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Flight deck displays



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Instruments

- What do we need to know to fly?
 - Where we are going?
 - What is the attitude of the aircraft?
 - How are the systems performing?
- Humans have poor situational awareness in the air
 - Even worse in bad weather or at night!
- ‘Blind flying’ was demonstrated as early as 1929.....

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An early aircraft cockpit



Basic instruments, mainly monitoring the engine

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Bristol Blenheim

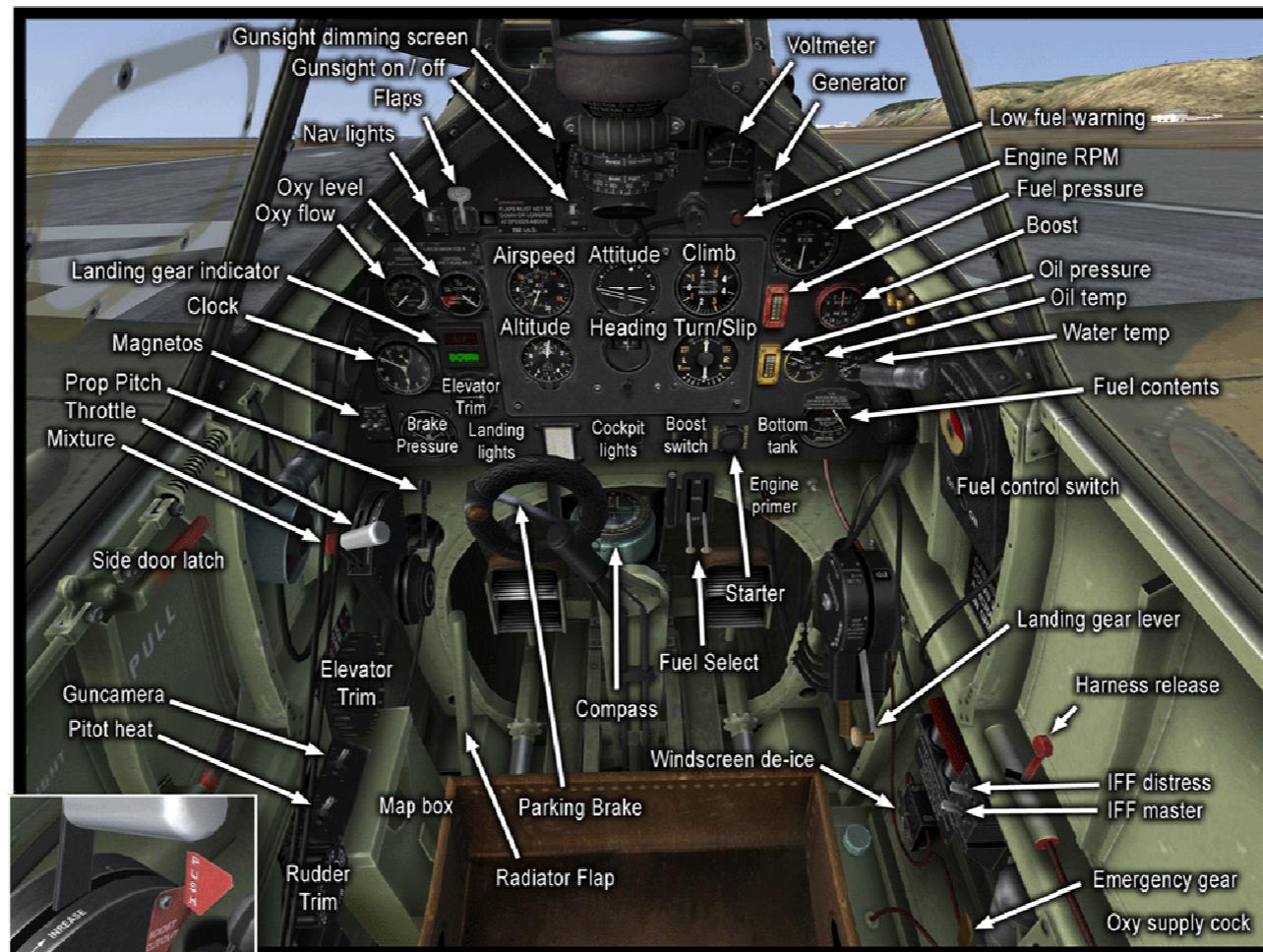


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Spitfire



Spitfire



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747 (early)



Primary flight Instruments – the Basic Six



- The ‘basic six’, defined in 1937 by the RAF, standardised instruments.

Attitude indicator

- The attitude indicator displays pitch and roll
- Also known as an 'artificial horizon'.
- Aircraft represented by stationary symbolic 'wings', while the horizon (earth = brown, sky = blue) rotates behind.
- Russian instruments are reverse!



