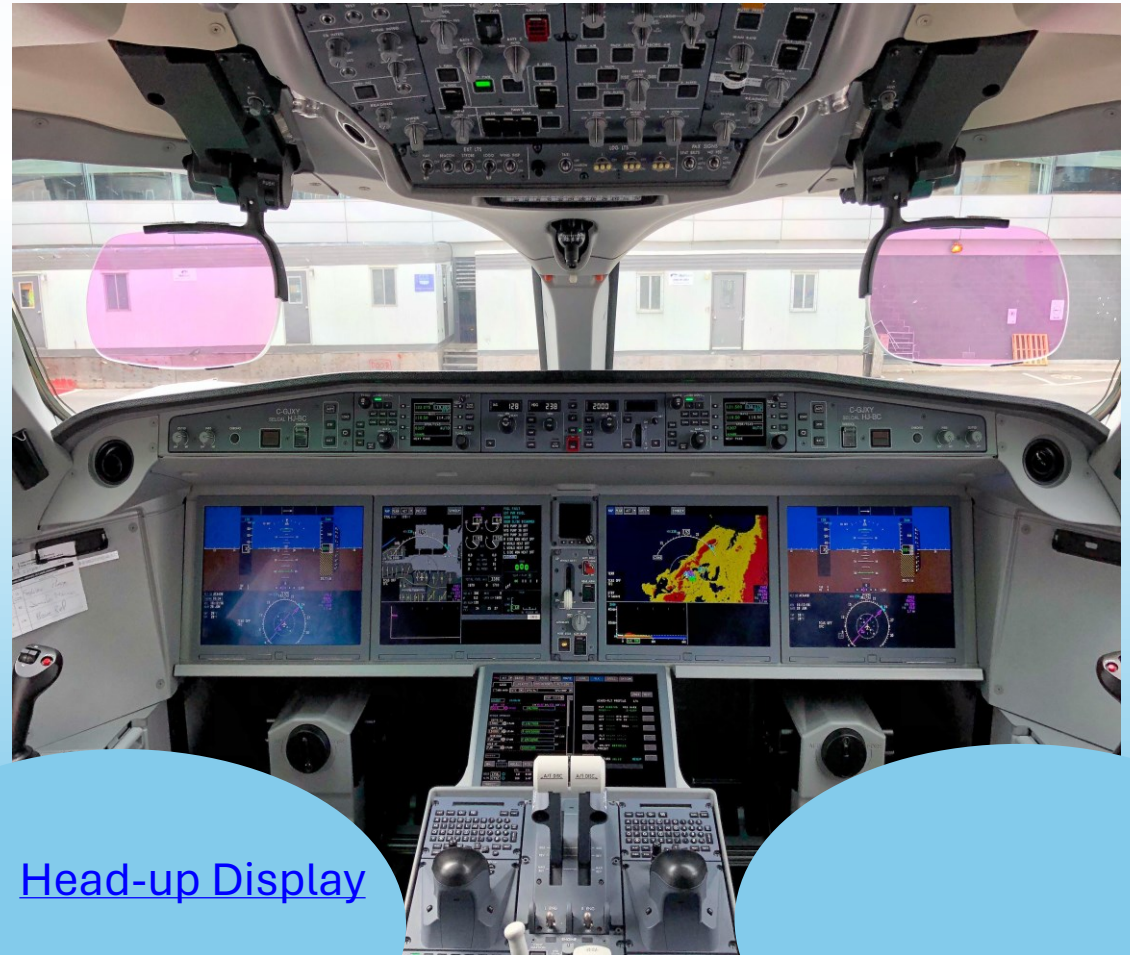
A220-300 => 150 seats => 3,4 l/km (**12.8% less fuel than A319neo**)

A319 => 150 seats => 3,9 l/km neo, 4,3 l/km ceo (neo 9.3% less fuel)
A320 => 180 seats => 4,2 l/km neo, 4,4 l/km ceo (neo 4.5% less fuel)



(2) Cockpit Preparation – Modern Avionic

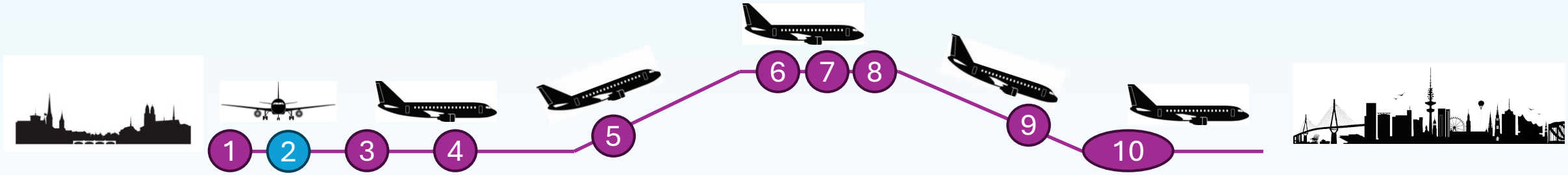
A220



A320

[Head-up Display]

ATA 31: Instruments
ATA 46: Information Systems
A220: EICAS – Engine Indication and Crew Alerting System
A230: ECAM – Electronic Centralized Aircraft Monitoring



(2) Cockpit Preparation – Modern Avionic

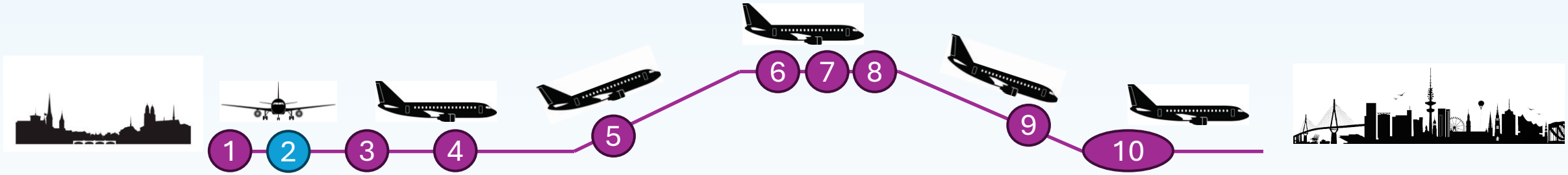
Displays can be freely configured.
In this case:

Left:
Taxi guidance, apron (MAP)
Engine and Warning Display

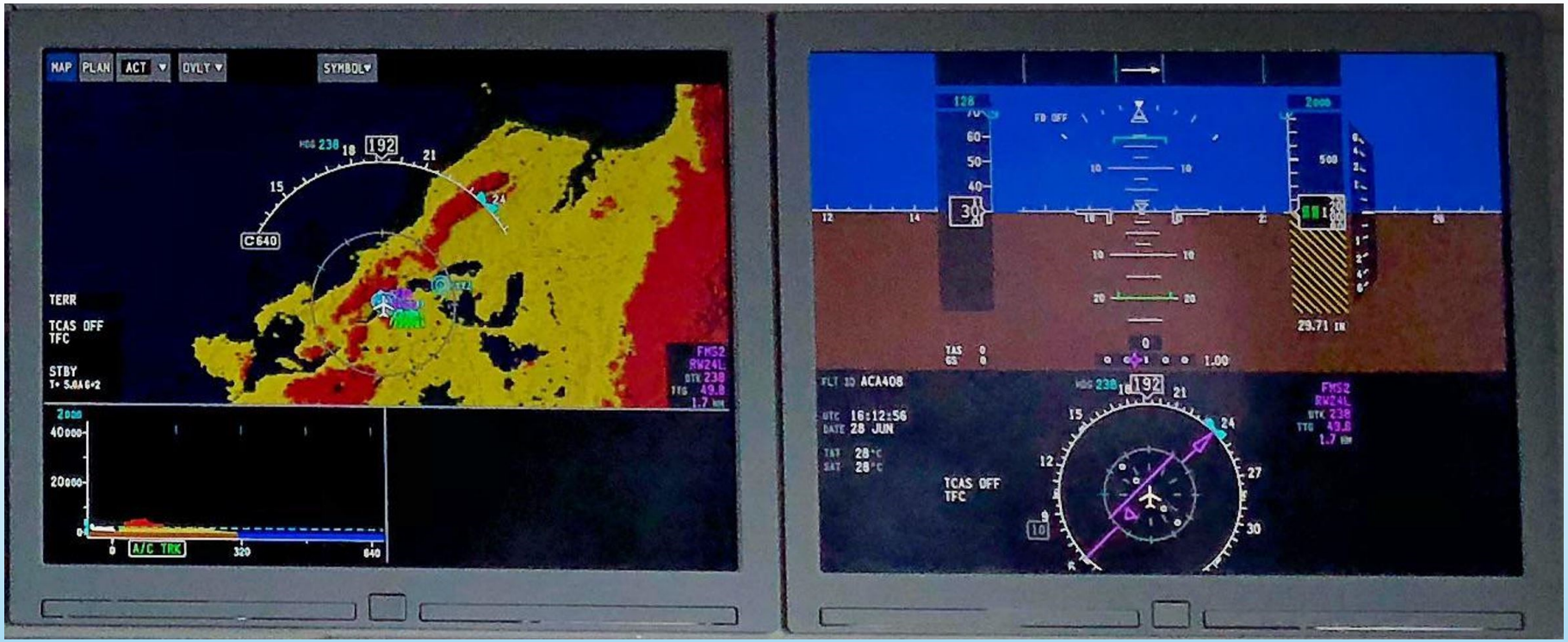
Right:
Navigation Display (ND)

Bottom:
FMS display

Evaluation compared to A320:
FMS
bigger screen
FLP with upload function via ACARS (VHF)



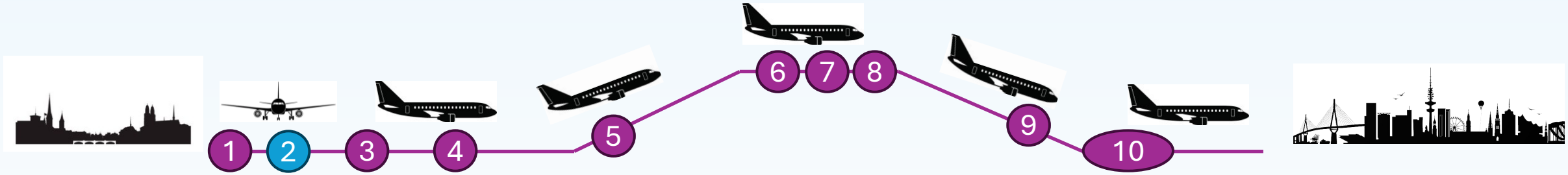
(2) Cockpit Preparation – Modern Avionic



Navigation Display (ND) with vertical profile

Primary Flight Display (PFD)

Evaluation compared to A320:
PFD: much bigger, better situational awareness
ND: More information



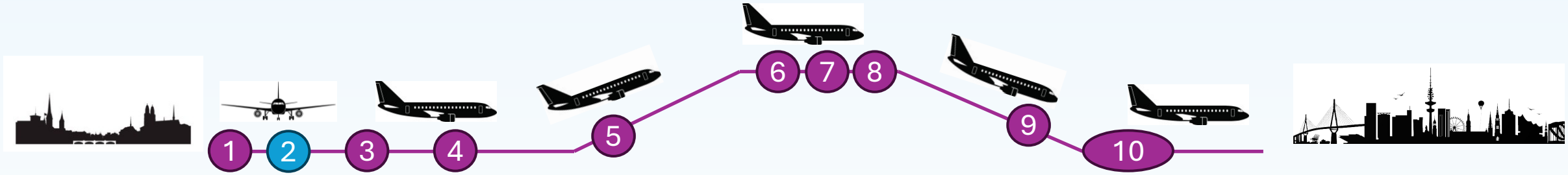
(2) Cockpit Preparation – Modern Avionic

Displays can be freely configured.
In this case:

Left:
System Display (ELEC)
Engine and Warning Display

Right:
Check List
System Display (FLT CTRL)

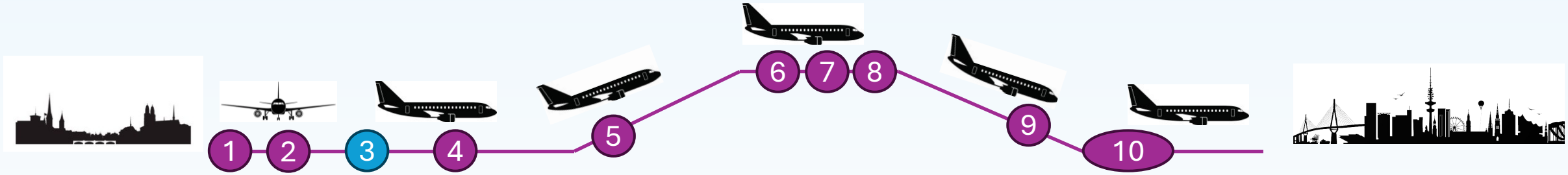
Bottom:
Flight Plan (ROUTE)
Performance (PERF)



(2) Cockpit Preparation – Modern Avionic

Top, left:
Flight Plan (ROUTE)

Bottom:
Control with **trackball** (like A350),
pointing also on map display – very handy.

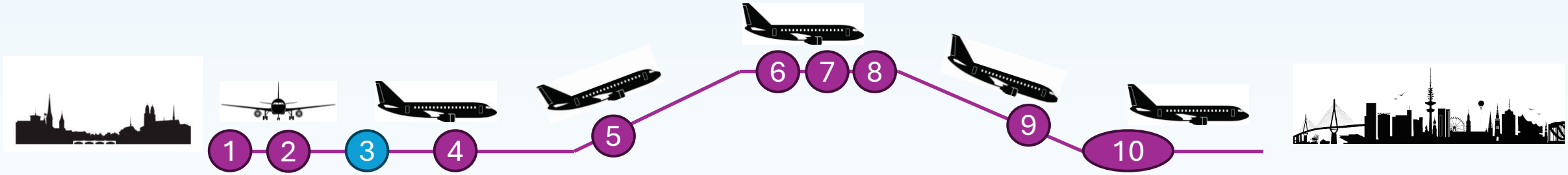


(3) Engine Start – Geared Turbofans

Pratt & Whitney PW1500G geared turbofan (GTF).

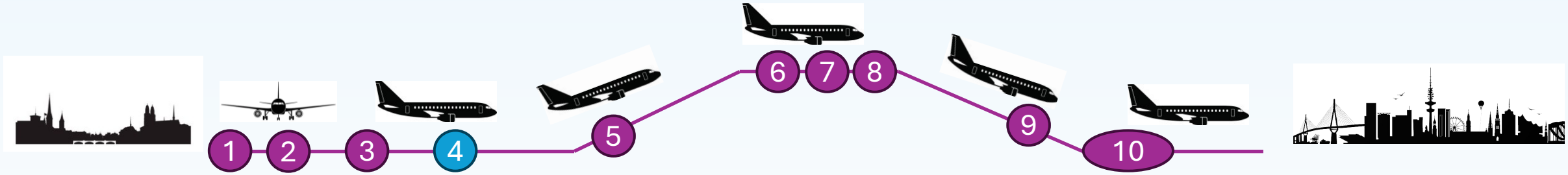
A220:
PW1500G with
high bypass ratio (BPR) of 12.0
low specific fuel consumption (SFC)

A319neo:
even higher bypass ratio of
PW1100G with BPR: 12.5

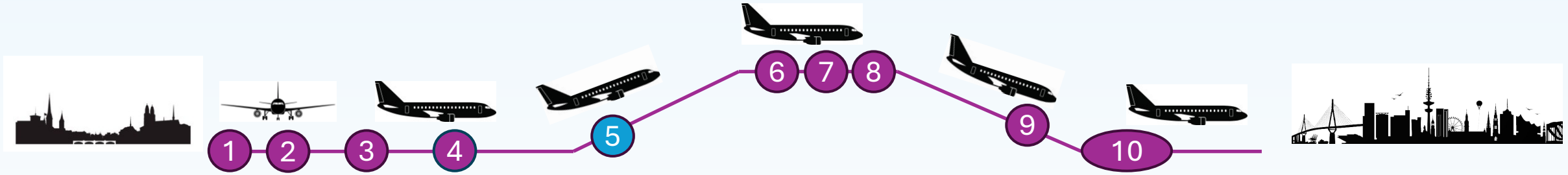


(3) Engine Start – Trust Lever

Moving thrust levers.
Better feedback to pilots than on A320.
A320: Thrust levers are moved to detents, where they remain in this fixed position.

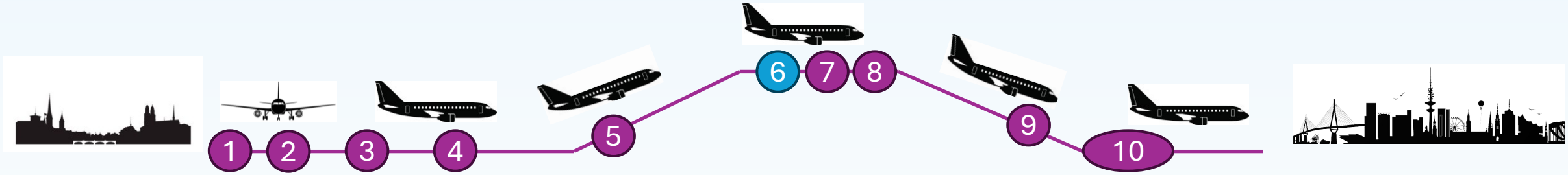


(4) Taxi – Detailed Ground Charts on big screens



(5) Take-Off – Video

Start Video:
https://youtu.be/q2iXmT2_FqY



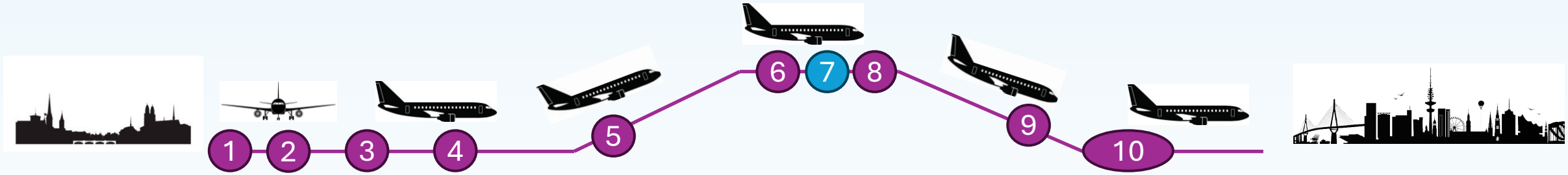
(6) Cruise – High Cruise Level / Low Cabin Altitude

	A220 - 300	A320 neo	B737 - 800
Max cruising altitude	FL410	FL395	FL410
Usual cabin altitude	less than 6.000 ft	6.000 ft - 8.000 ft	6.000 ft - 8.000 ft
Cabin relative humidity	humidifier	no humidifier	no humidifier

A220:

6000 ft cabin altitude, despite high FL410
=> large Δp sustained by extensive use of aluminium–lithium in the fuselage.

Humidifier available.



(7) Cruise – Cabin Layout

Five-abreast cabin cross section.
18.5 in wide economy seats,
19.0 in wide middle seats,
20.0 in wide aisle for fast turnarounds.

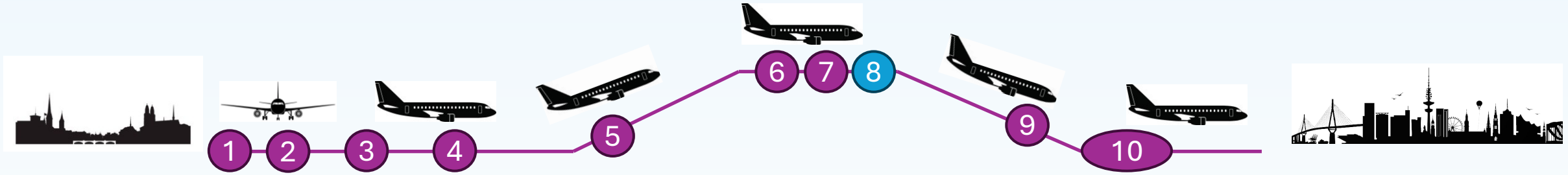
Rotating overhead bins with 70 l volume allows one carry-on bag per passenger.

Windows at every seat row with 11 in × 16 in larger than on A320.

Color LEDs with mood lighting.

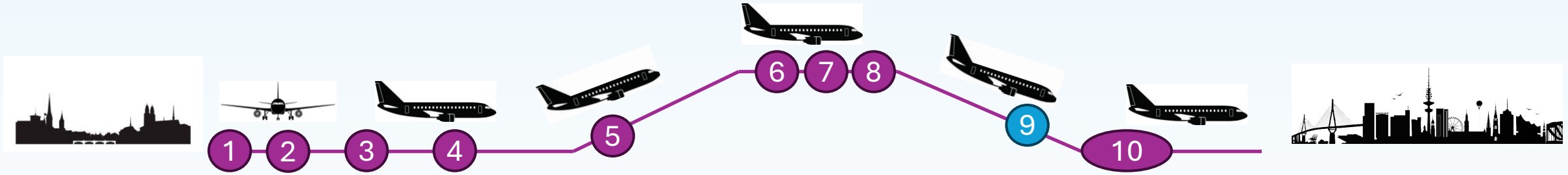
In-flight-entertainment with wireless content distribution. Overhead video display.

ATA 25: Equipment / Furnishings, ATA 44: Cabin Systems



(8) Cruise – Emergency Descent Mode (EDM)

Flight Control Unit (FCU) is the interface to the Flight Management System (FMS).
Special feature on the A220: Emergency Descent Mode (EDM):
Pilot action very easy (almost automatic in case of pilot incapacitation during rapid decompression):
1.) Mask on
2.) Press one button: EDM
3.) Add spoilers to increase descent rate
=> The aircraft descents on its own to 15000 ft



(9) Approach – Designed for GPS/RNAV/RNP

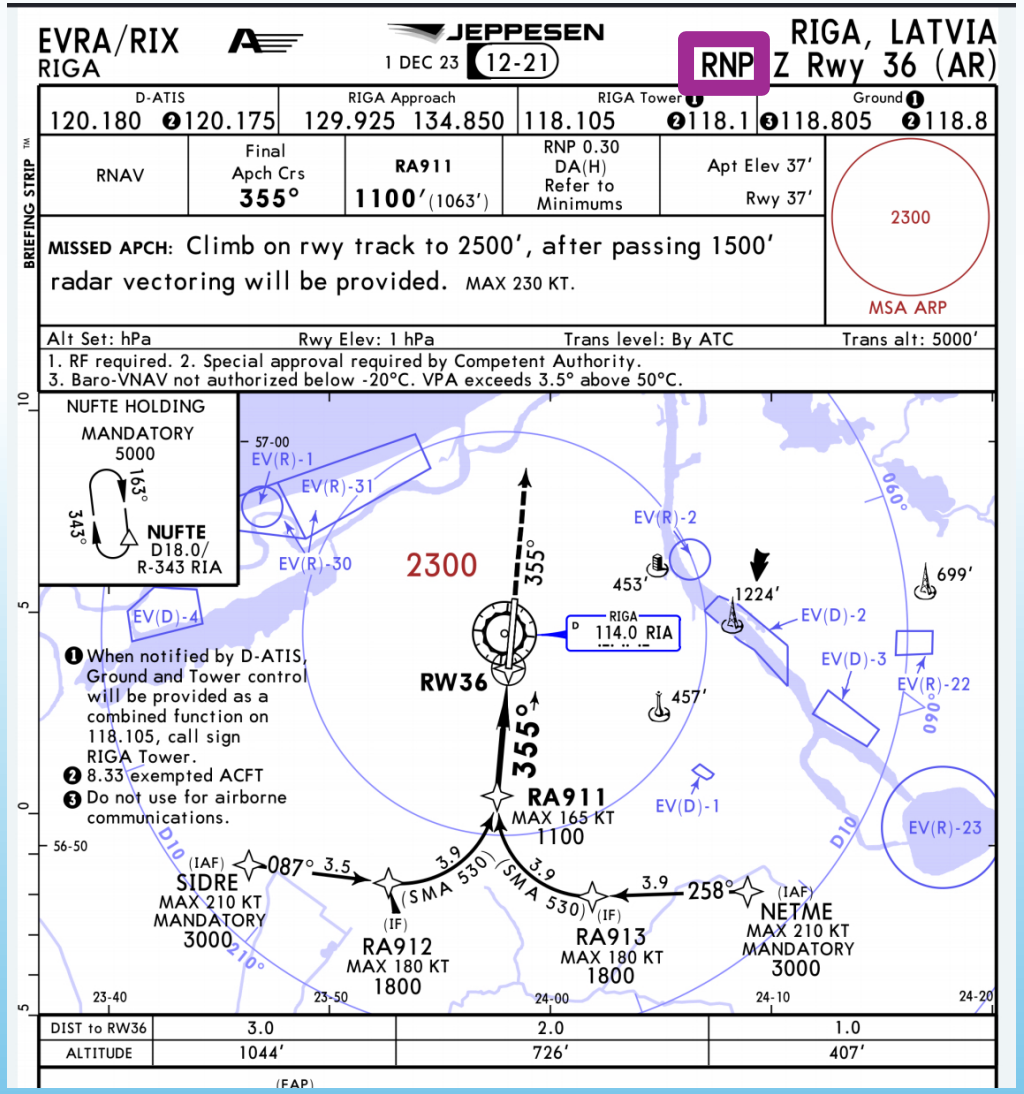
The A220 is able to fly **RNP approaches**. An RPN approach is based on GPS. It can be curved and is much shorter than the standard ILS approach. Advantages:
=> saving of flight time,
=> saving of fuel.

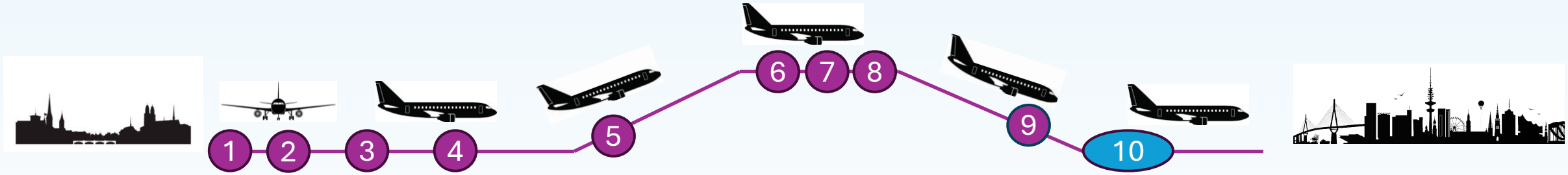
A Global Navigation Satellite System (GNSS) is a worldwide position, velocity, and time determination system, that includes a satellite constellation, receivers, and system integrity monitoring, to support the required navigation for a phase of operation (cruise, approach, ...).

The most important GNSS is the US developed Global Positioning System (GPS).

An Area Navigation System (RNAV) is a method of navigation which permits the operation of an aircraft on any desired flight path; it allows its position to be continuously determined wherever it is rather than only along tracks between individual ground navigation aids.

Required Navigation Performance (RNP) and RNAV navigation specifications are very similar. Difference: If the RNP system does not perform, an alert is provided to the flight crew.





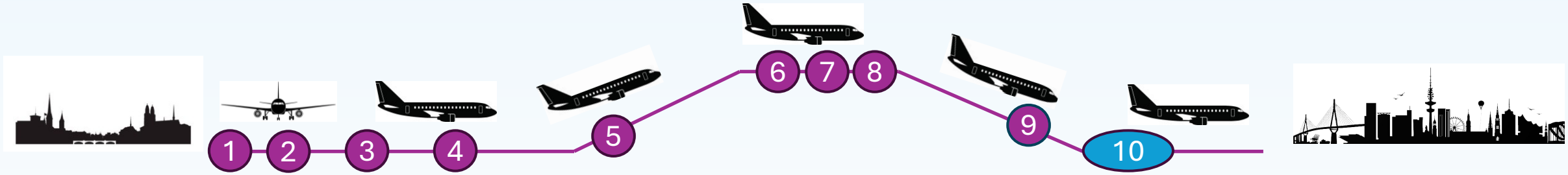
(10) Landing – Video

Handling Qualities:

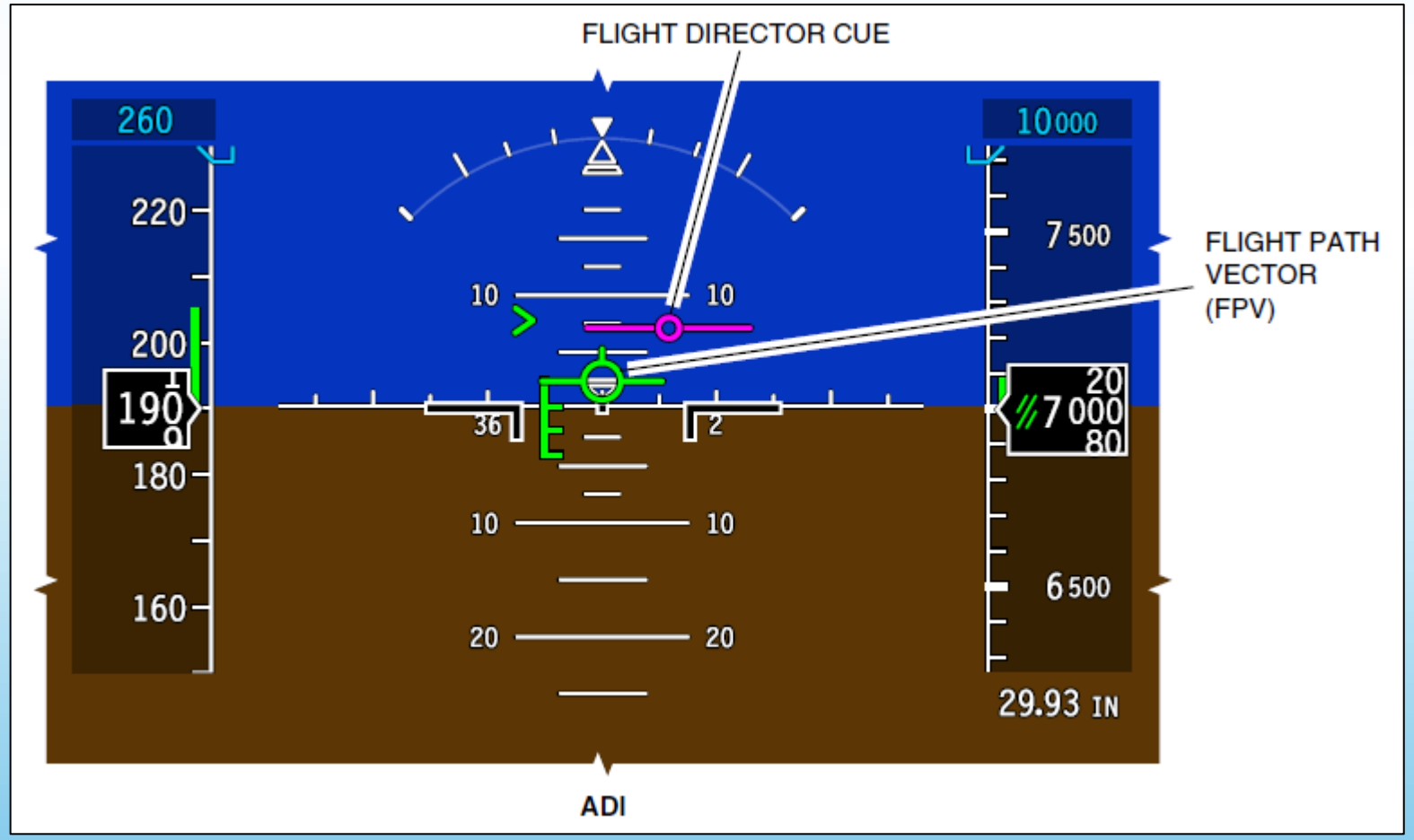
A220:
Manual trim during manual flight:
=> more conventional,
=> easier to adapt to FBW coming from conventional aircraft.

A320:
Auto trim: less workload during manual flying

Start Video:
https://youtu.be/yeb_t0HDA6w



(10) Landing – Flight Path Vector (FPV)



Handling Qualities:

Flying with **Flight Path Vector** (FPV):

The FPV materializes the instantaneous flight path angle (FPA) and track (TRK) flown by the aircraft, hence its instantaneous trajectory.

The FPV assists the pilot to fly and control stabilized segments of trajectory, particularly during final approach.

On the Airbus A220:
The aircraft must be maneuvered so that the green Flight Path Vector (FPV) is over the purple Flight Director (FD) cue.

Bombardier, 2019: CS300 Flight Crew Operating Manual (FCOM) – Volume 1. Available from: https://perma.cc/54Y5-U77Q

Thank you
and welcome back to Hamburg

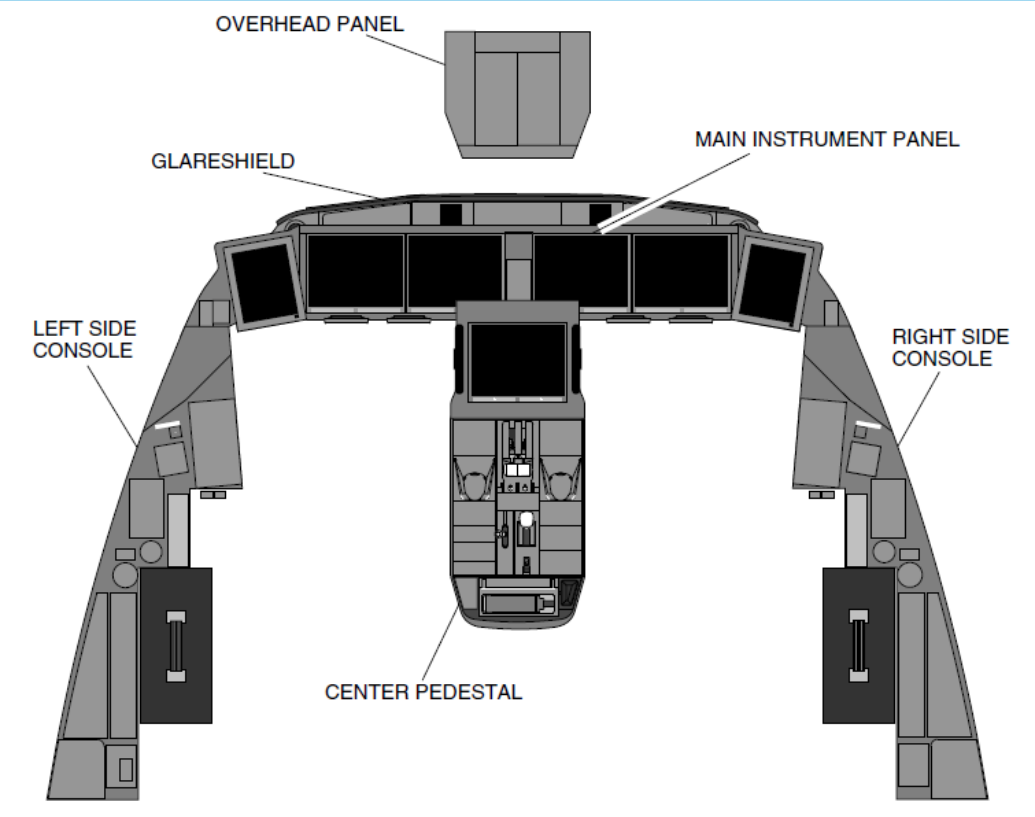
Dieter Scholz:

Visualization of the Q & A: Airbus A220 Systems

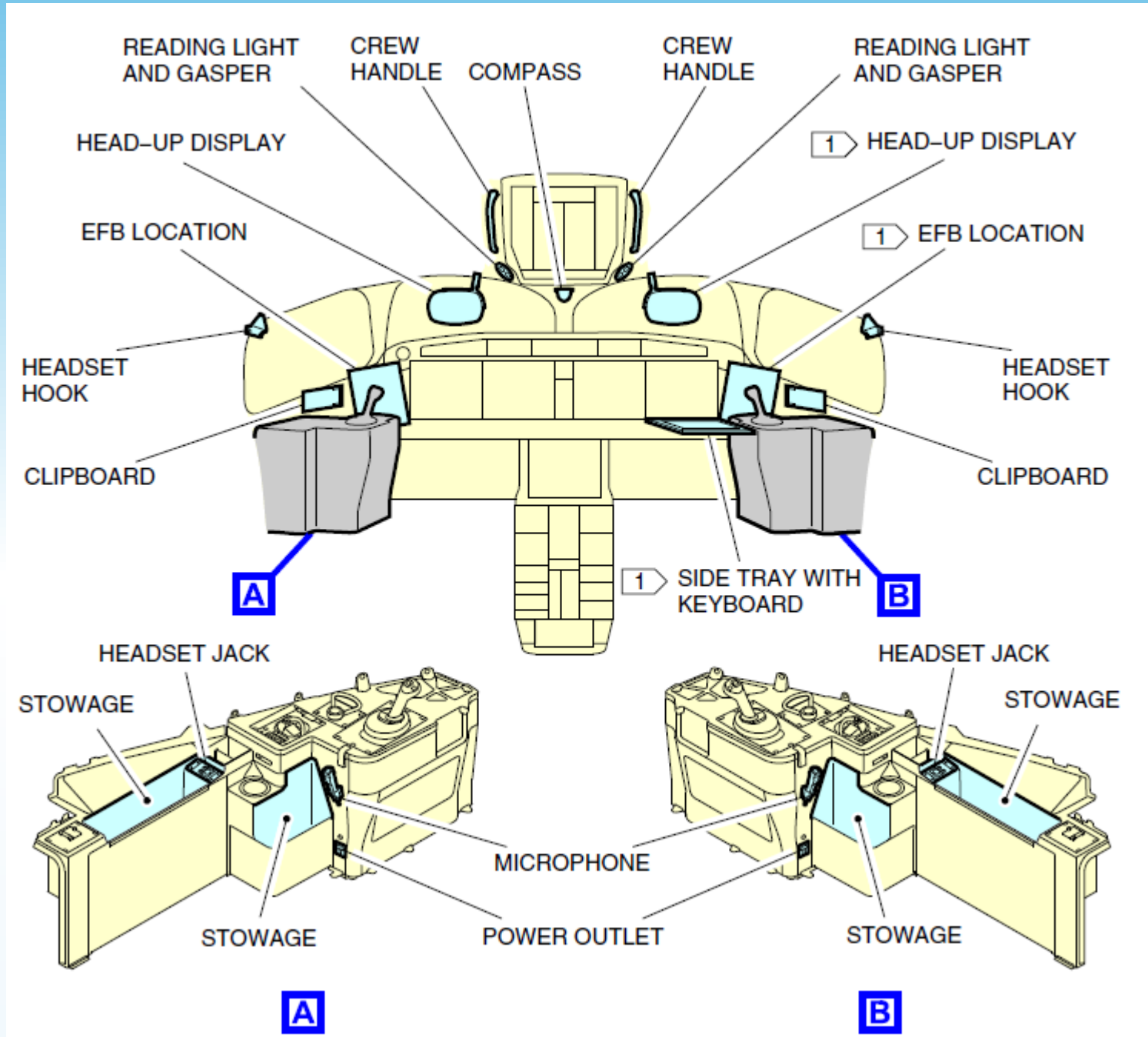
- Flight Compartment (ATA 31: Instruments)
- Cabin (ATA 25: Equipment / Furnishings)
- ATA 21: Air Conditioning
- ATA 22: Auto Flight
- ATA 23: Communication
- ATA 24: Electric Power
- ATA 52: Doors (Cabin)
- ATA 27: Flight Controls
- ATA 28: Fuel
- ATA 29: Hydraulic Power
- ATA 30: Ice and Rain Protection
- ATA 32: Landing Gear
- ATA 33: Lights
- ATA 34: Navigation
- ATA 35: Oxygen
- ATA 38: Water / Waste
- Electronic Checklist (ECL)

Source: Bombardier, 2019: CS300 Flight Crew Operating Manual (FCOM) – Volume 1. Available from: https://perma.cc/54Y5-U77Q