Turn indication / coordination

- The ‘turn coordinator’ developed from the ‘turn and slip indicator’ uses yaw measurement to provide information on the rate and quality of turn, i.e. a good turn is one without side slip.
- Normally used on smaller aircraft. The rate of turn is standardised so a pilot will know how long it will take to turn through a particular angle. Here 2 mins/ 360°



Coord nated turn



Skid



Slip

Direction indicator, Horizontal situation indicator

- The direction indicator is normally driven from the inertial instruments and is complementary to a magnetic compass.
- On larger aircraft a more complex ‘horizontal situation indicator’ is used in place of the direction indicator, providing track information.



Primary flight Instruments – the Basic Six



Inertial

Air-data

- The ‘basic six’, defined in 1937 by the RAF, standardised instruments.

Primary flight Instruments – the Standard ‘T’



- The Standard ‘T’ arrangement is a subset of the basic six found in nearly every aircraft.

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Concorde

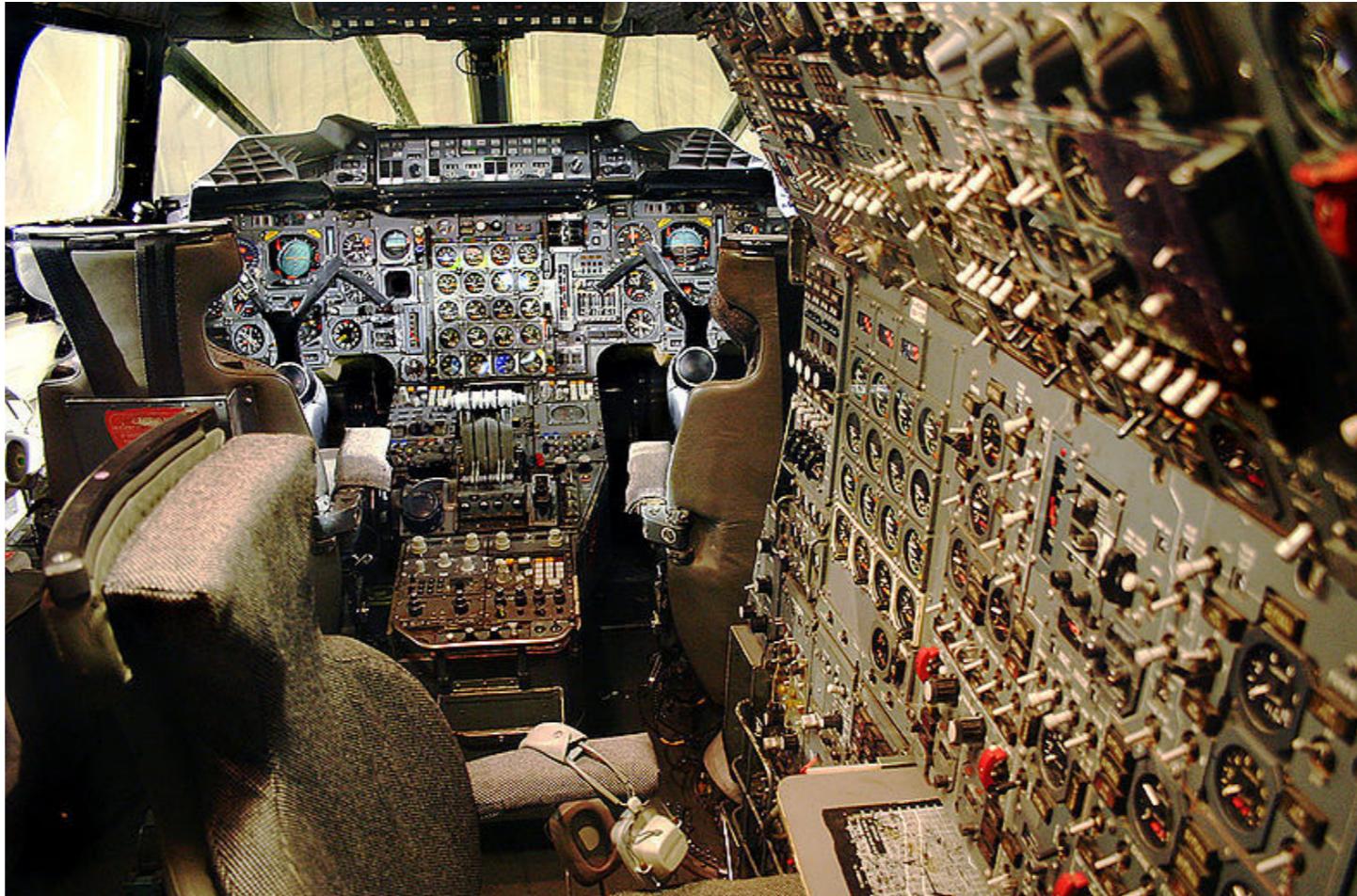


The flight engineer

- In addition to primary flight, navigation and system information are needed to operate the aircraft
- As aircraft became more complex it became impossible for the pilot to fly the aircraft alone.
- The post of 'flight engineer' was introduced in the late 1930's into both military and civilian aircraft.
- The flight engineer is responsible for the control and monitoring of the aircraft systems.
- Up until the recent advent of modern computer control systems, civil airliners would have a three-man crew: Captain, First Officer and flight engineer (or Second Officer).