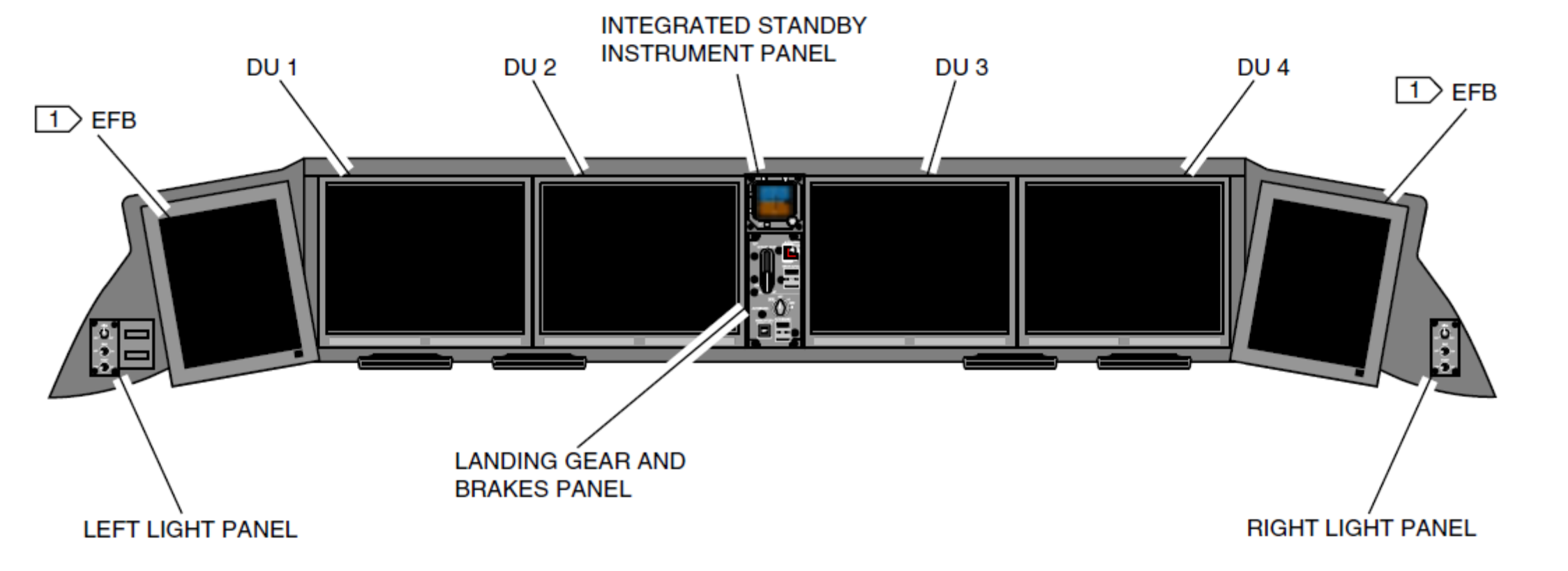
Flight Compartment



Flight deck control panel overview

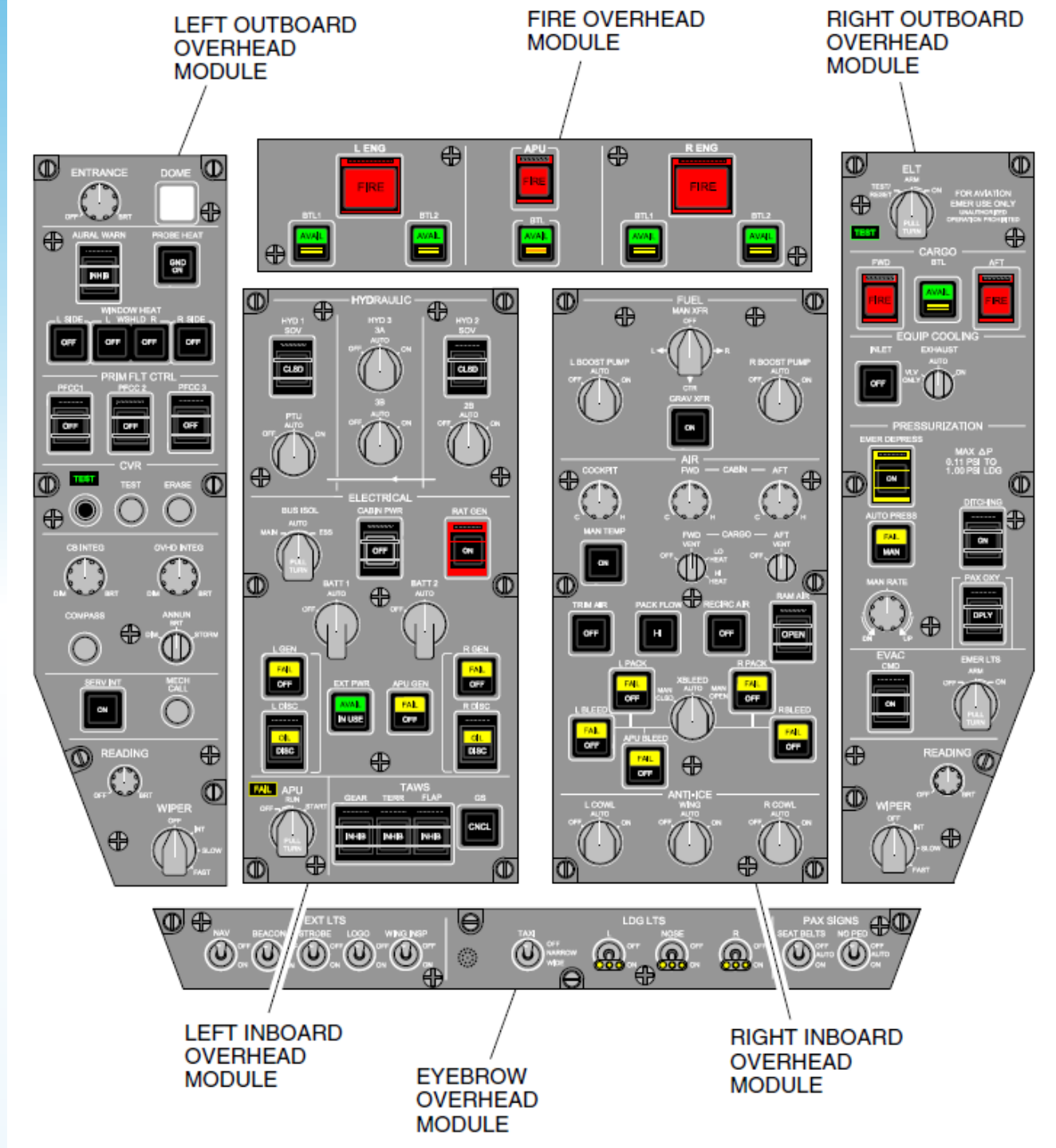


ATA 31: Instruments

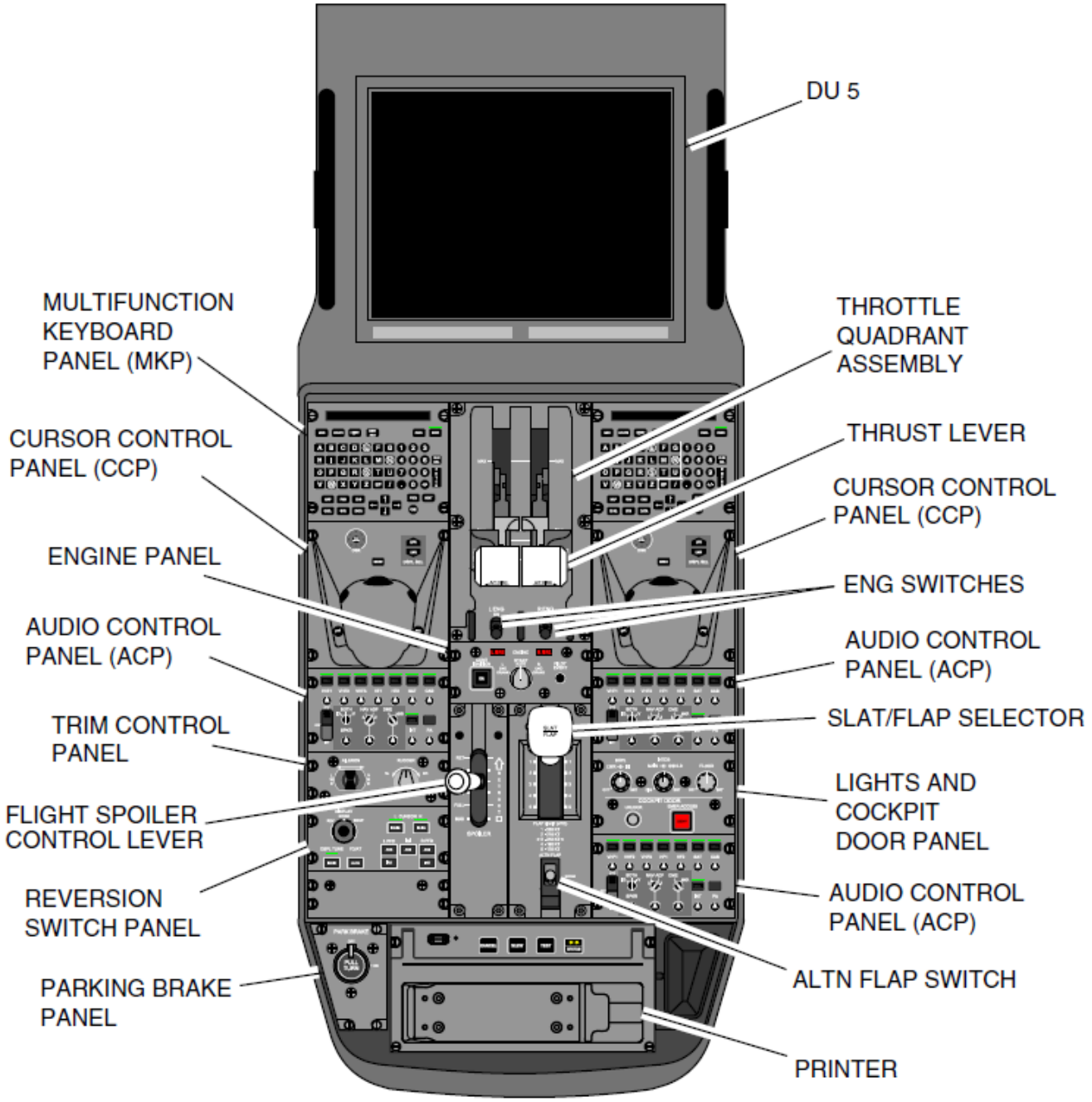


Main instrument panel

ATA 31: Instruments



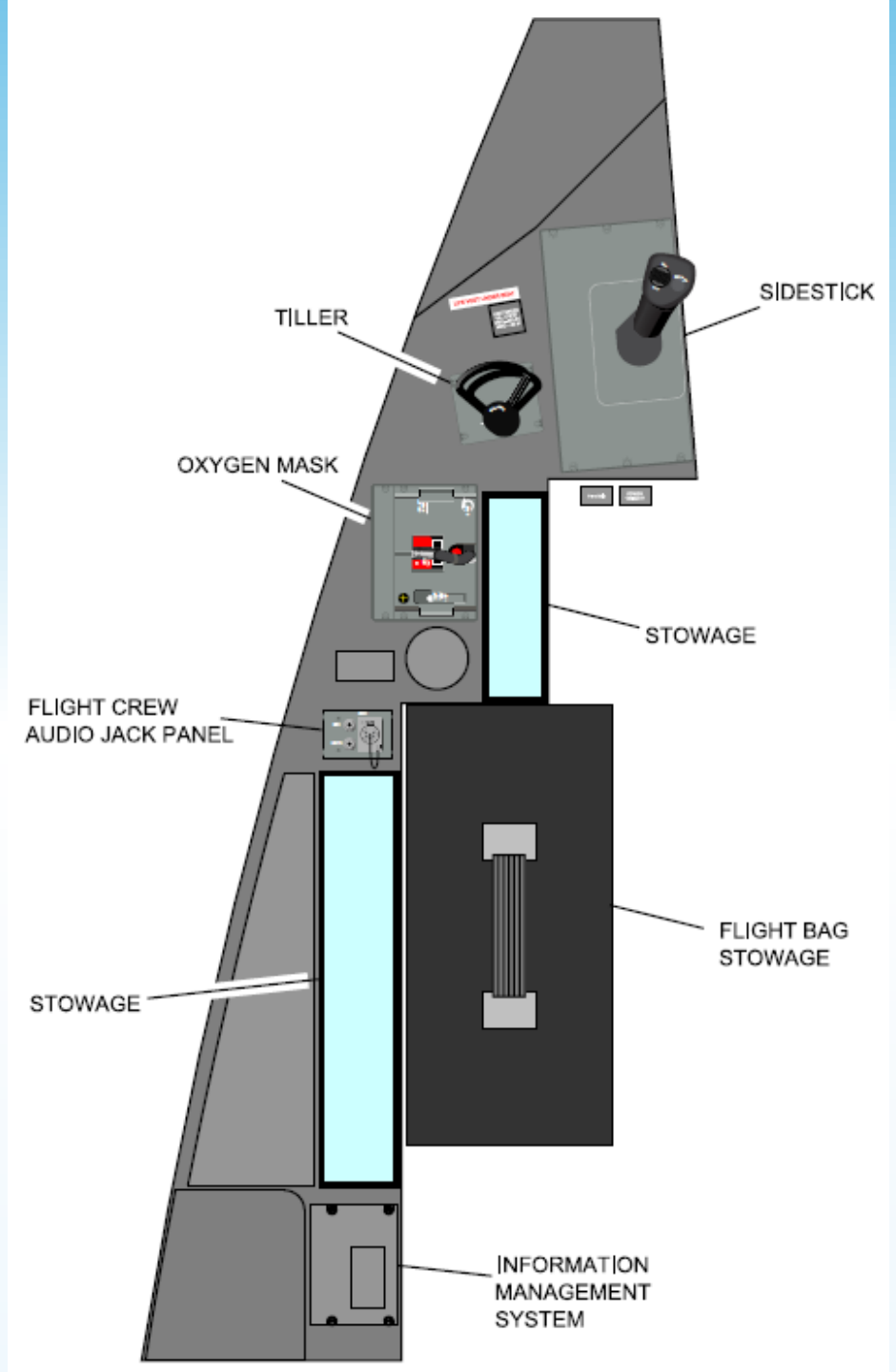
ATA 31: Instruments



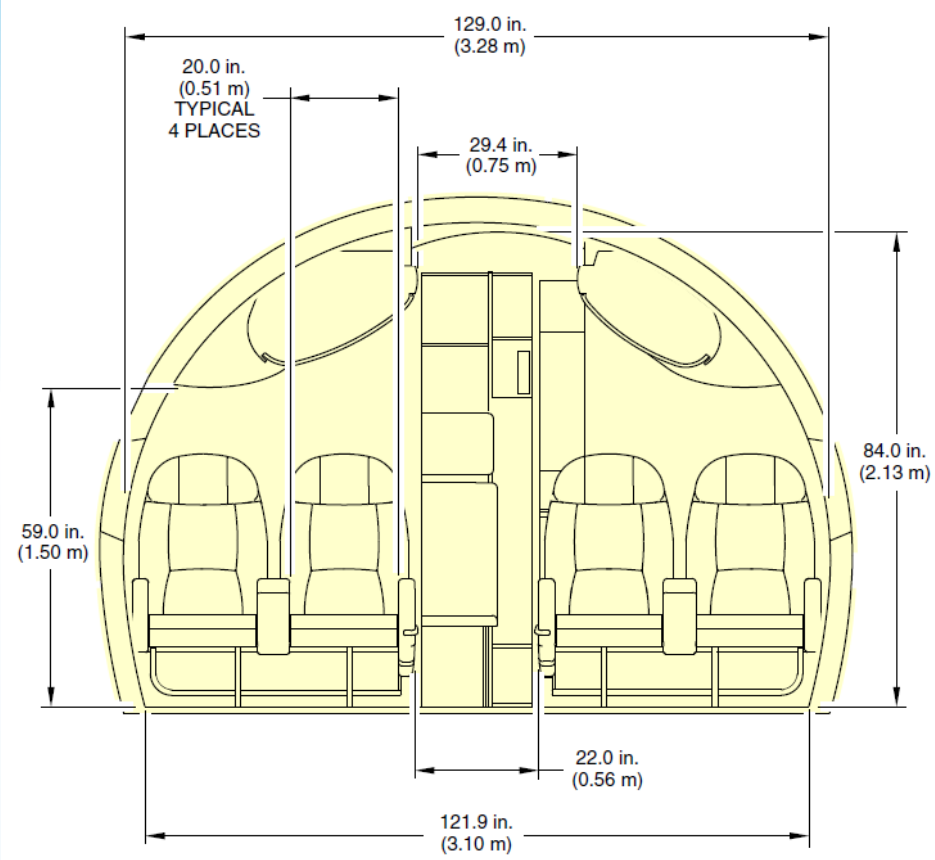
Center pedestal

ATA 31: Instruments

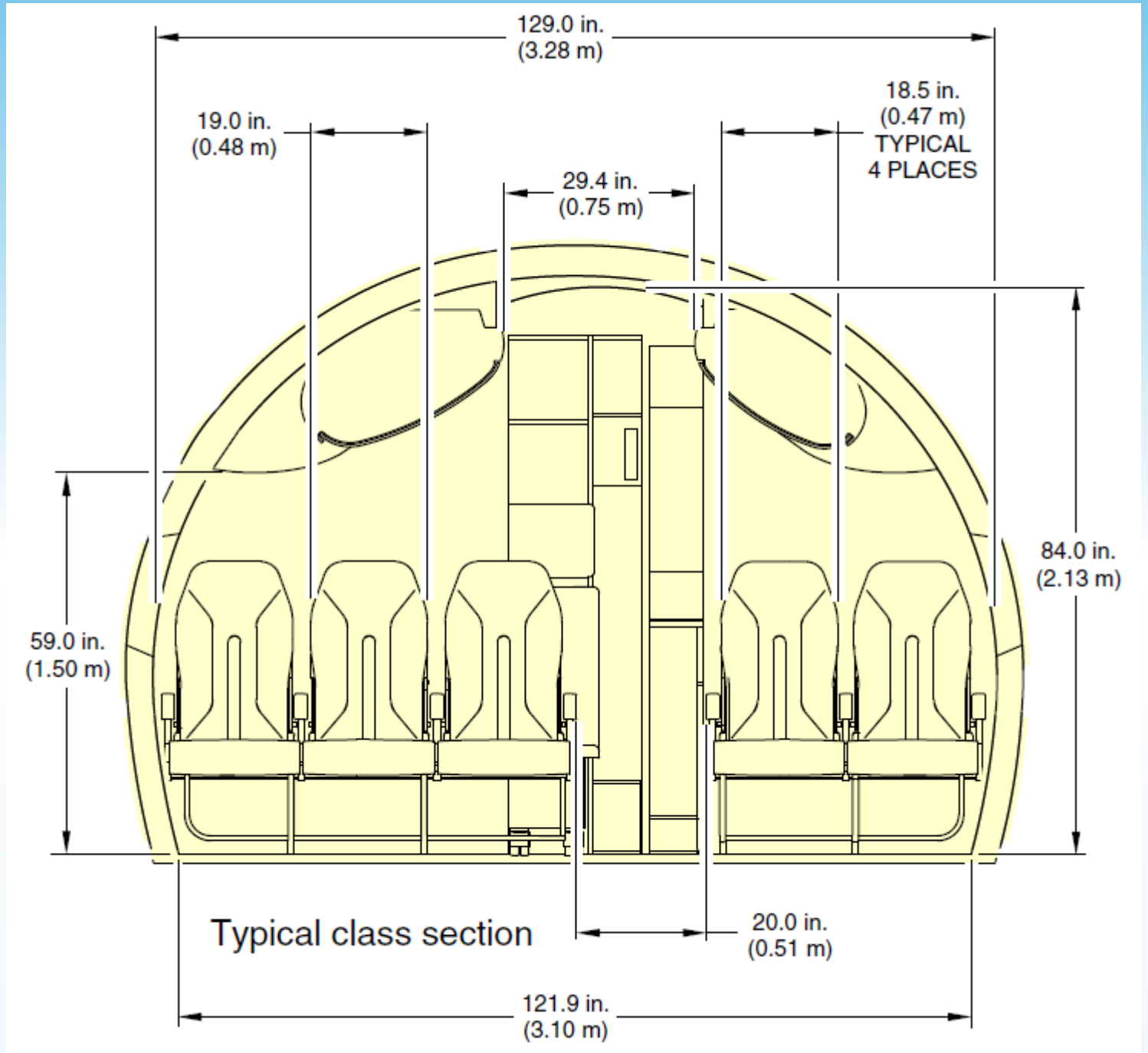
Side console



ATA 25: Equipment / Furnishings (Cabin)



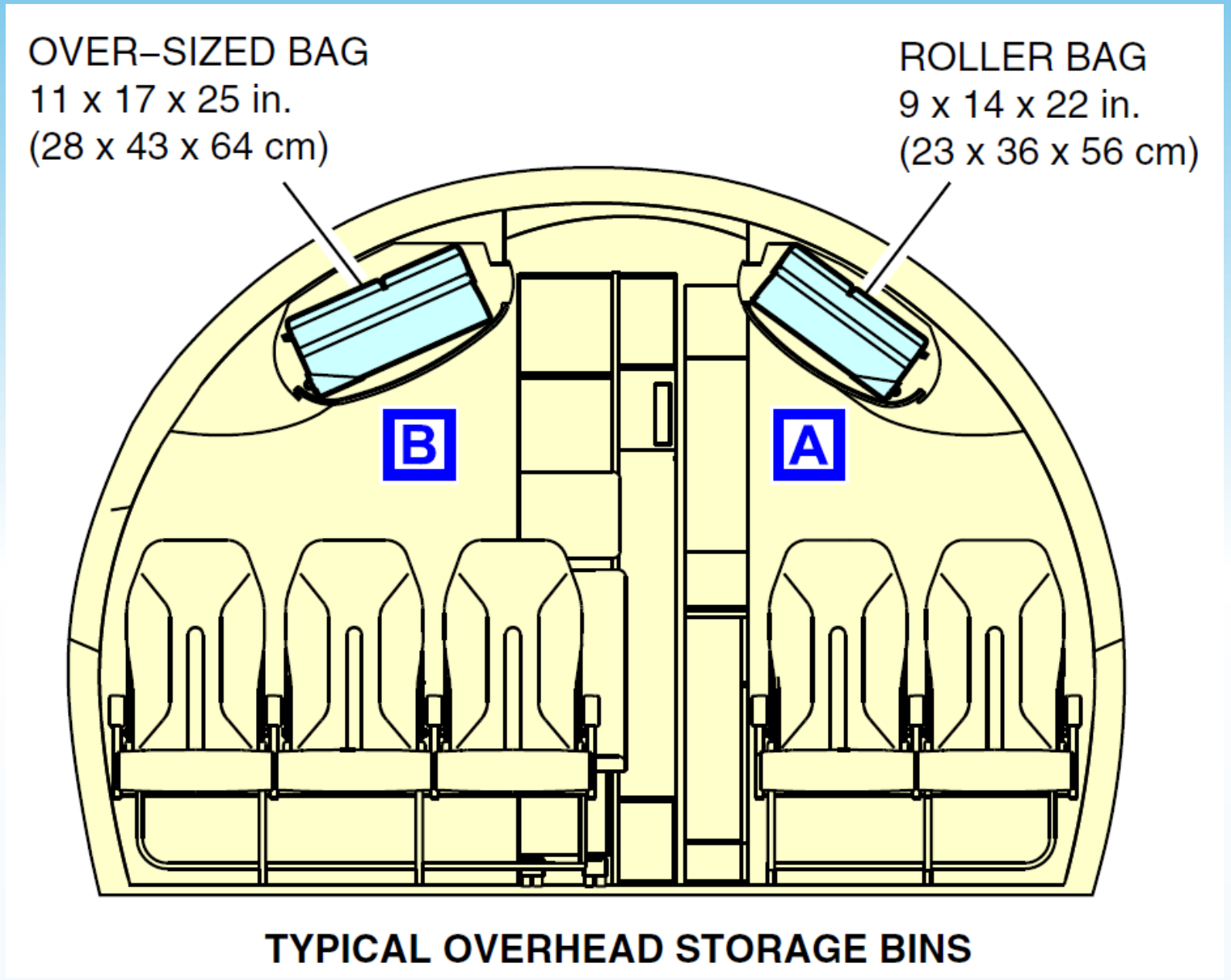
Business class section (optional)



ATA 25: Equipment / Furnishings (Cabin)

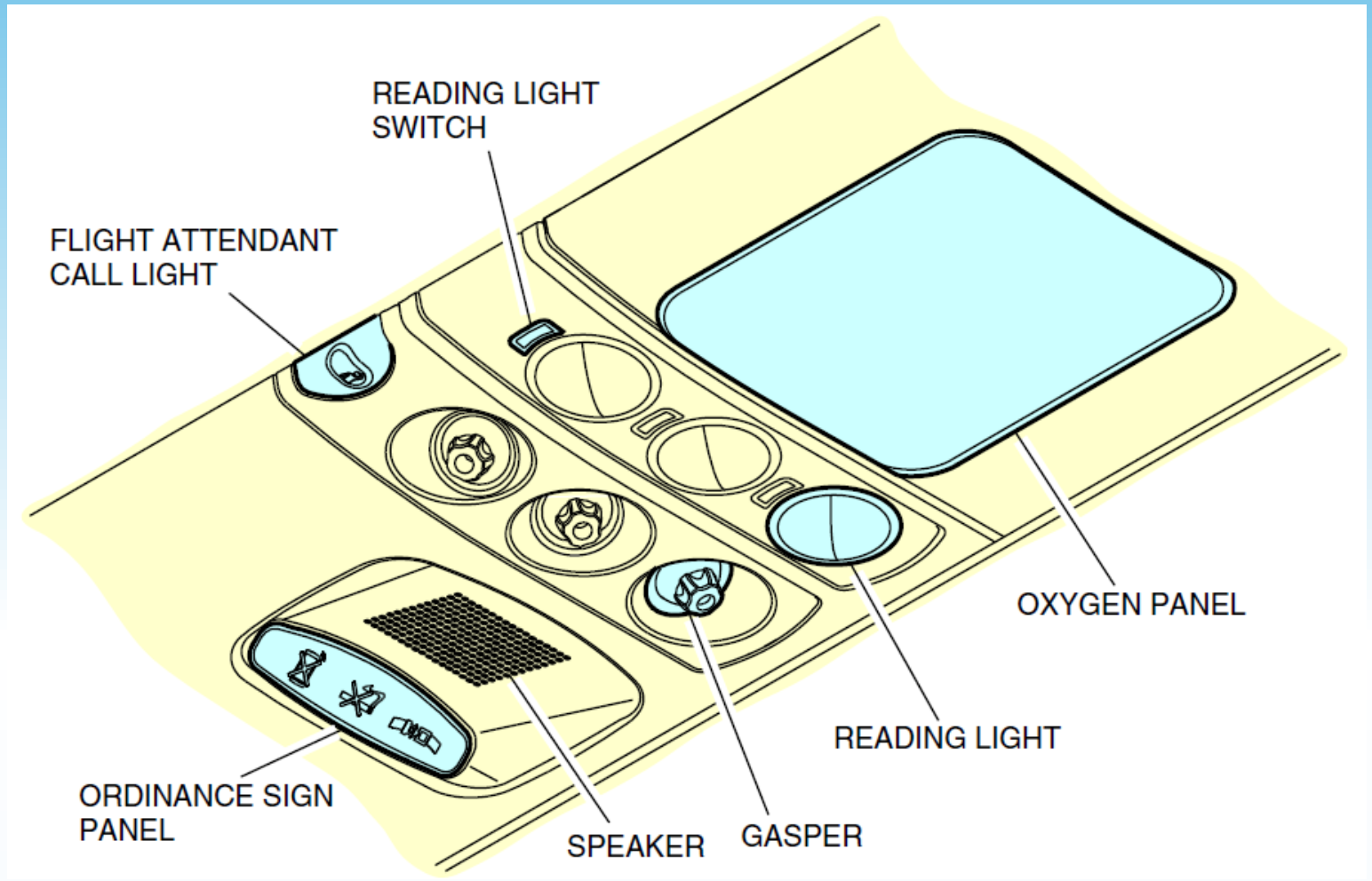
A

B



TYPICAL OVERHEAD STORAGE BINS

ATA 25: Equipment / Furnishings (Cabin)



Passenger Service Unit (PSU)

ATA 21: Air Conditioning

INTEGRATED AIR MANAGEMENT SYSTEMS (IAMS) – OVERVIEW

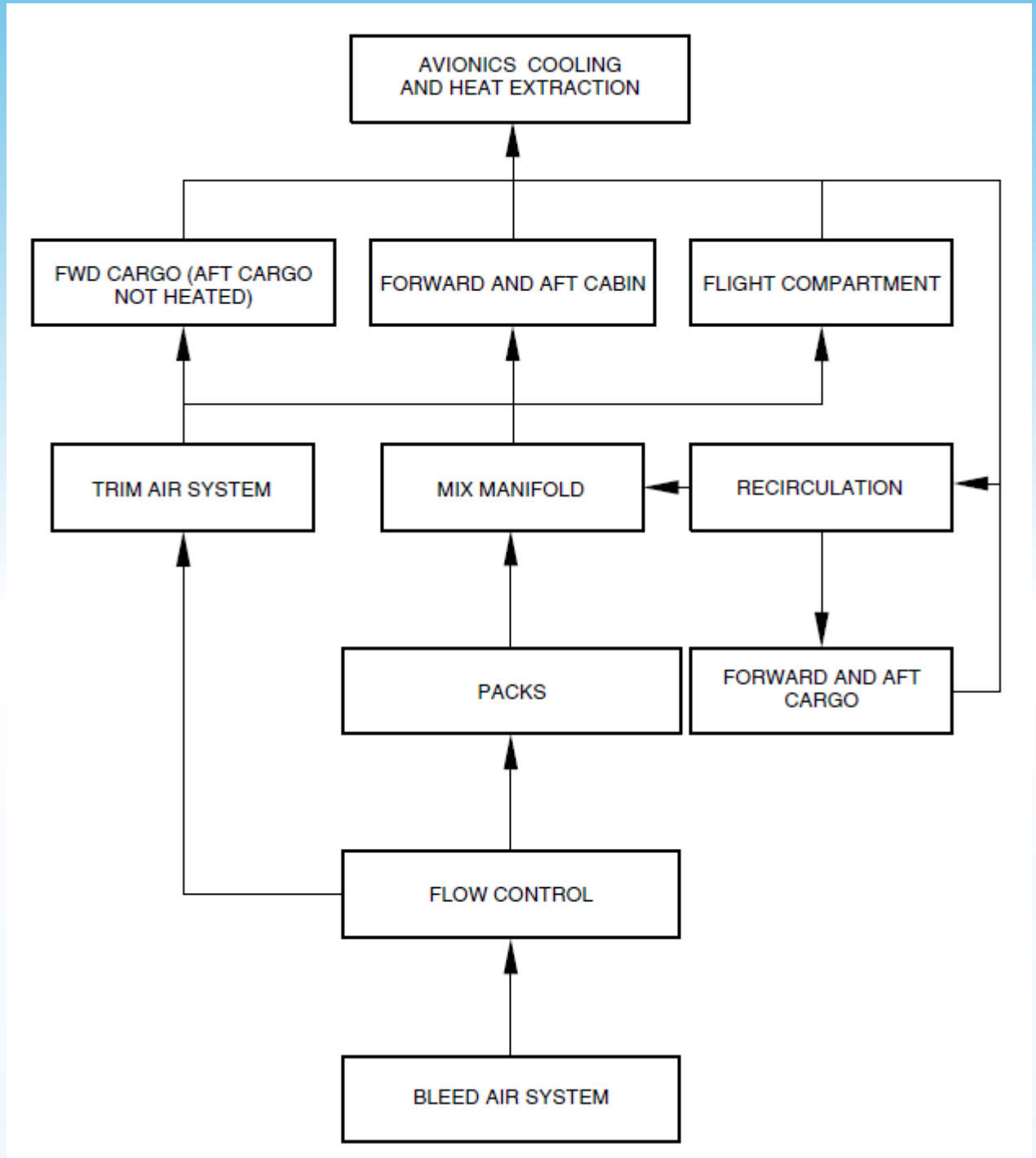
The aircraft has an Integrated Air Management System (IAMS). It consists of:

- Bleed air system,
- Bleed Air Leak and Overheat Detection System (BALODS),
- Air-conditioning system,
- Avionics cooling and heat extraction system, and
- Pressurization system,

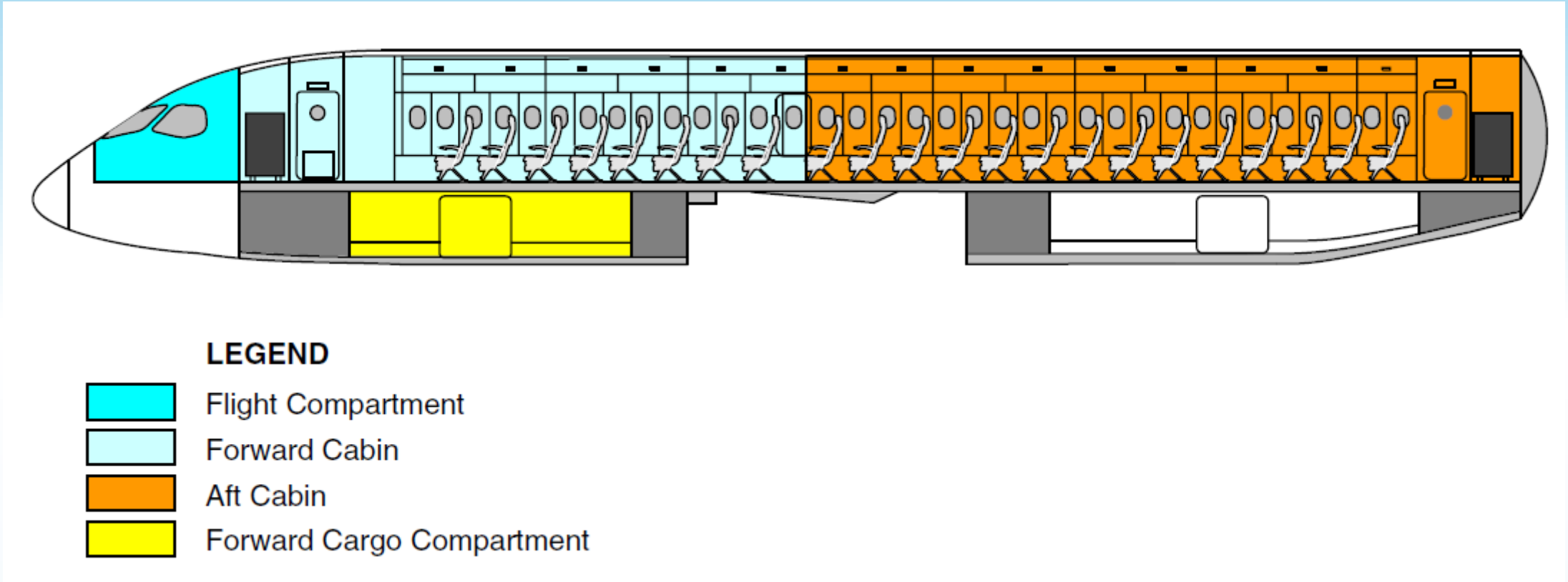
Engine cowl and wing anti-ice systems use bleed air but are addressed in the Ice and Rain chapter.

Two dual-channel Integrated Air System Controllers (IASCs) manage, monitor, and control the systems. The specific relation between the IASCs and each system will be covered in the components description section.

ATA 21:
Air Conditioning



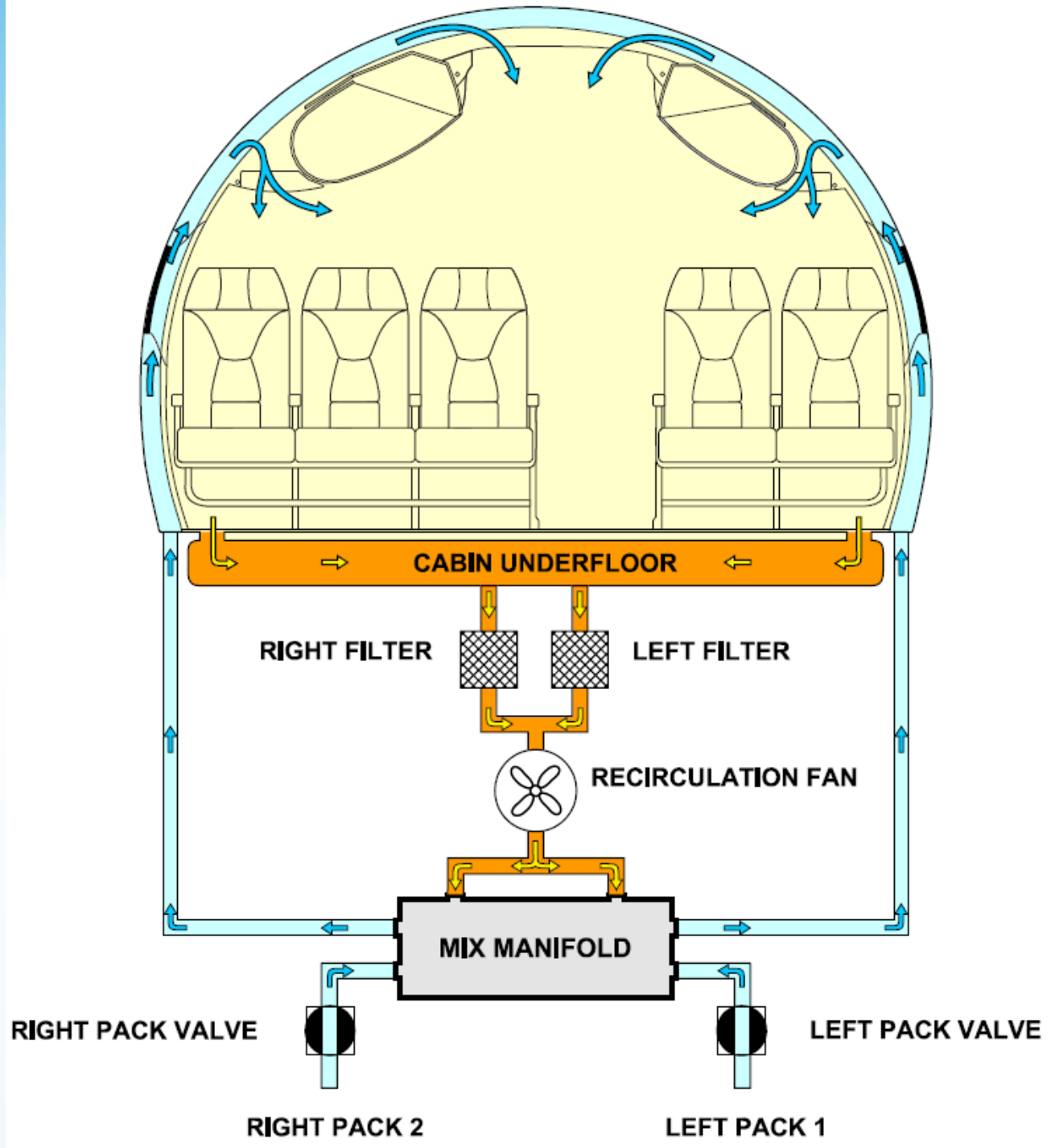
ATA 21: Air Conditioning



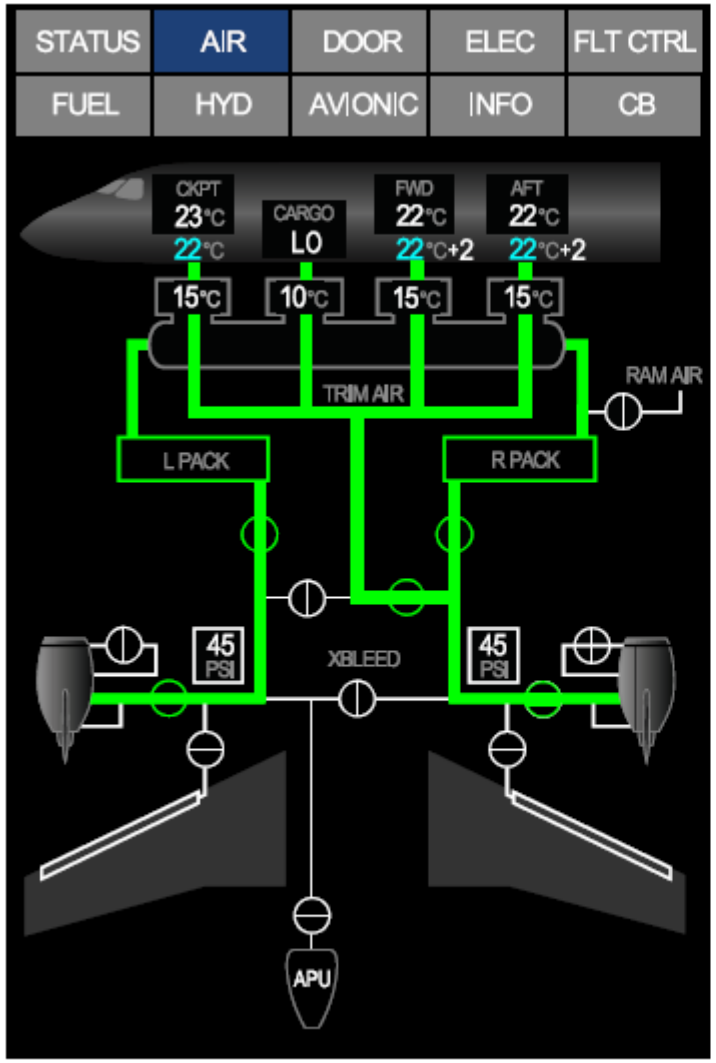
Temperature controlled zones

ATA 21: Air Conditioning

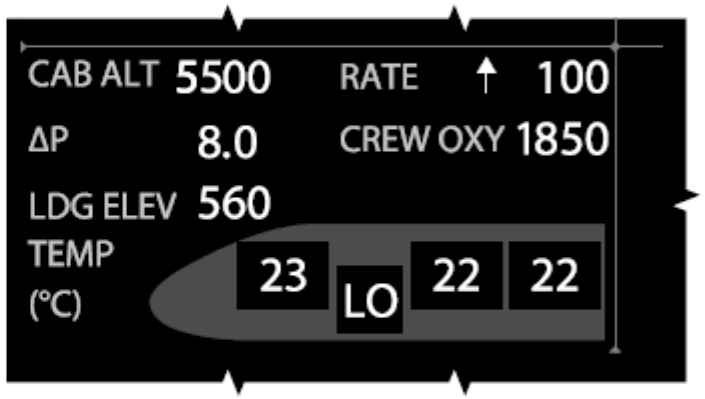
Cabin air distribution and recirculation



ATA 21: Air Conditioning

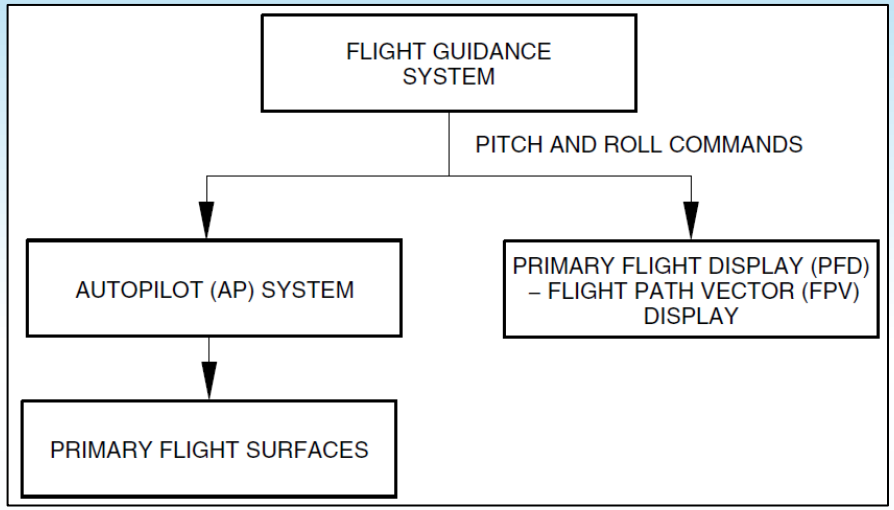


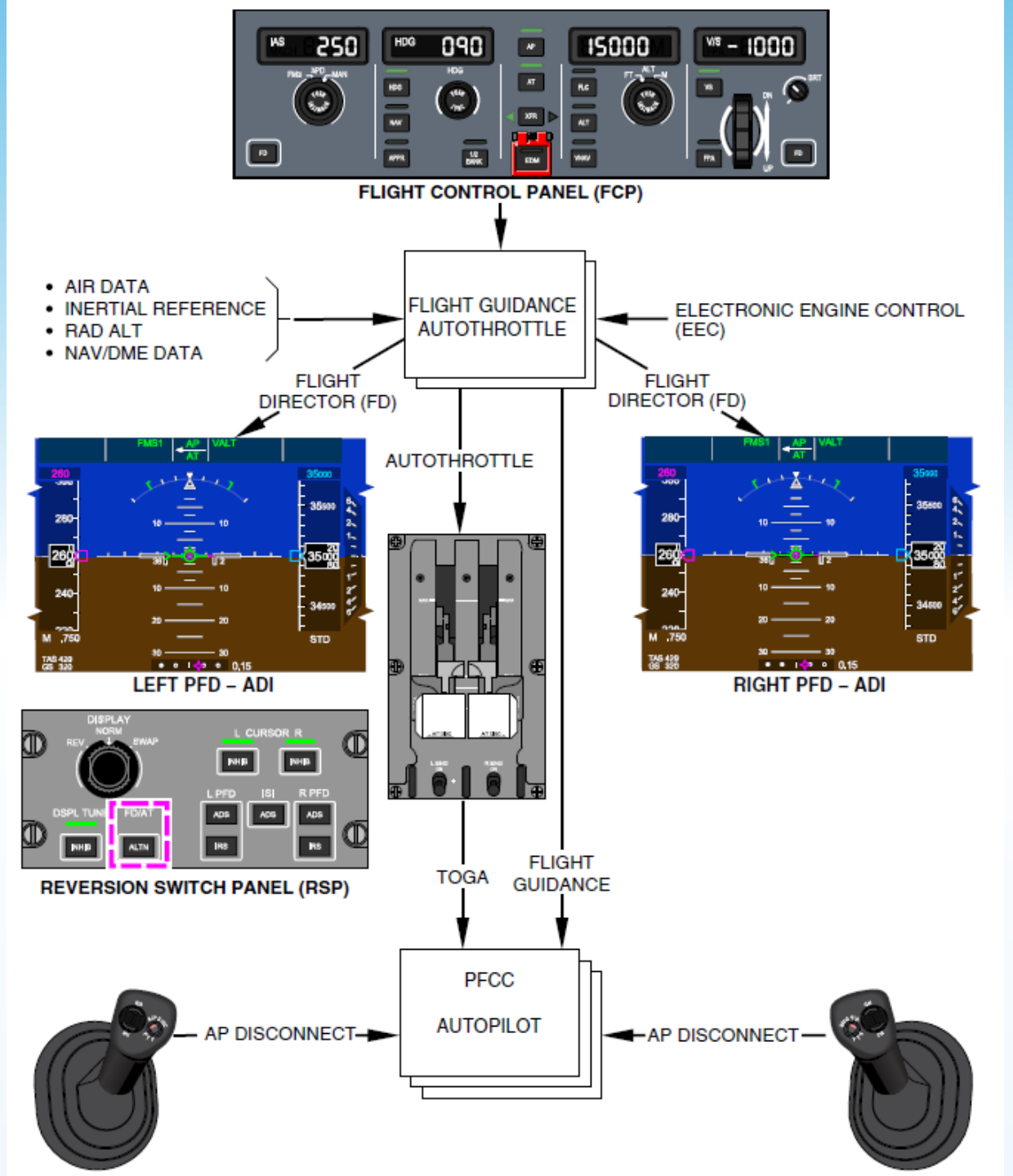
AIR SYNOPTIC PAGE



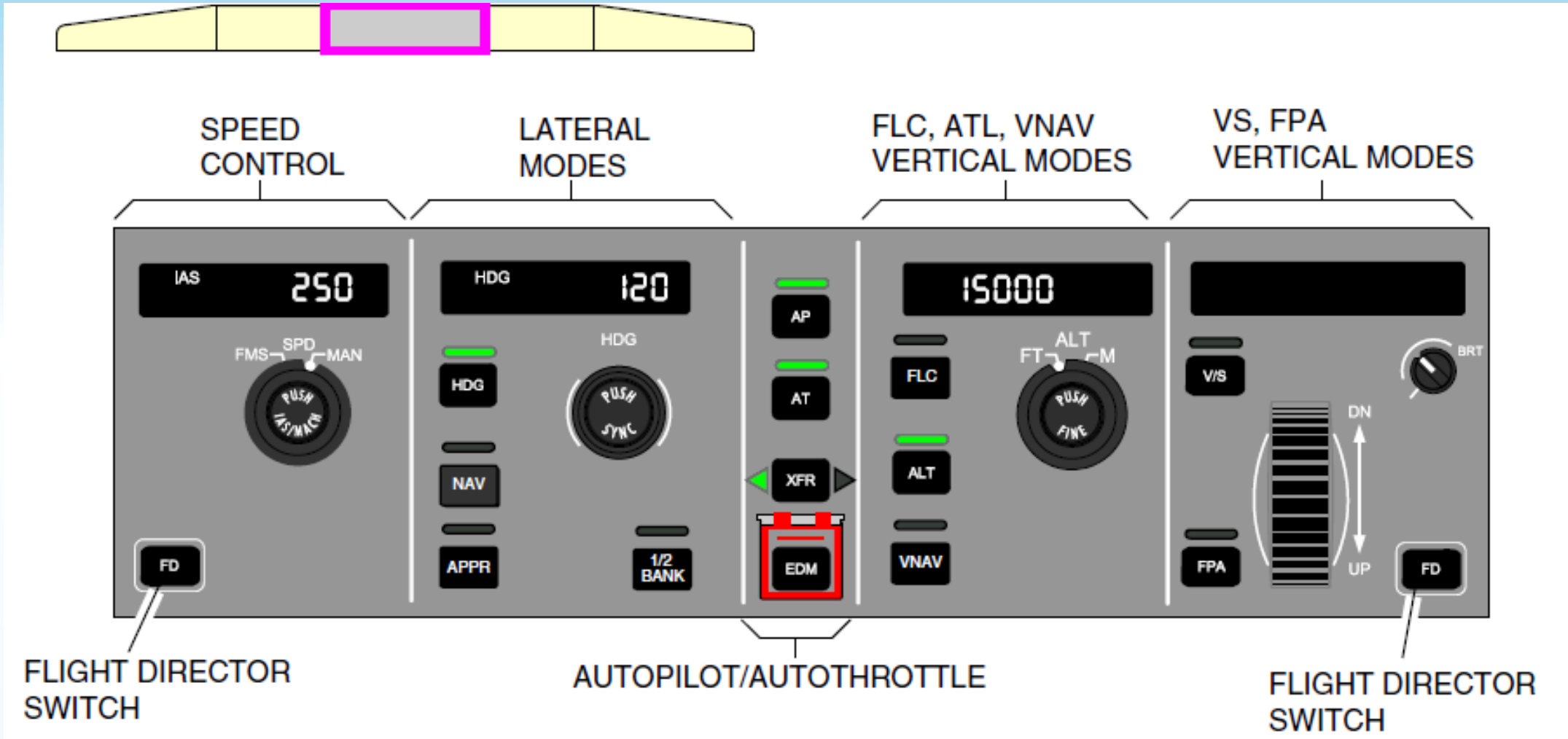
EICAS PAGE - AIR SECTION

ATA 22: Auto Flight

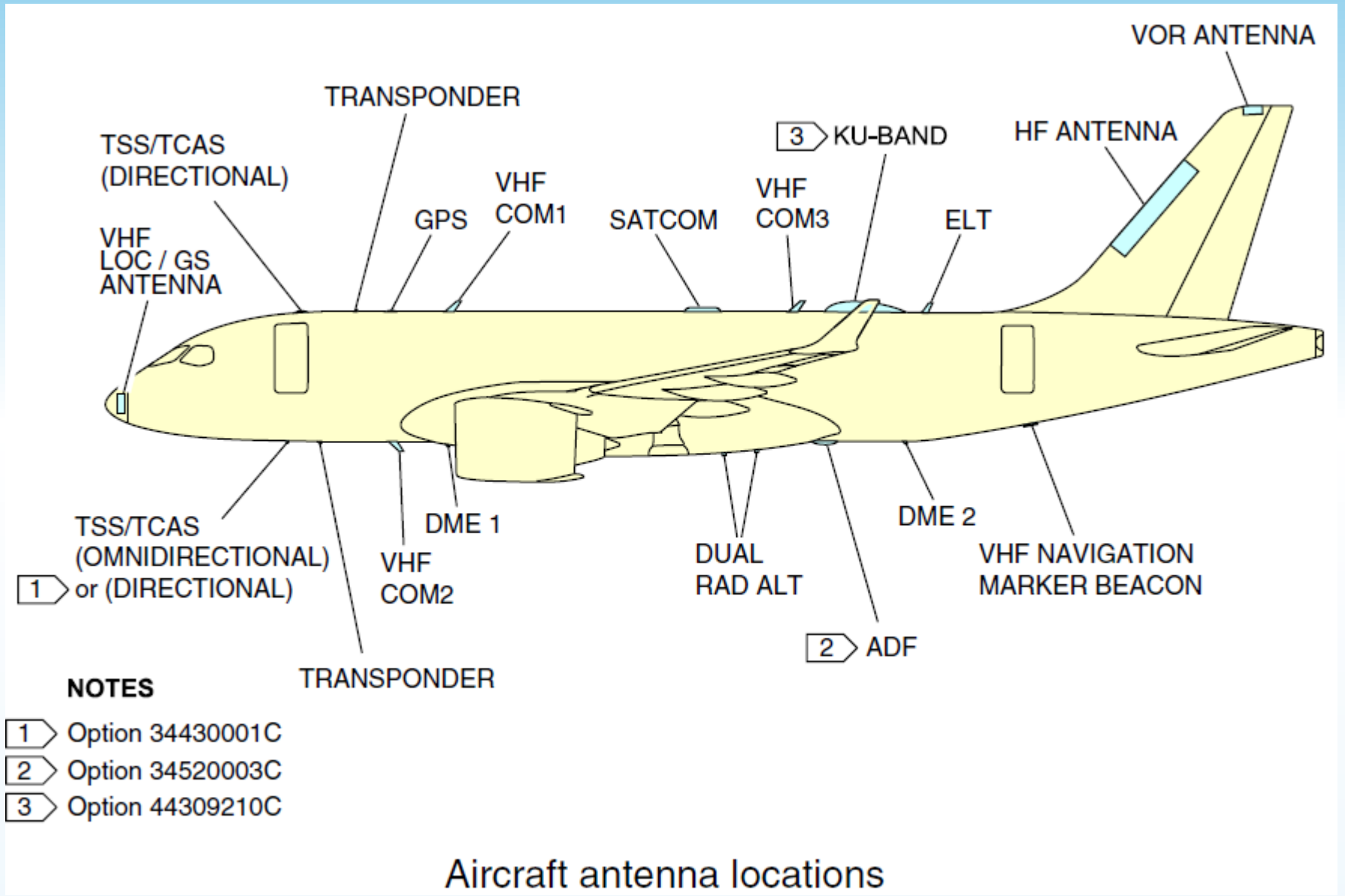




ATA 22: Auto Flight

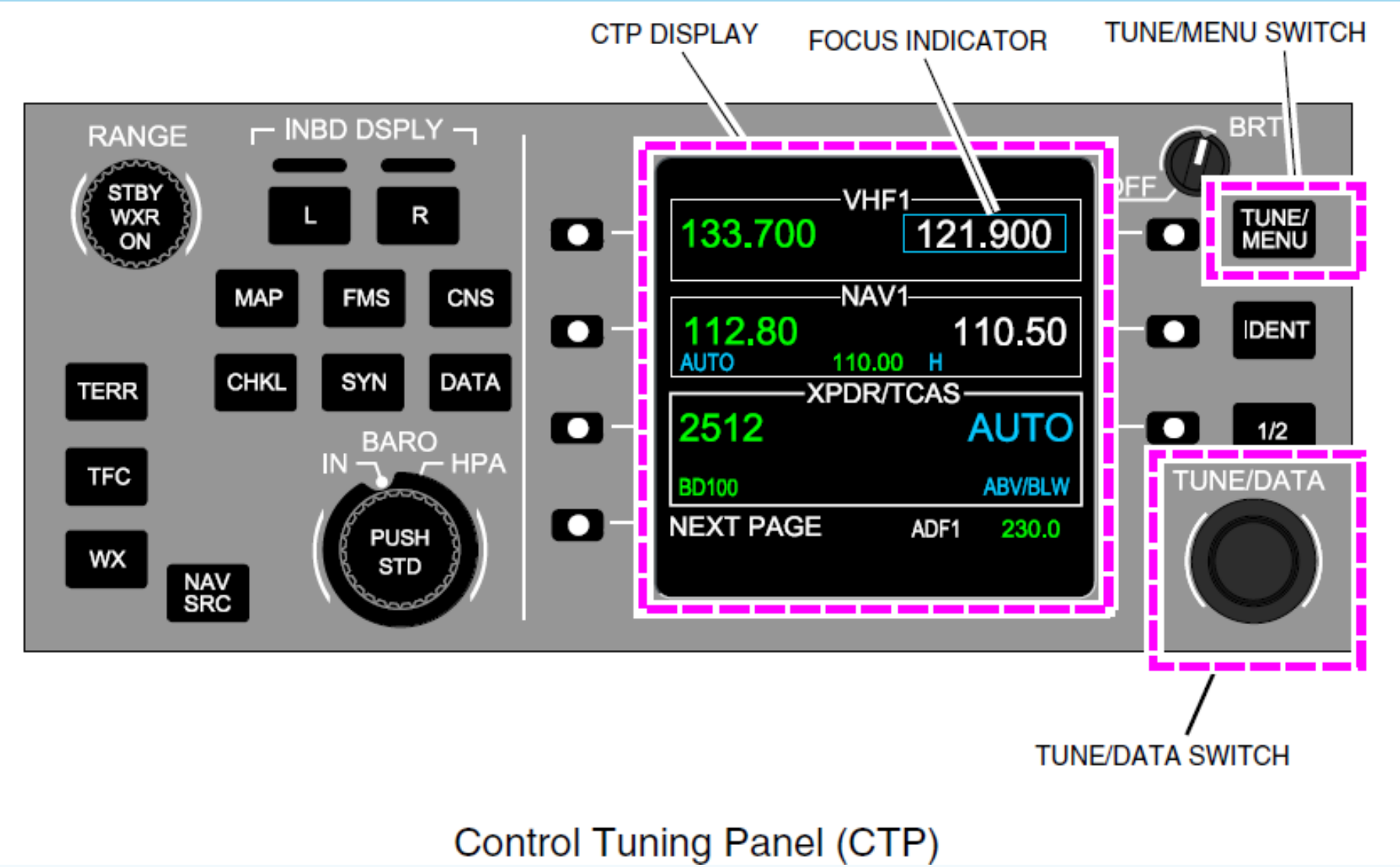


ATA 23: Communication



Aircraft antenna locations

ATA 23: Communication



Control Tuning Panel (CTP)

ATA 24: Electric Power

ELECTRICAL SYSTEM – OVERVIEW

The aircraft uses both 115 VAC and 28 VDC electrical power.

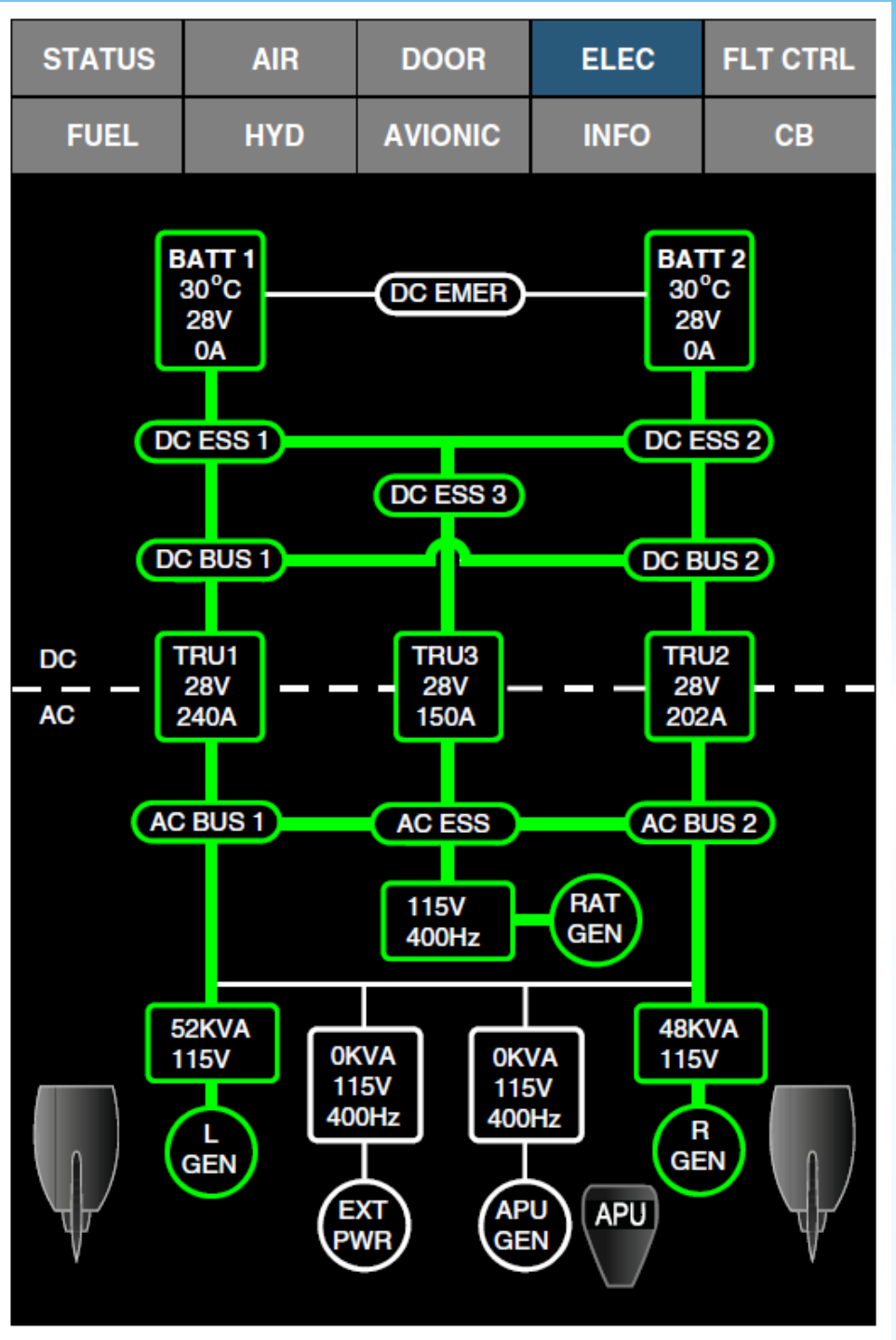
Two engine-driven Variable Frequency Generators (VFGs) are the primary source of AC power. An Auxiliary Power Unit (APU) generator supplies auxiliary power. A Ram Air Turbine (RAT) supplies emergency AC power. AC ground power is supplied through an electrical power connection on the left side of the forward fuselage.

Three Transformer Rectifier Units (TRUs) and two Nickel Cadmium (NiCad) batteries supply the required DC power.

Two dedicated Permanent Magnet Alternator/Generators (PMAGs) supply power to two Fly-By-Wire Power Converters (FBWPCs) for the fly-by-wire components.

The electrical control and distribution system is divided into three Electrical Power Centers (EPCs) that are managed by Bus Power Control Units (BPCUs) and an Emergency Power Control (EMPC).

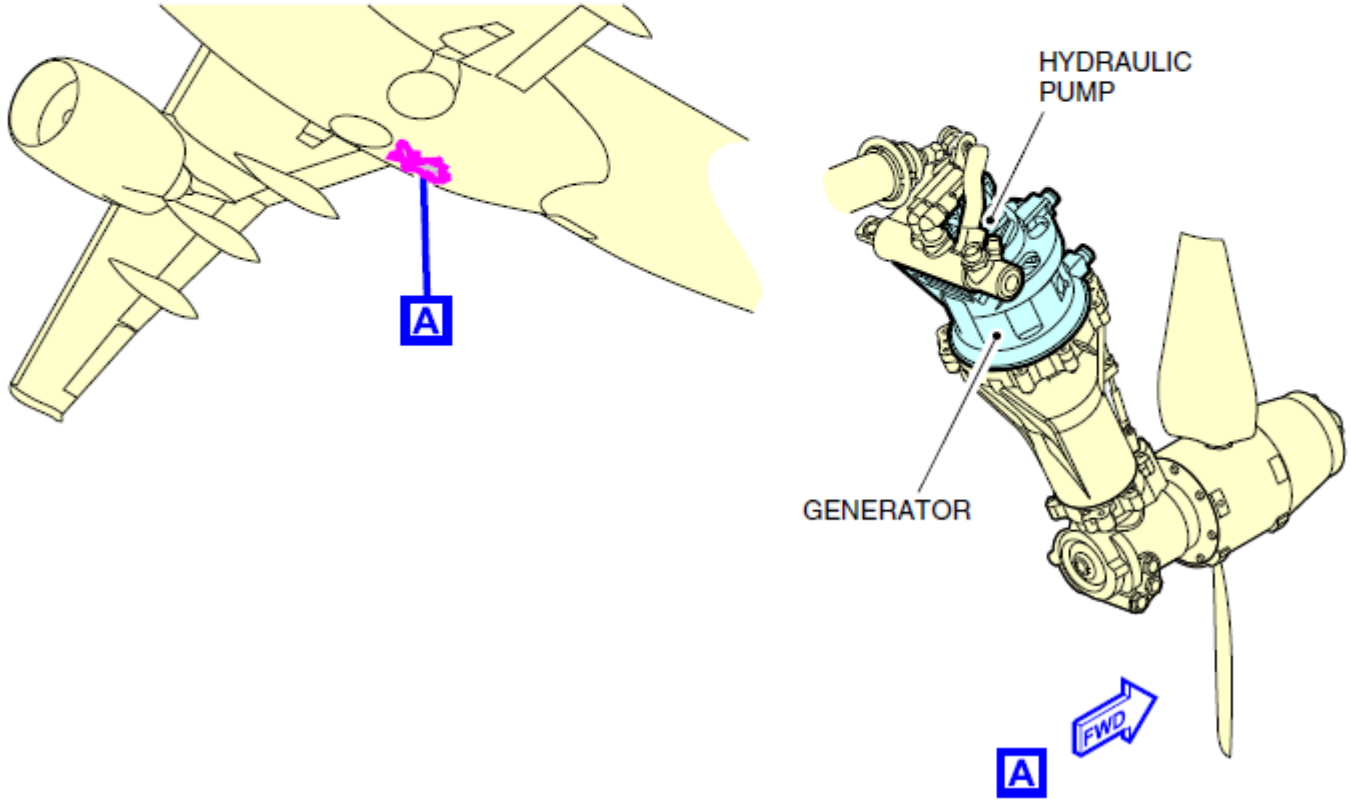
The ELEC synoptic page displays the system distribution architecture and status of the system components. The EICAS gives system fault and status information. The ELECTRICAL panel is part of the overhead panel.



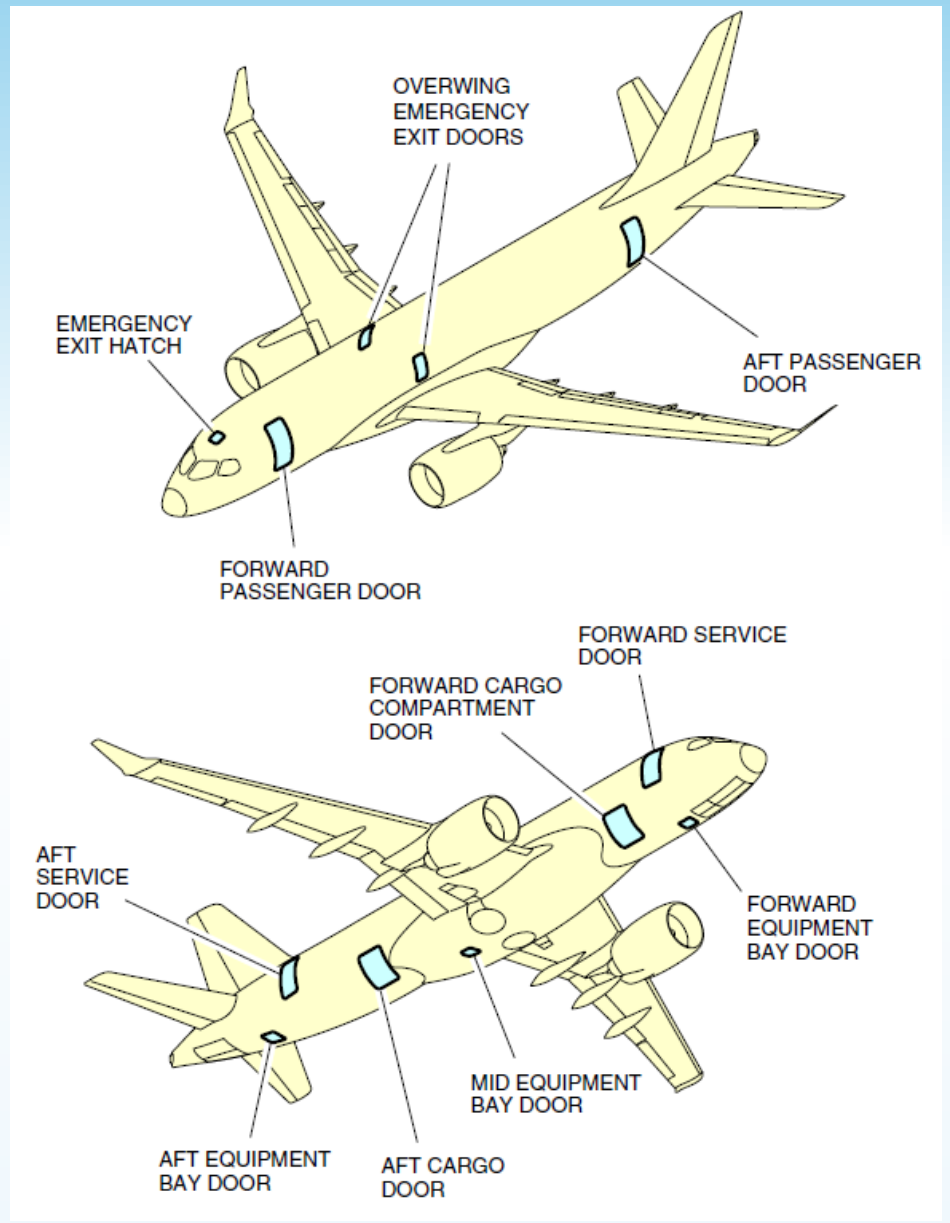
ATA 24: Electric Power

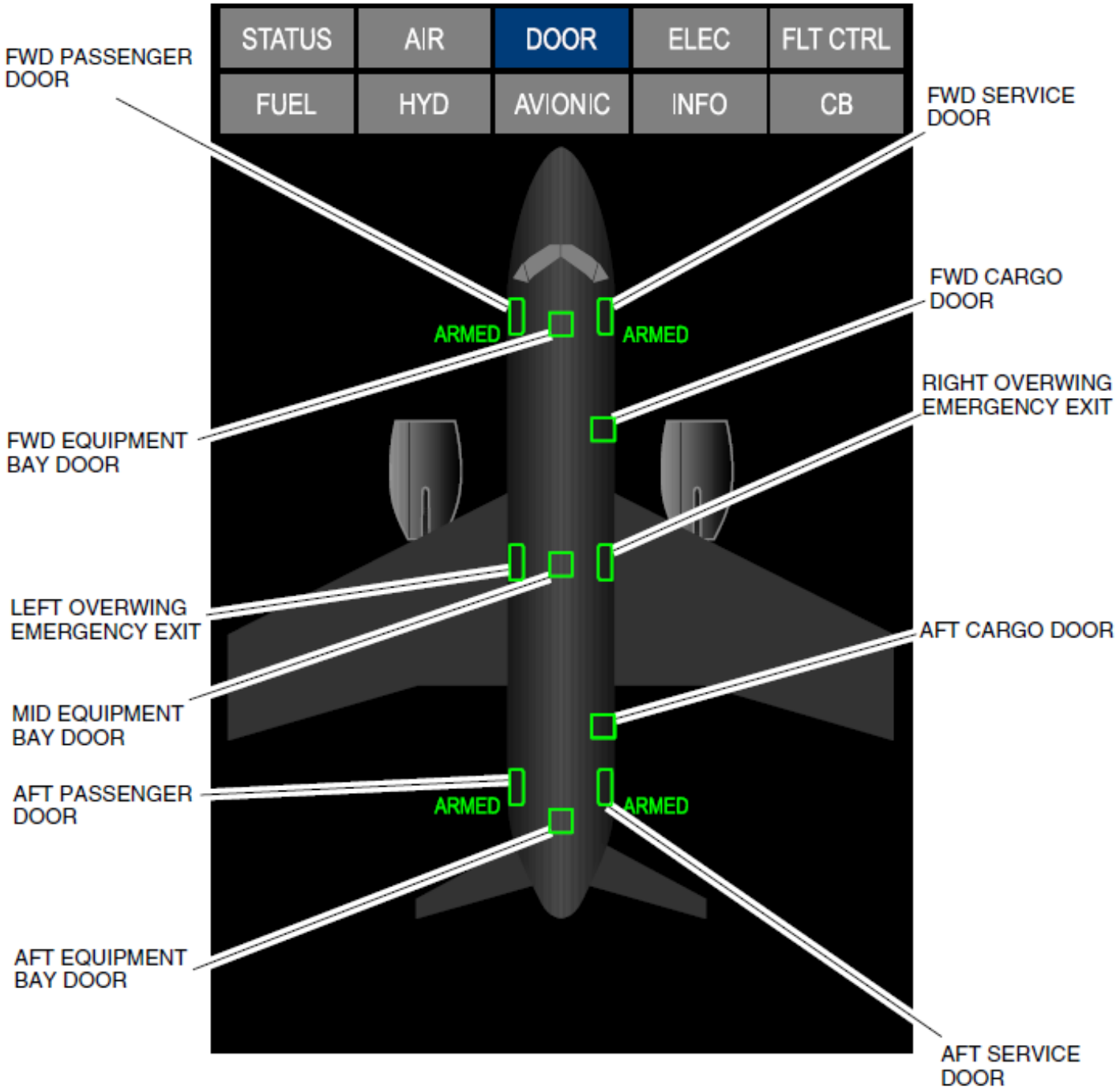
Ram Air Turbine (RAT)

If there is full loss of AC power, a Ram Air Turbine (RAT) supplies emergency AC power and hydraulics. The RAT is stored in the right side of the wing-to-body fairing near the right main landing gear (refer to Figure 07–02–4). It is a two-bladed, wind-driven turbine that powers a 115 VAC, air-cooled generator, rated at 10 kVA. It also drives a hydraulic pump.



ATA 52: Doors

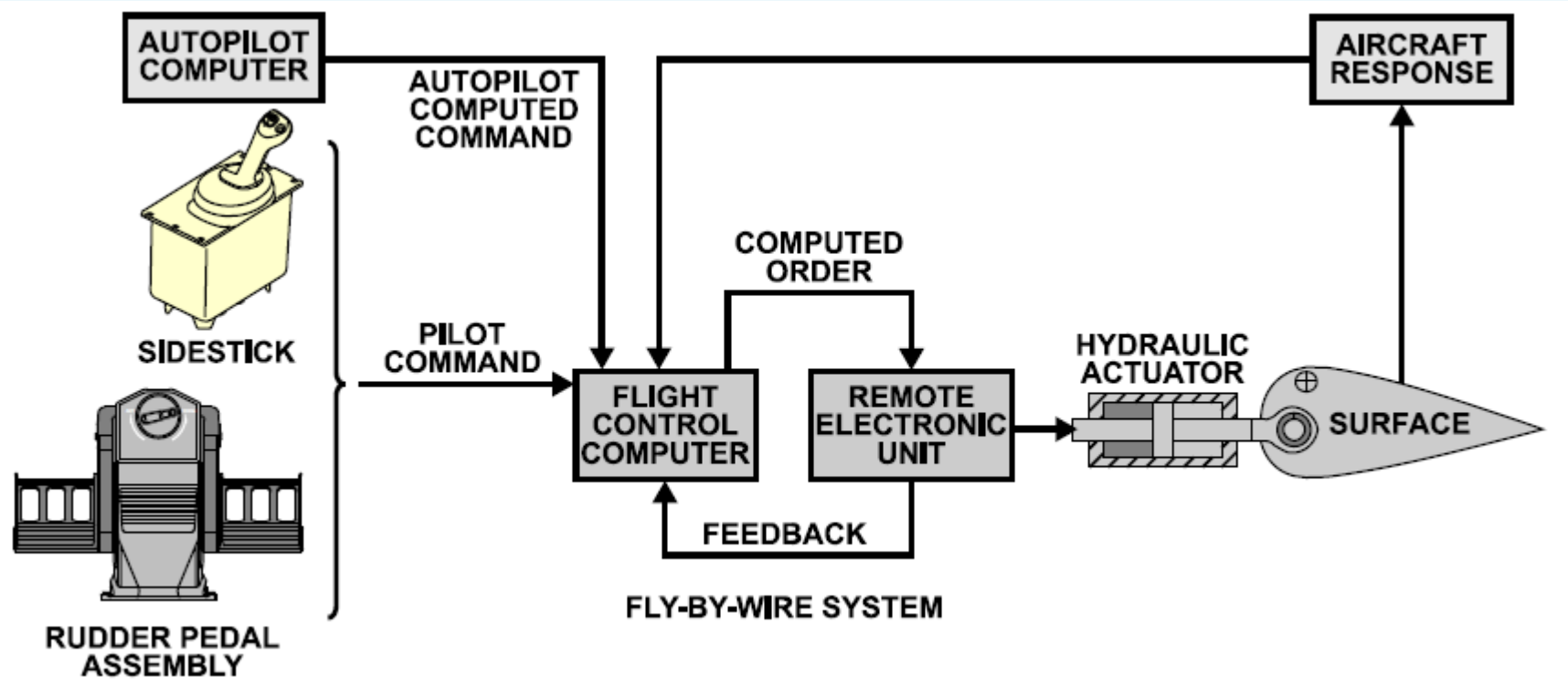

OVERWING
EMERGENCY
EXIT DOORS
EMERGENCY
EXIT HATCH
AFT PASSENGER
DOOR
FORWARD
PASSENGER DOOR
FORWARD SERVICE
DOOR
FORWARD CARGO
COMPARTMENT
DOOR
AFT
SERVICE
DOOR
FORWARD
EQUIPMENT
BAY DOOR
MID EQUIPMENT
BAY DOOR
AFT EQUIPMENT
BAY DOOR
AFT CARGO
DOOR


STATUS
AIR
DOOR
ELEC
FLT CTRL
FUEL
HYD
AVIONIC
INFO
CB
FWD PASSENGER
DOOR
FWD SERVICE
DOOR
FWD CARGO
DOOR
ARMED
ARMED
RIGHT OVERWING
EMERGENCY EXIT
FWD EQUIPMENT
BAY DOOR
LEFT OVERWING
EMERGENCY EXIT
AFT CARGO DOOR
MID EQUIPMENT
BAY DOOR
AFT PASSENGER
DOOR
ARMED
ARMED
AFT EQUIPMENT
BAY DOOR
AFT SERVICE
DOOR

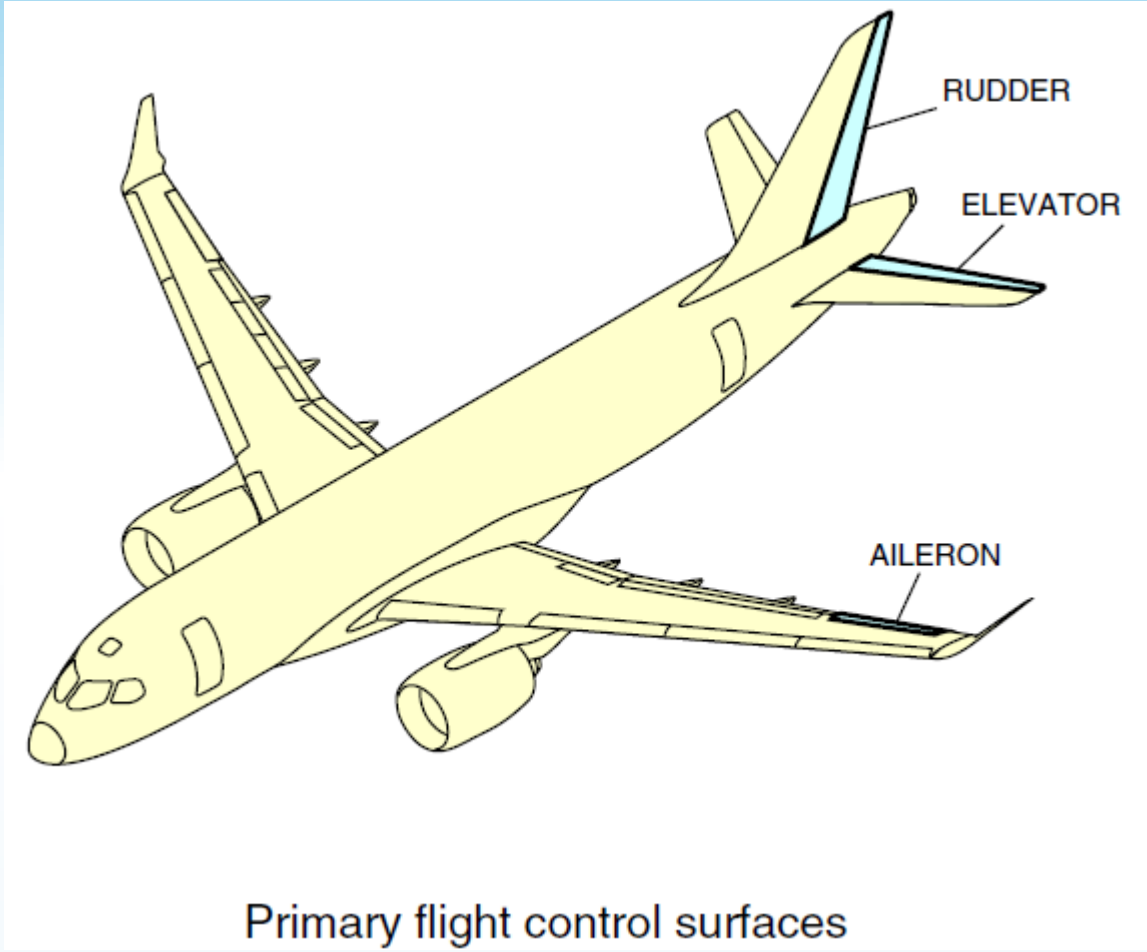
ATA 27: Flight Controls

FBW SYSTEM – OVERVIEW

The Fly-By-Wire (FBW) system controls and monitors all primary and secondary flight controls (except the slats and flaps). The FBW system receives input commands electronically from the flight deck controls (initiated by the pilot) or directly from the autopilot. It converts them into output commands to move the aircraft control surfaces.



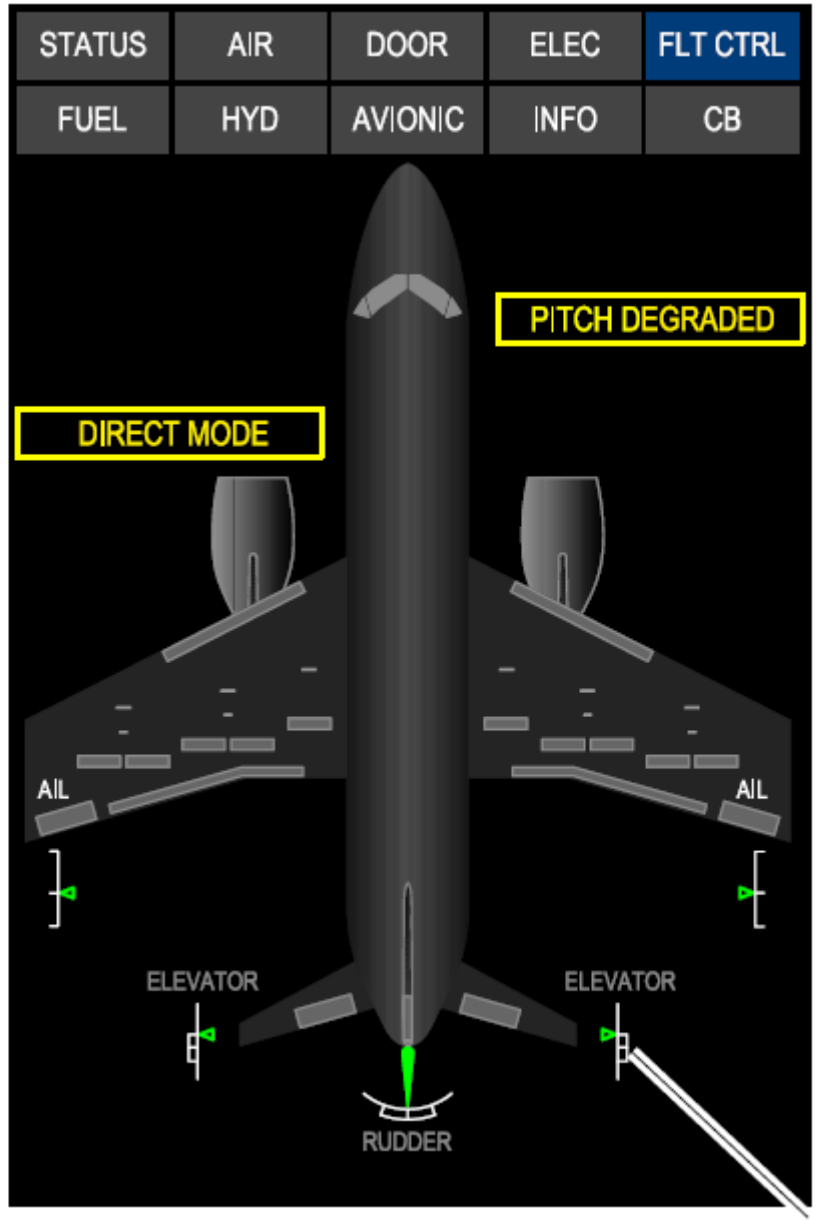
ATA 27: Flight Controls



Primary flight control surfaces

ELEVATOR POSITION INDICATOR	
Symbol	Condition
	Normal
	Fail
	Invalid

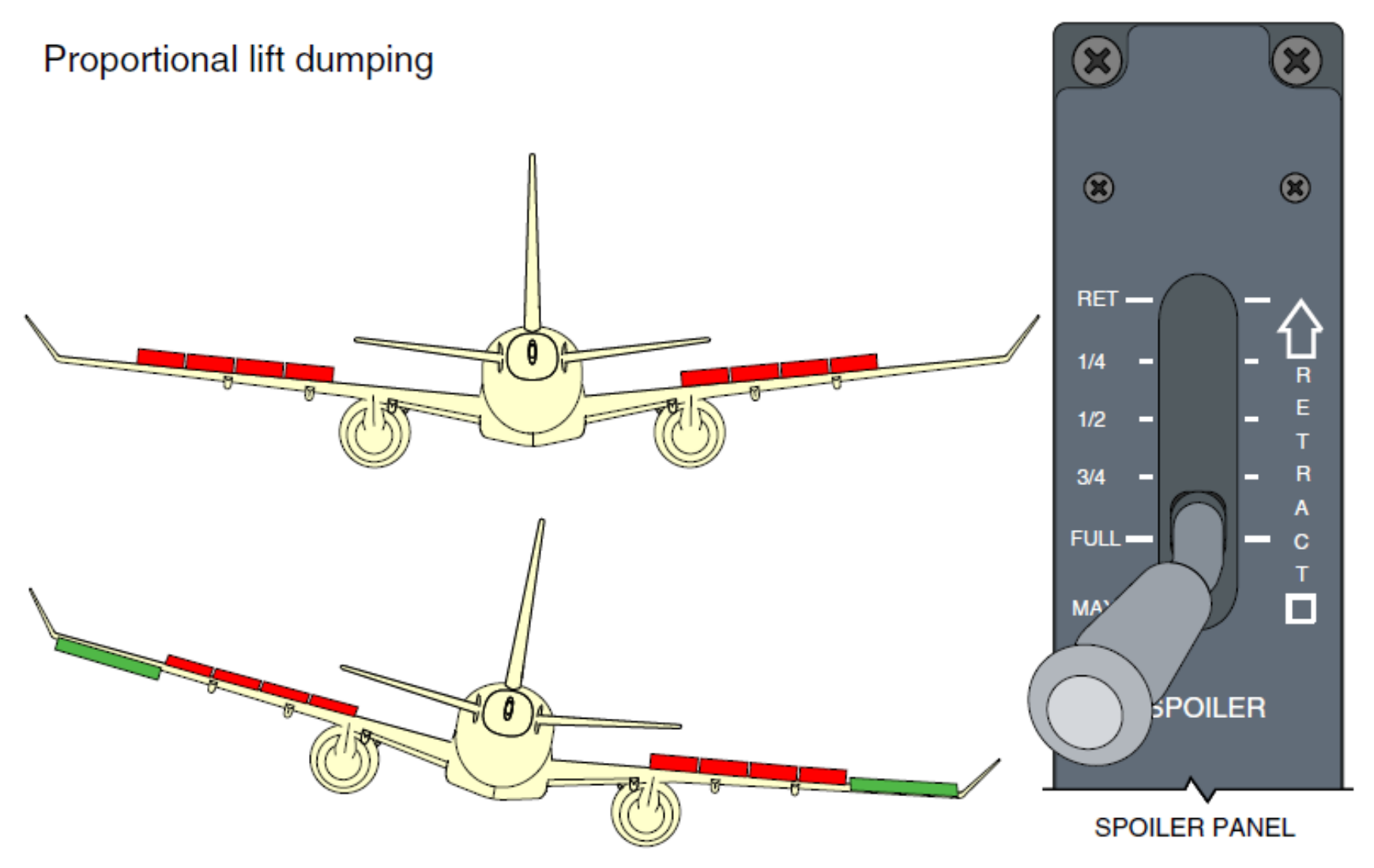
ELEVATOR SURFACE STATE	
Symbol	Condition
	Normal
	Fail
	Invalid



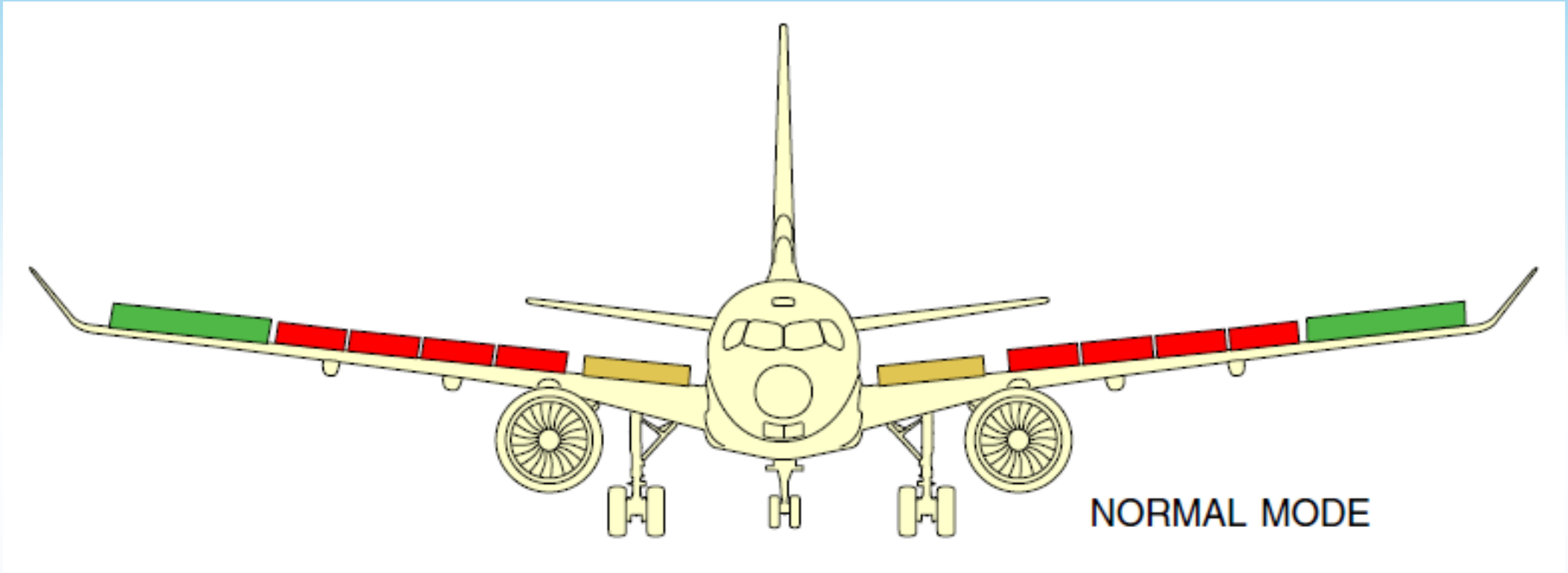
SYNOPTIC PAGE - FLT CTRL

ELEVATOR POSITION

ATA 27: Flight Controls

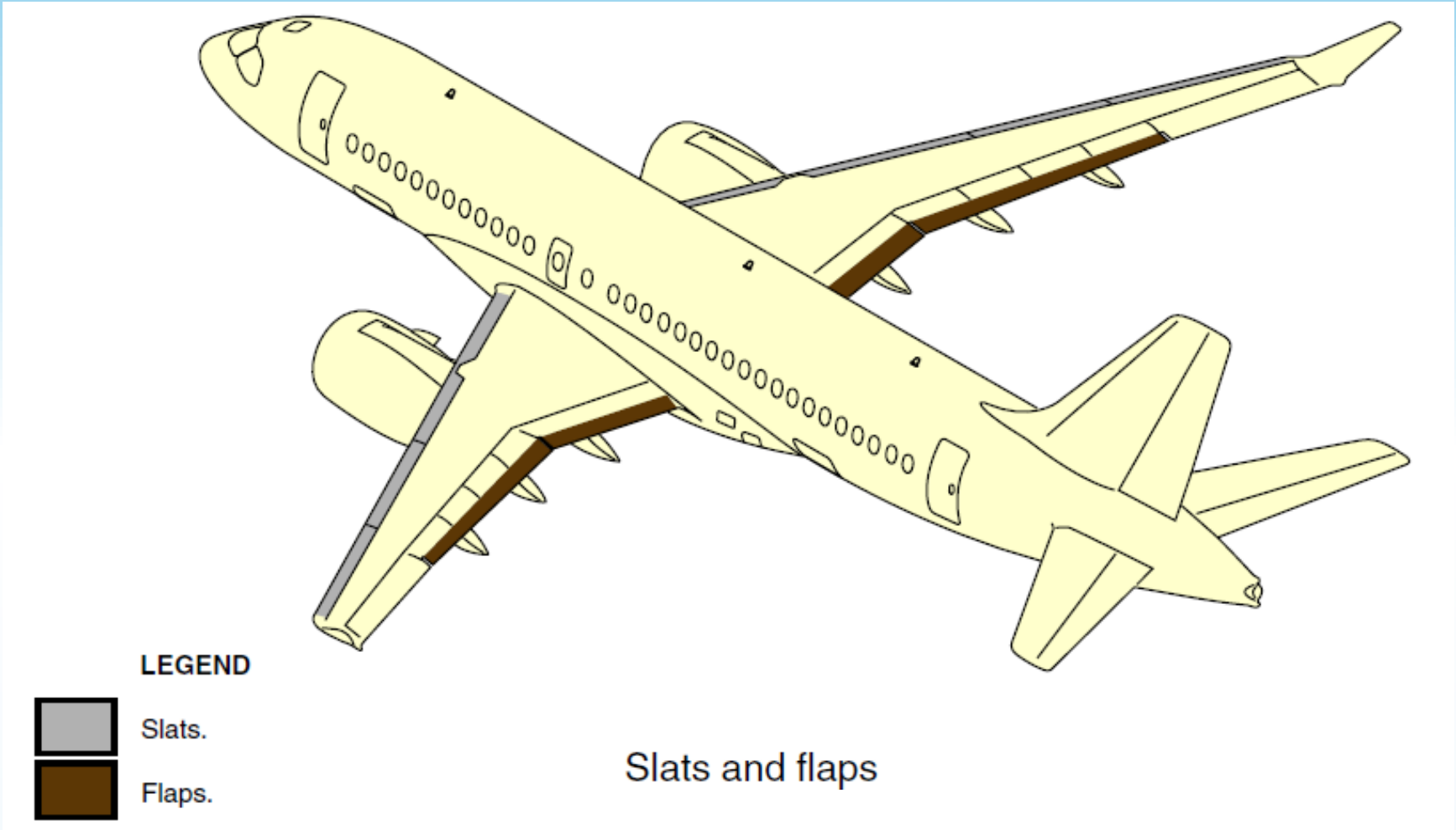


ATA 27: Flight Controls

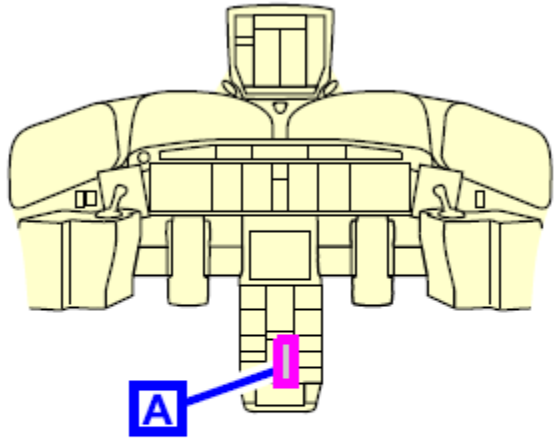


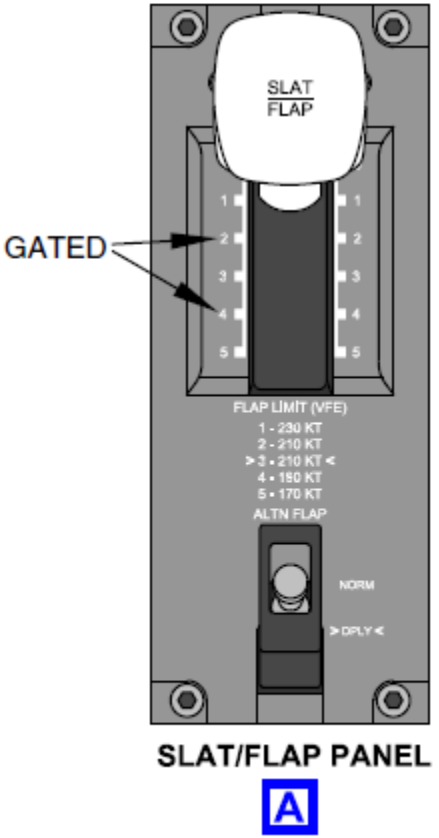
Ground lift dumping

ATA 27: Flight Controls



Slats and flaps



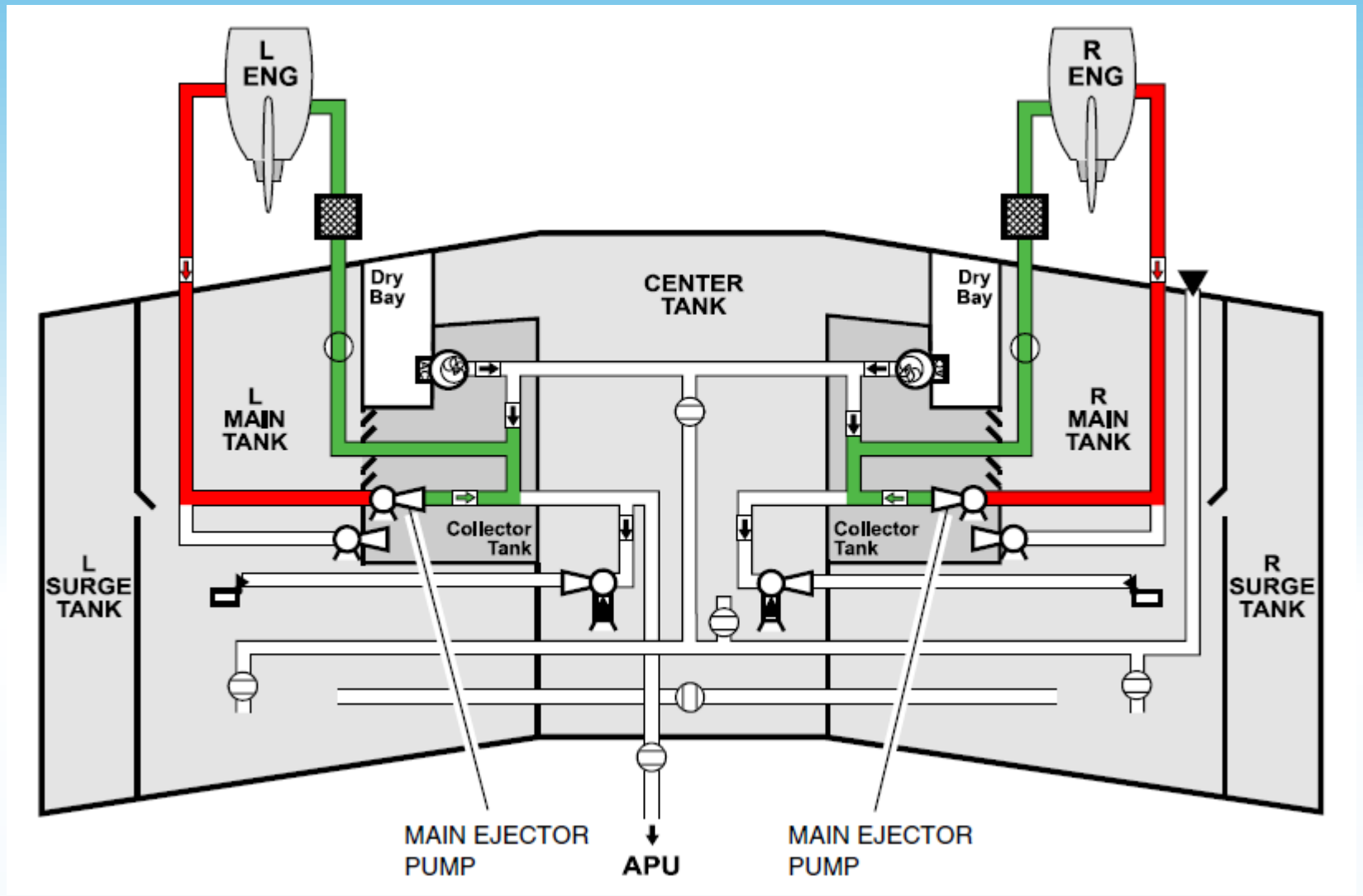


SLAT/FLAP PANEL

ATA 28: Fuel

LEGEND

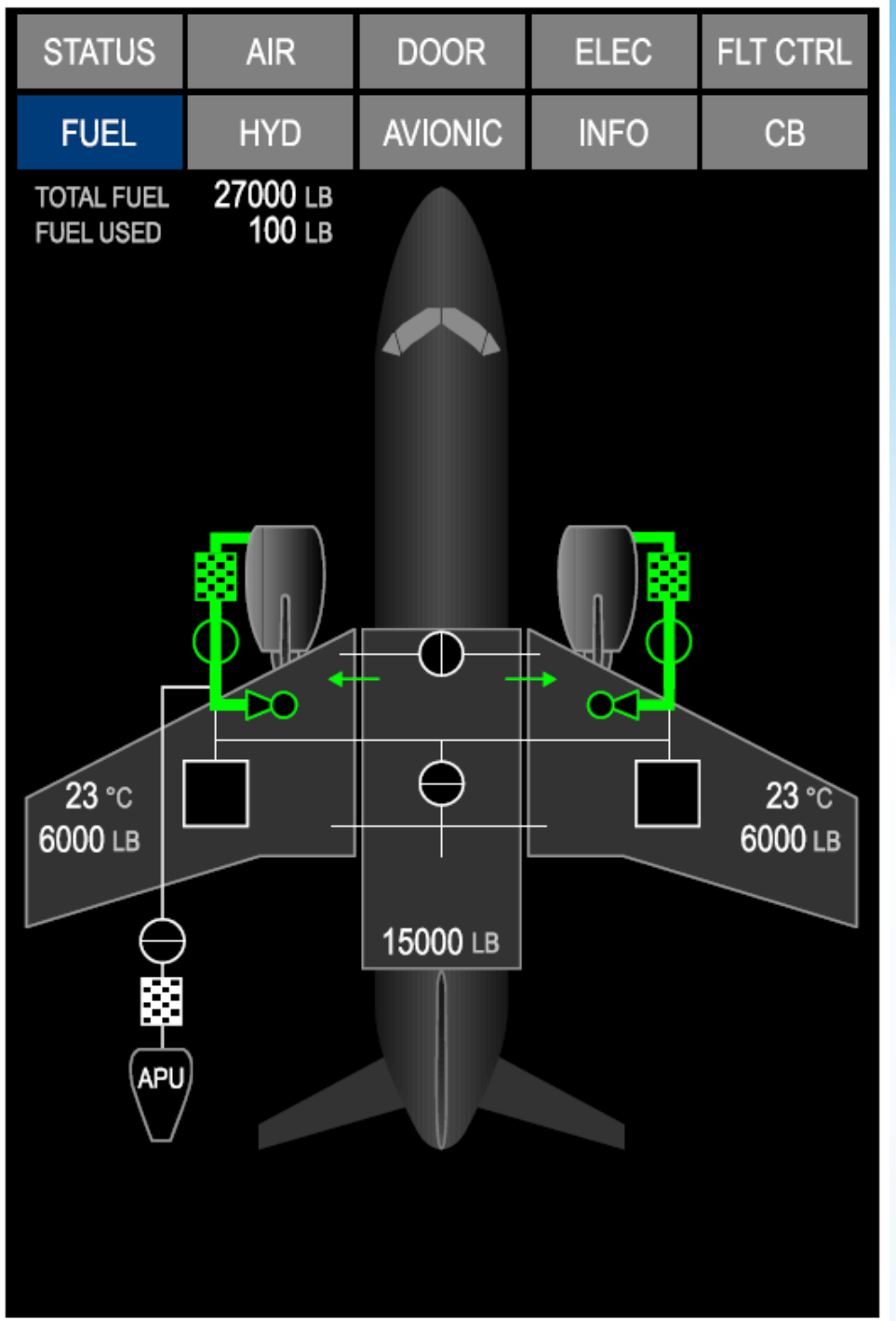
- High-Pressure Fuel
- Resulting Fuel Supply
- Shutoff Valve
- Flapper Check Valve
- Inlet Screen
- One-Way Check Valve
- Float Valve
- Ejector Pumps
- Single-Point Refueling
- AC Boost Pump



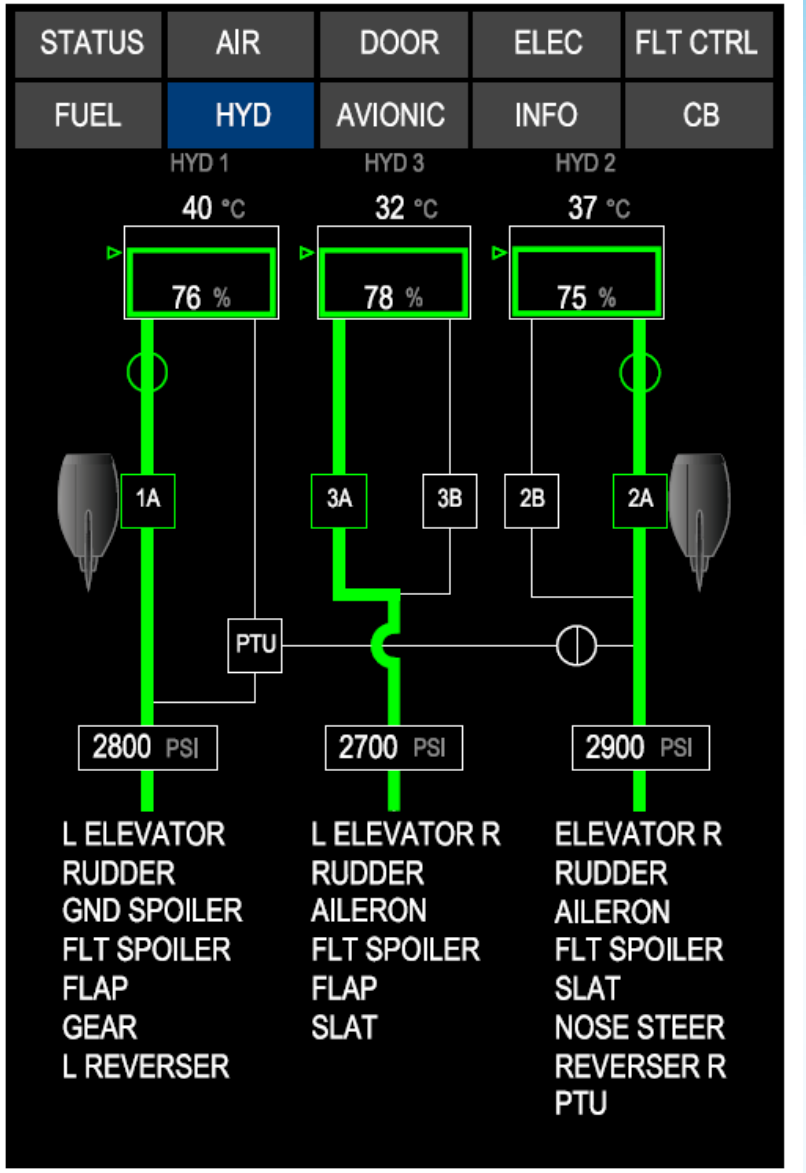
Normal engine fuel feed

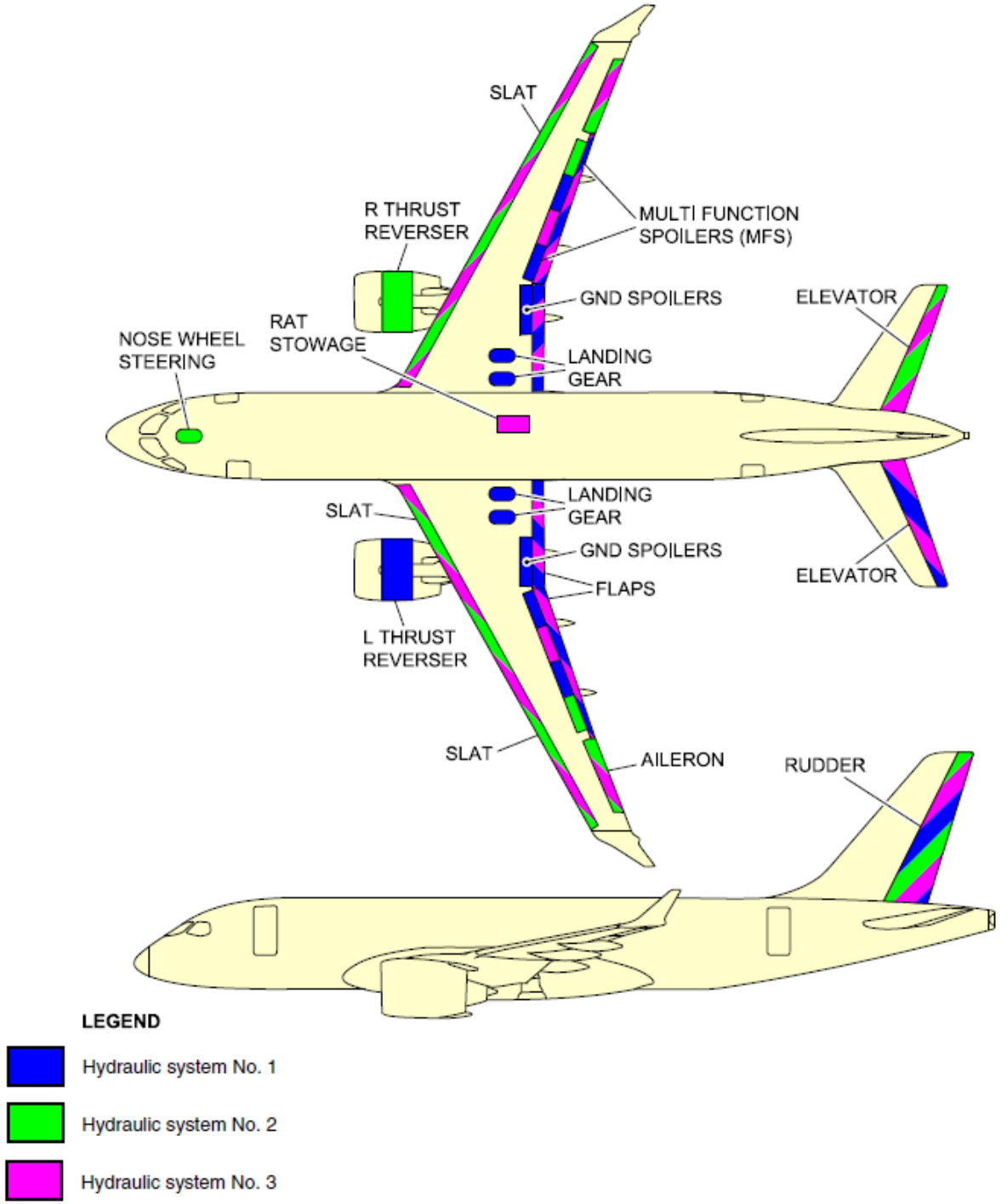
ATA 28: Fuel

Fuel synoptic page – Normal fuel feed

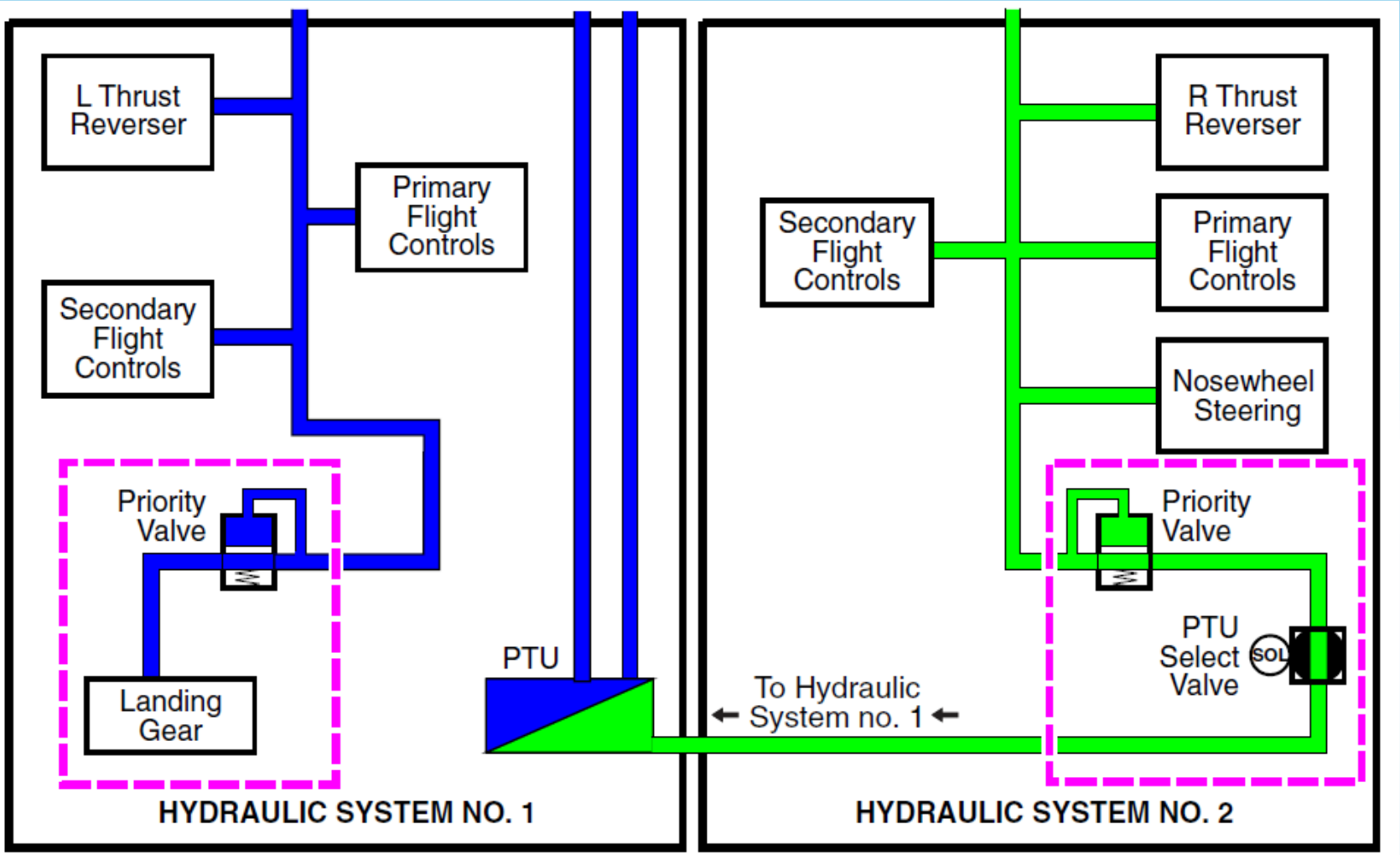


ATA 29: Hydraulic Power

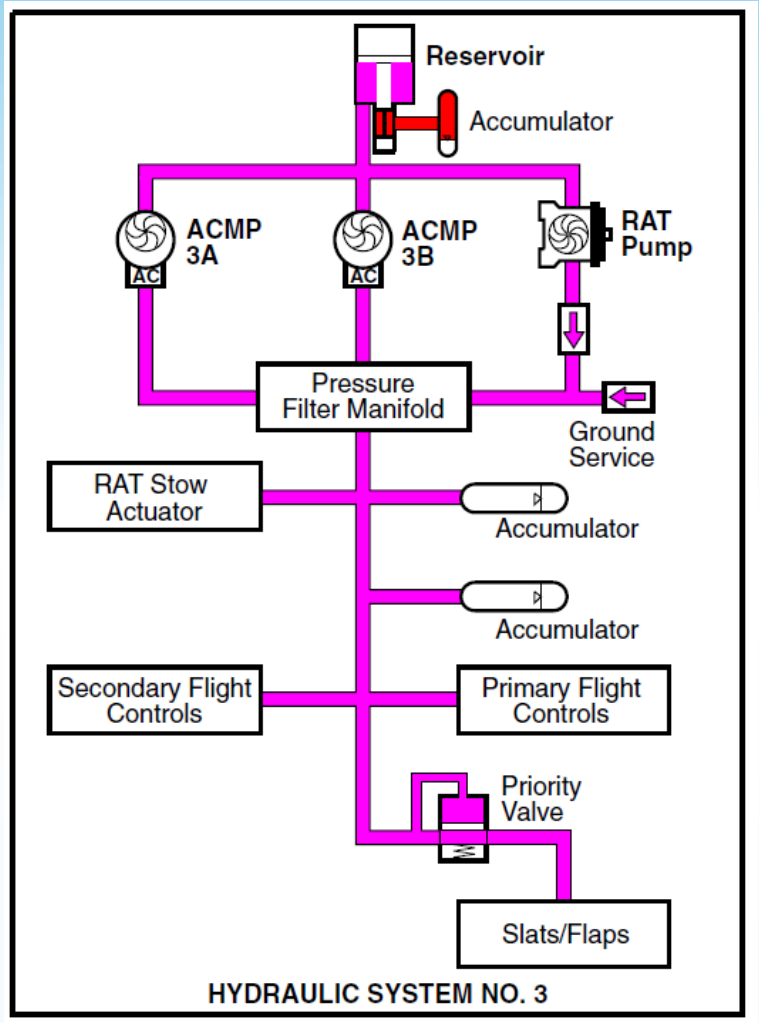




ATA 29: Hydraulic Power

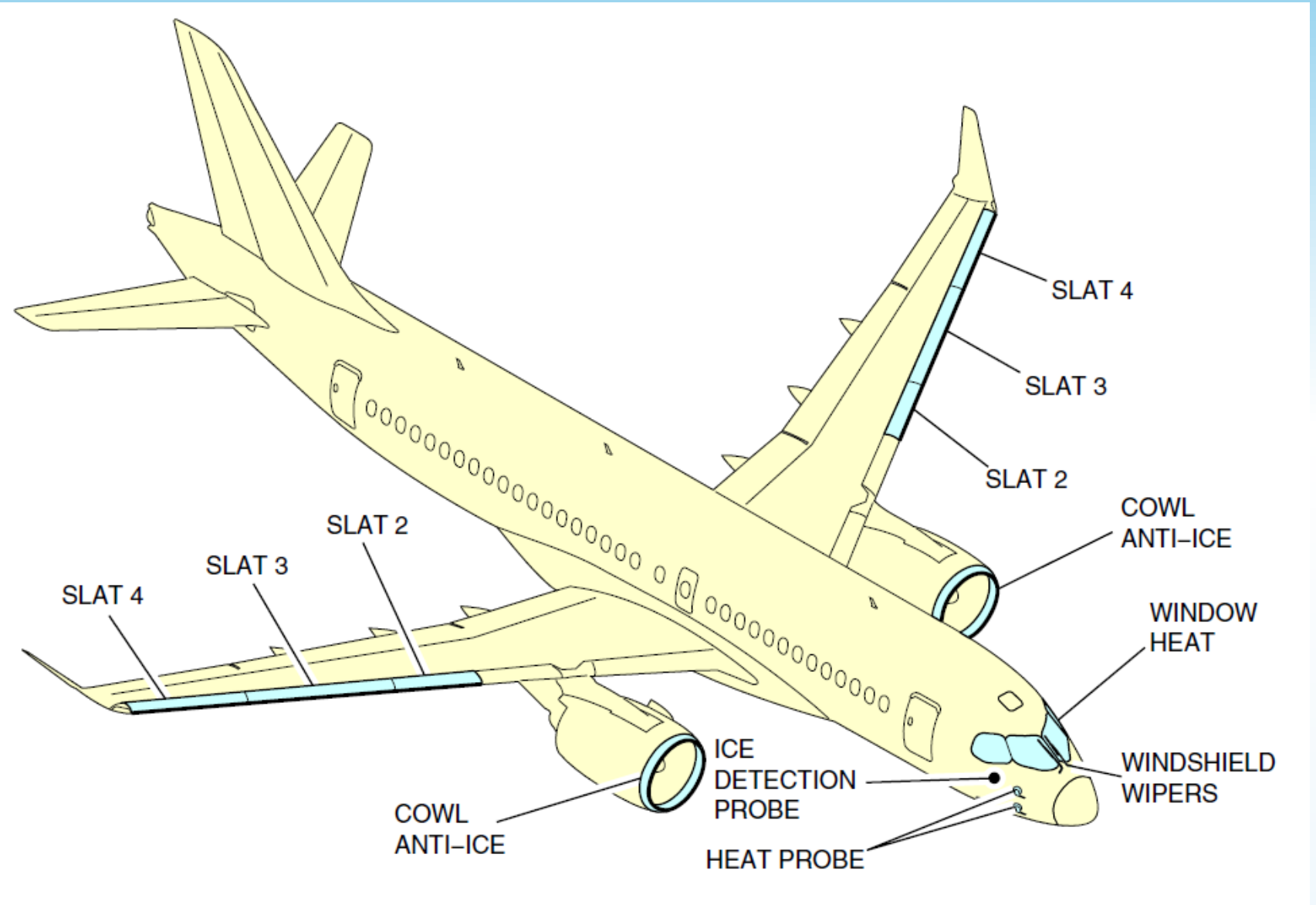


Hydraulic Systems no. 1 and no. 2 – Priority Valves

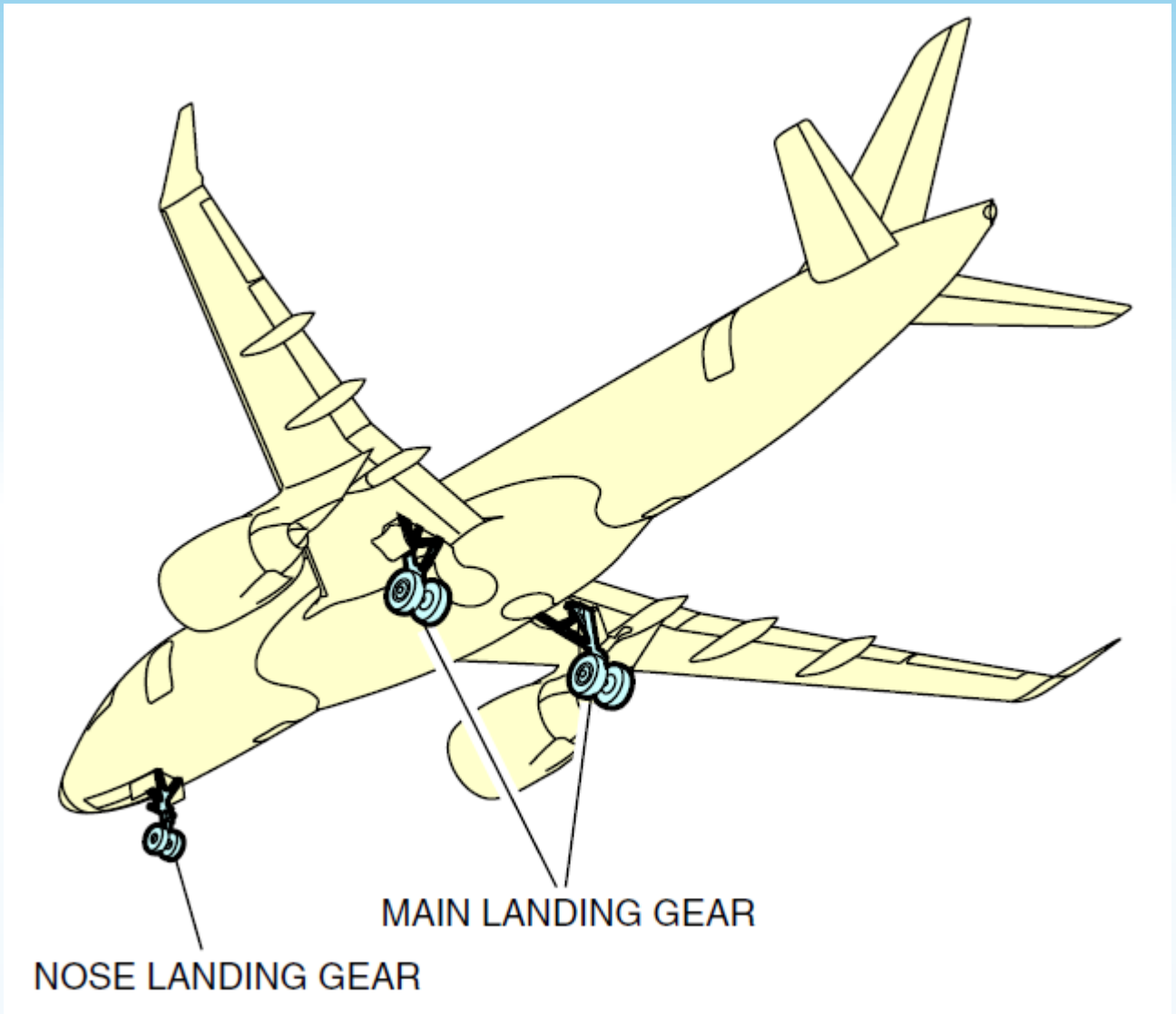


System No. 3 distribution – schematic

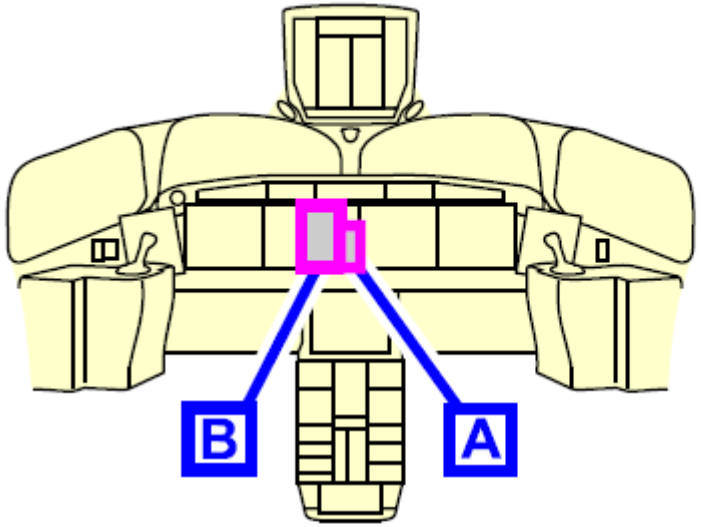
ATA 30: Ice and Rain Protection

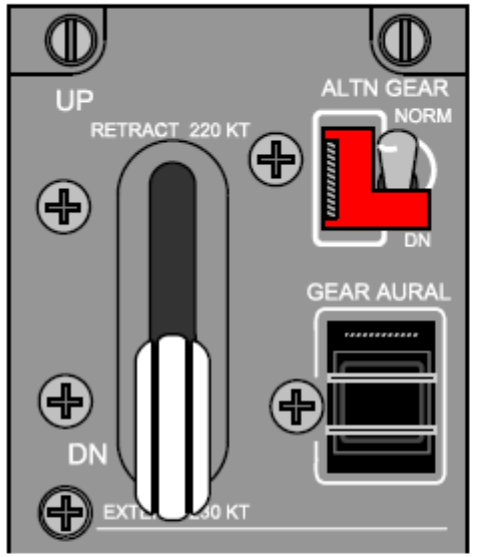


ATA 32: Landing Gear



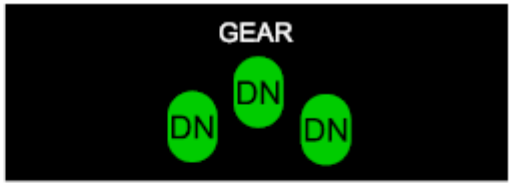
ATA 32: Landing Gear





LANDING GEAR PANEL

A

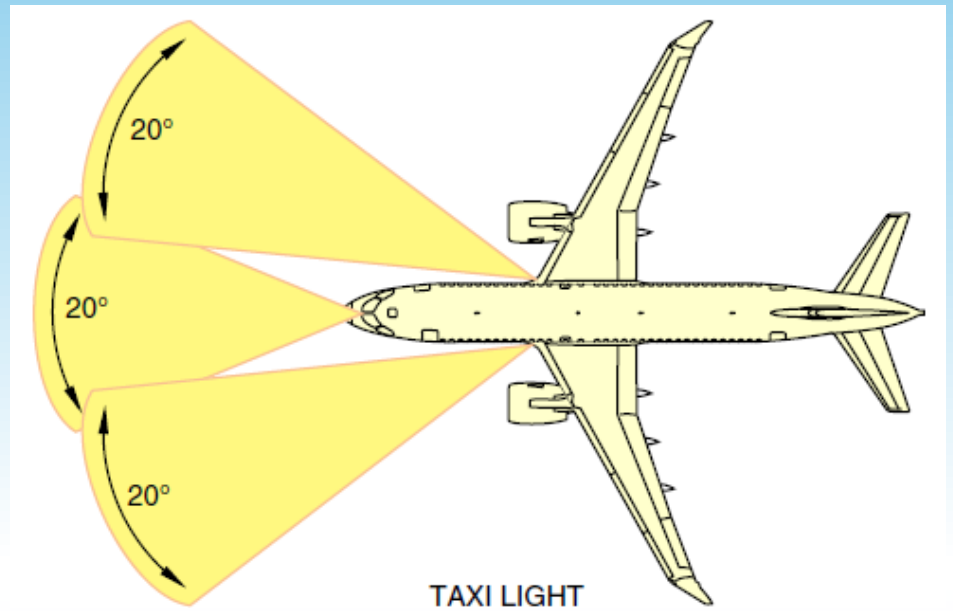


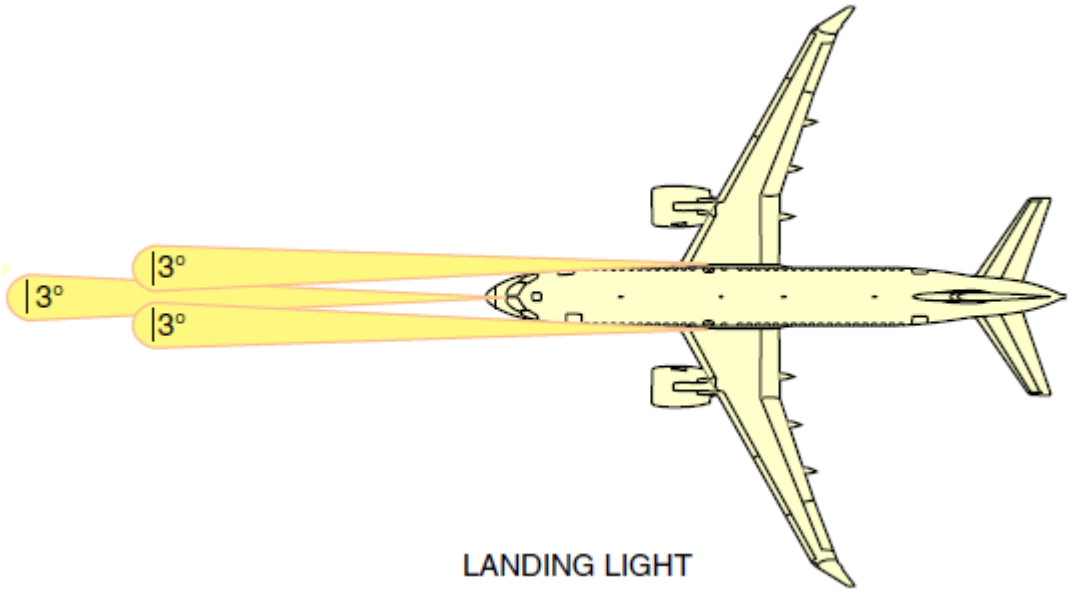
EICAS PAGE

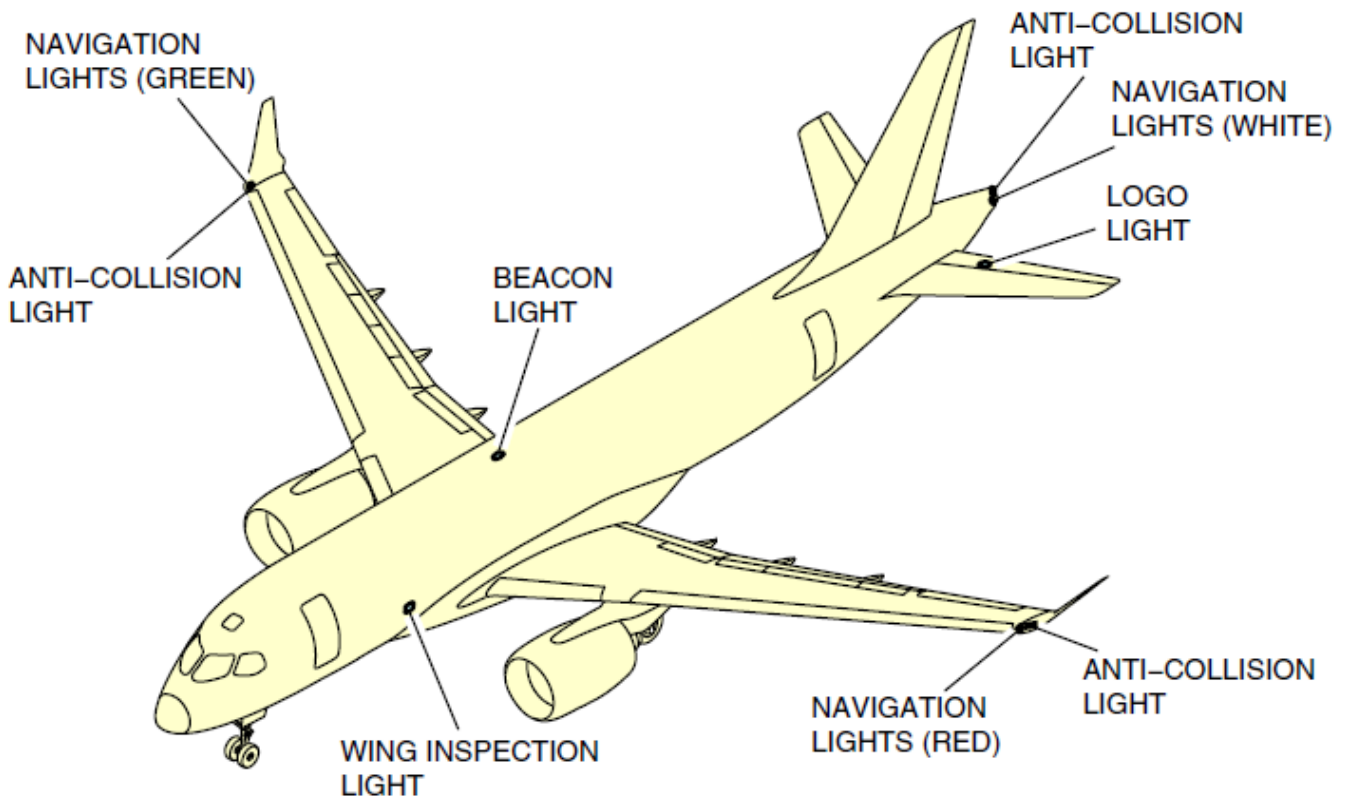
B

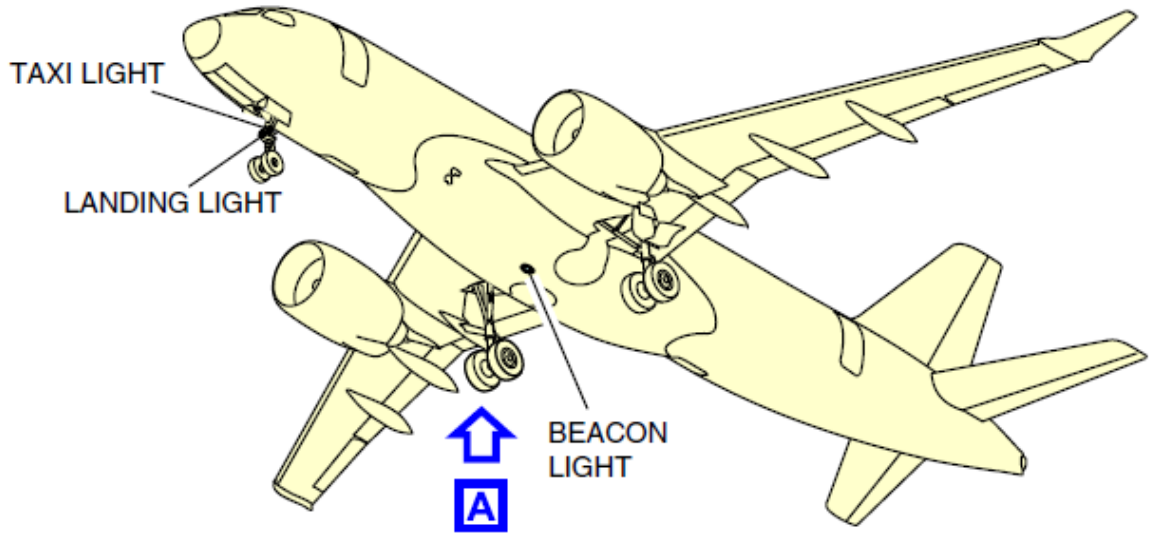
Extension operation

ATA 33: Lights

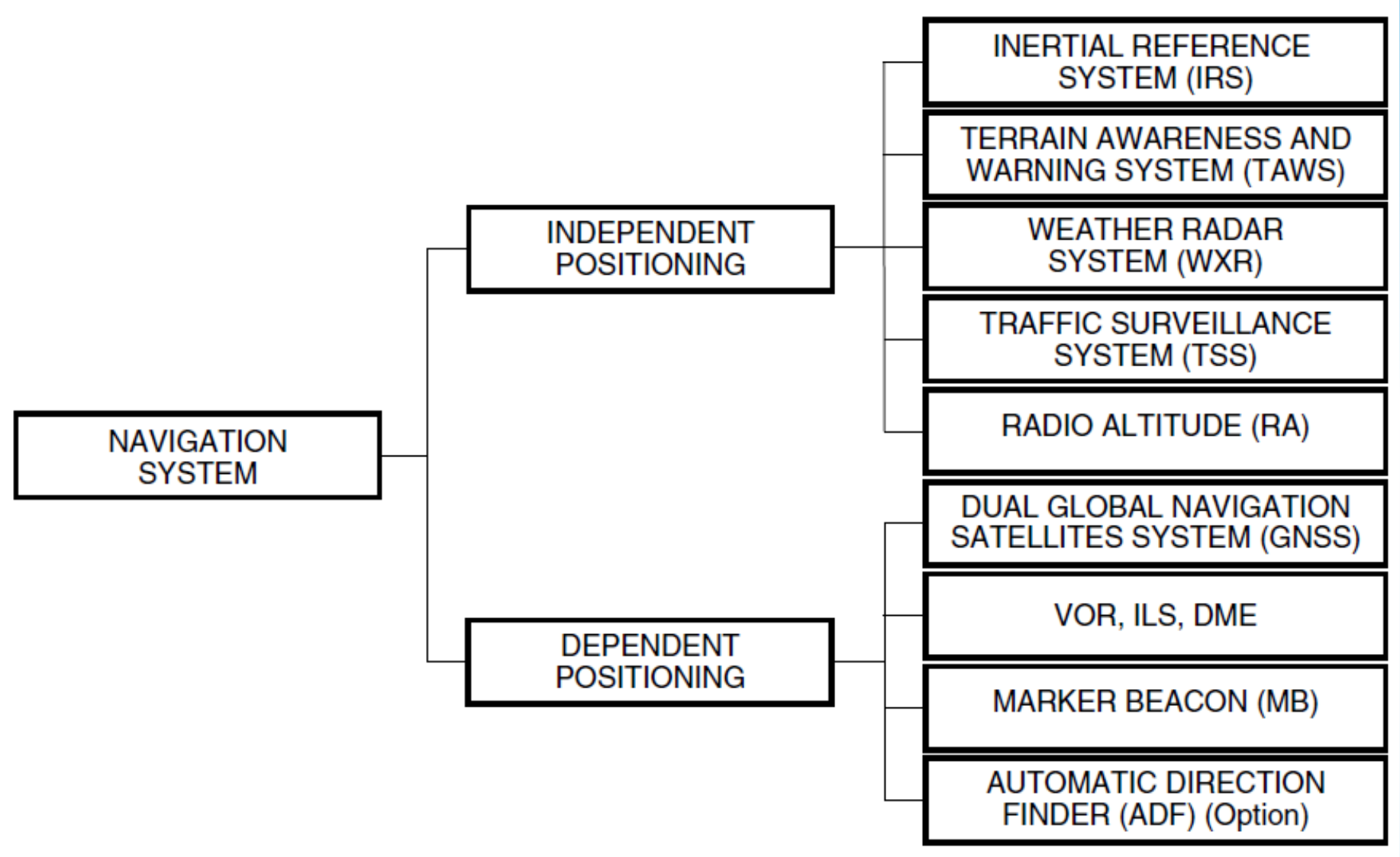








ATA 34: Navigation



ATA 35: Oxygen

OXYGEN AND EMERGENCY EQUIPMENT – OVERVIEW

The oxygen and emergency equipment system includes all the interior installations necessary for the flight and cabin crews to respond to emergency situations.

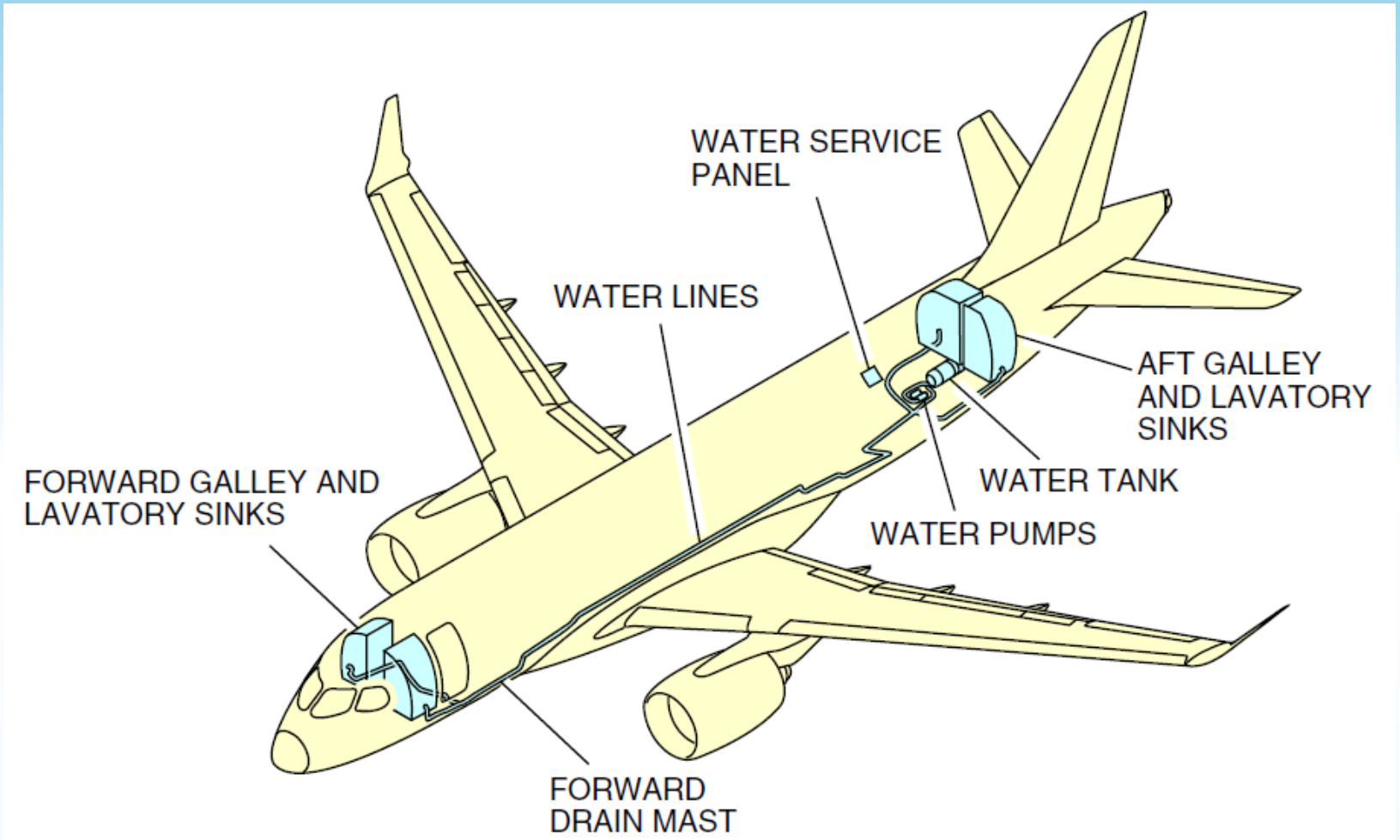
The oxygen system consists of:

- Flight compartment oxygen system,
- Cabin oxygen system, and
- Portable oxygen system.

The emergency equipment consists of:

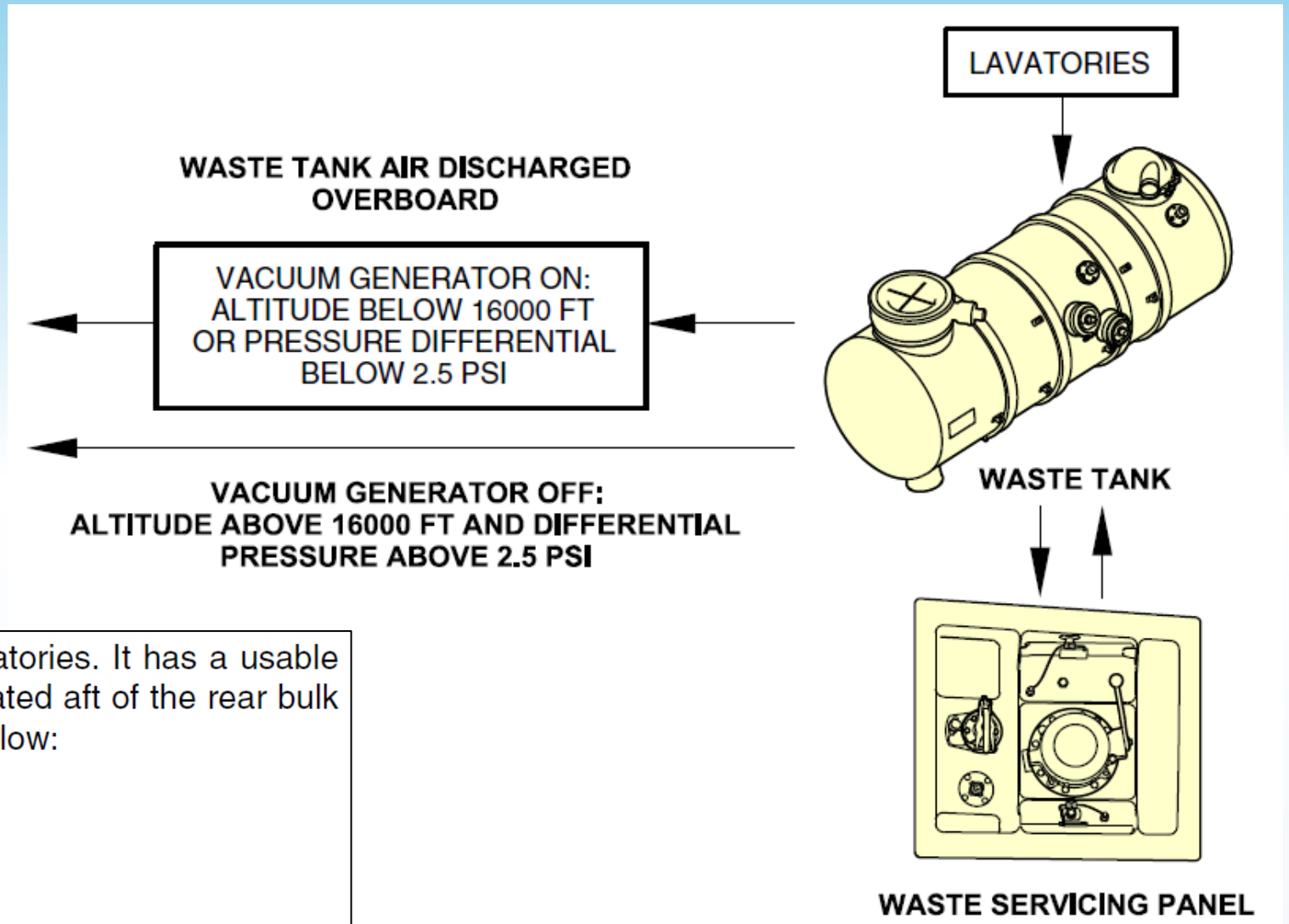
- Fire-fighting equipment,
- Overwater emergency equipment,
- Emergency exit slides,
- Emergency Locator Transmitter (ELT), and
- Other emergency equipment.

ATA 38: Water / Waste



Potable water system overview

ATA 38: Water / Waste



Waste system overview

One waste tank stores all the waste from the lavatories. It has a usable capacity of 144 liters (38 US gallons) and it is located aft of the rear bulk cargo compartment. It has the components that follow:

- An air/waste separator,
- Level sensors at 75% and 100%,
- An inlet assembly, and
- Rinse nozzles.

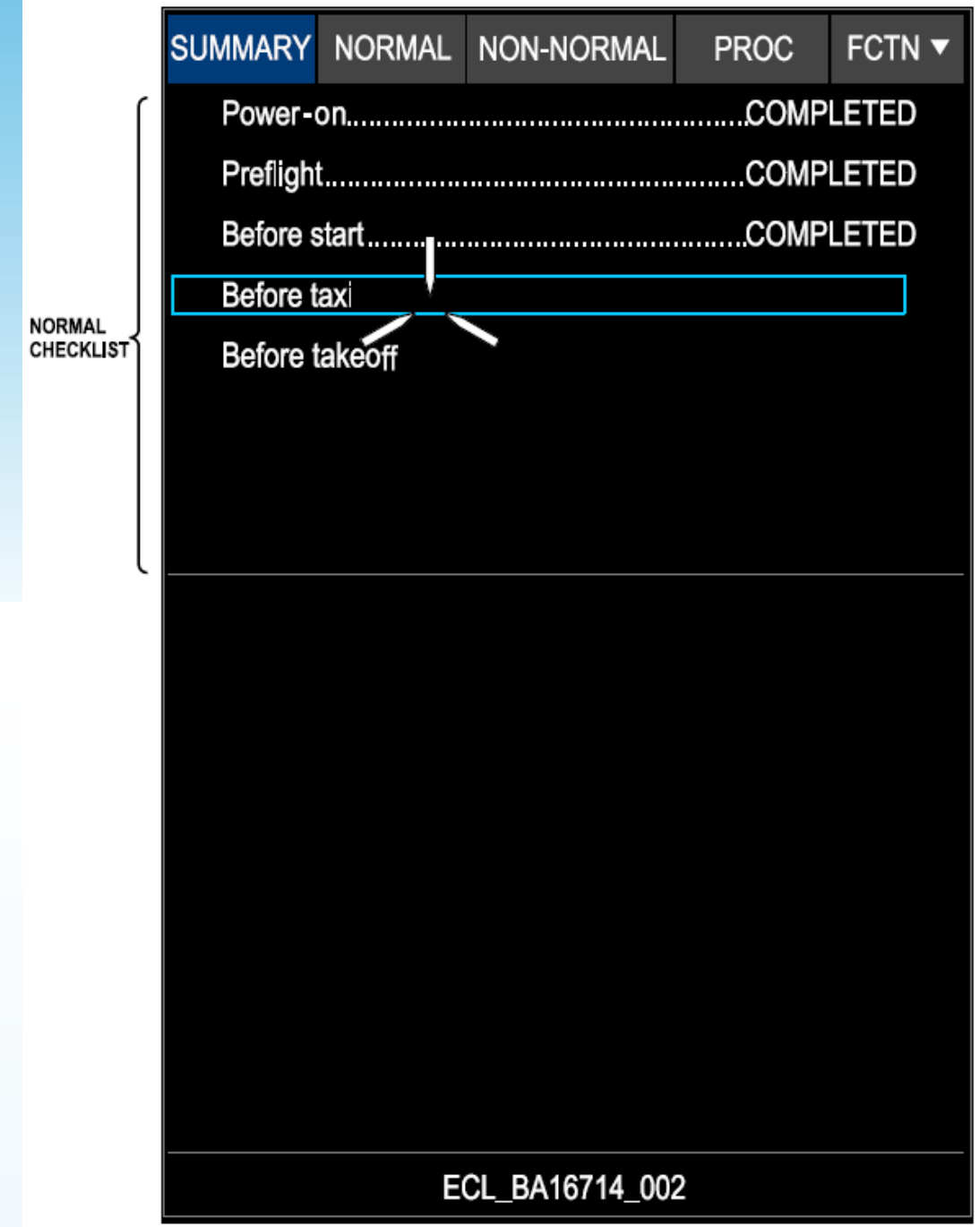
Electronic Checklist (ECL)

The Electronic Checklist (ECL) is displayed on the Multifunction Windows (MFWs) and is designed to reduce the flight crew workload. It gives access to the normal and non–normal procedures and checklists that are also available in the Electronic Flight Bag (EFB), iPad, or paper formats. The ECL, AFM, FCOM and QRH share the same content, with different formats.

The ECL is an interactive display with automatically sensed or manually selected items. The design of the ECL is efficient and helps the flight crews in regular and awareness situations.

The ECL controls include the panels that follow:

- Control Cursor Panel (CCP),
- Multifunction Keyboard Panel (MKP), and
- Control Tuning panel (CTP).



SUMMARY Page – ECL Upper Section