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The flight engineer



The Glass cockpit

- Concorde was the ‘high water mark’ for analogue gauges.
- The complexity of both the installation (e.g. number of cables and connectors) and pilot capability to deal with information was at the limits.
- Information display priority was based on frequency of use, not immediate importance - critical indicators might end up out of sight.

- Since the late 1980’s displays employ reconfigurable ‘glass cockpits’ first based on CRTs and more recently on large area LCD.
- This allows information to be displayed according to relevance – e.g. in response to fault or emergency situation the relevant information can be displayed.
- Multi-function displays also provide redundancy.

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Experimental CRT-based glass cockpit (1975)



Courtesy: Malcolm Jukes



Primary Flight Display



Navigation Display



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A320 CRT flight deck in 1988



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Boeing 747 LCD displays in 1995

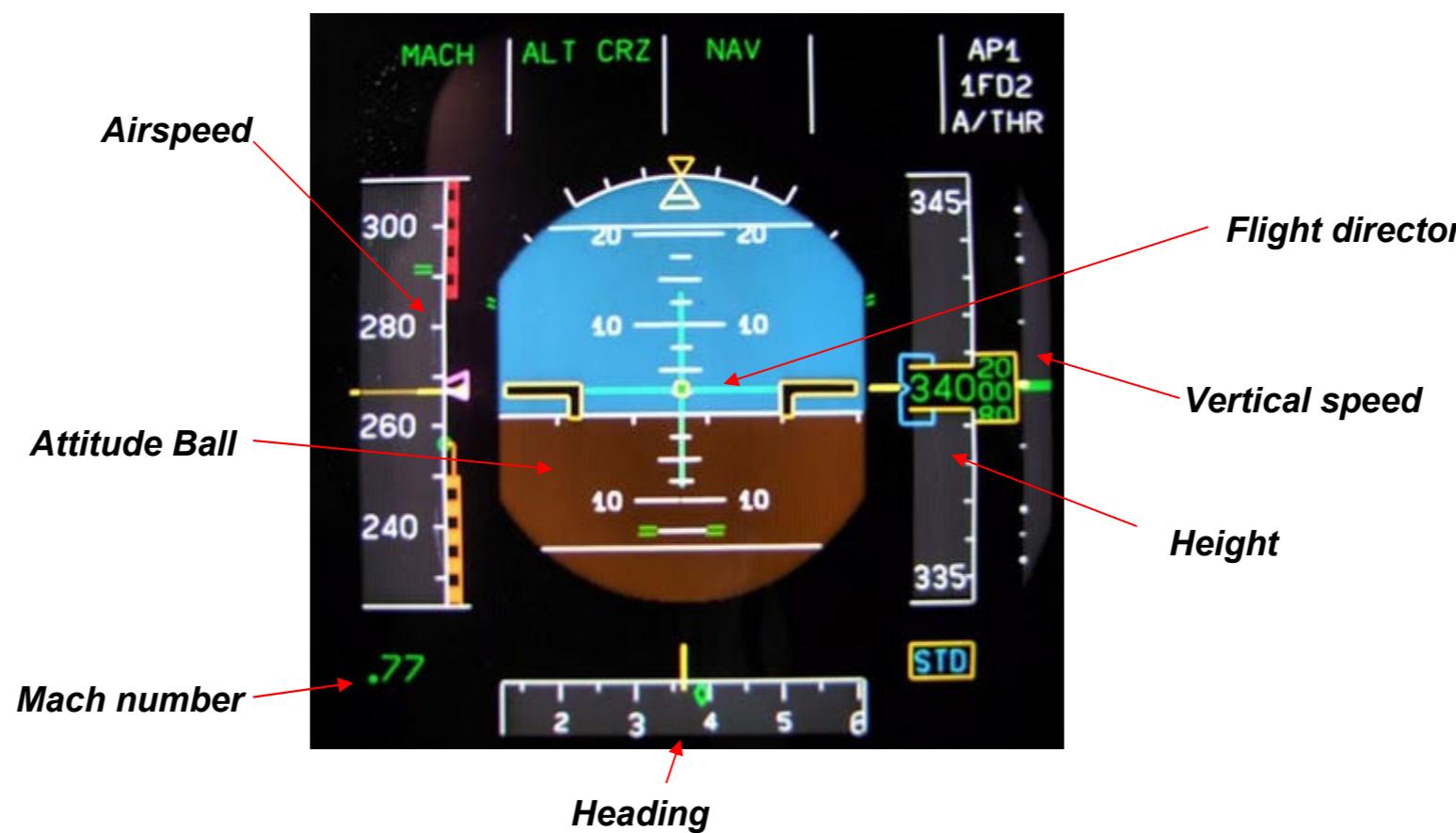


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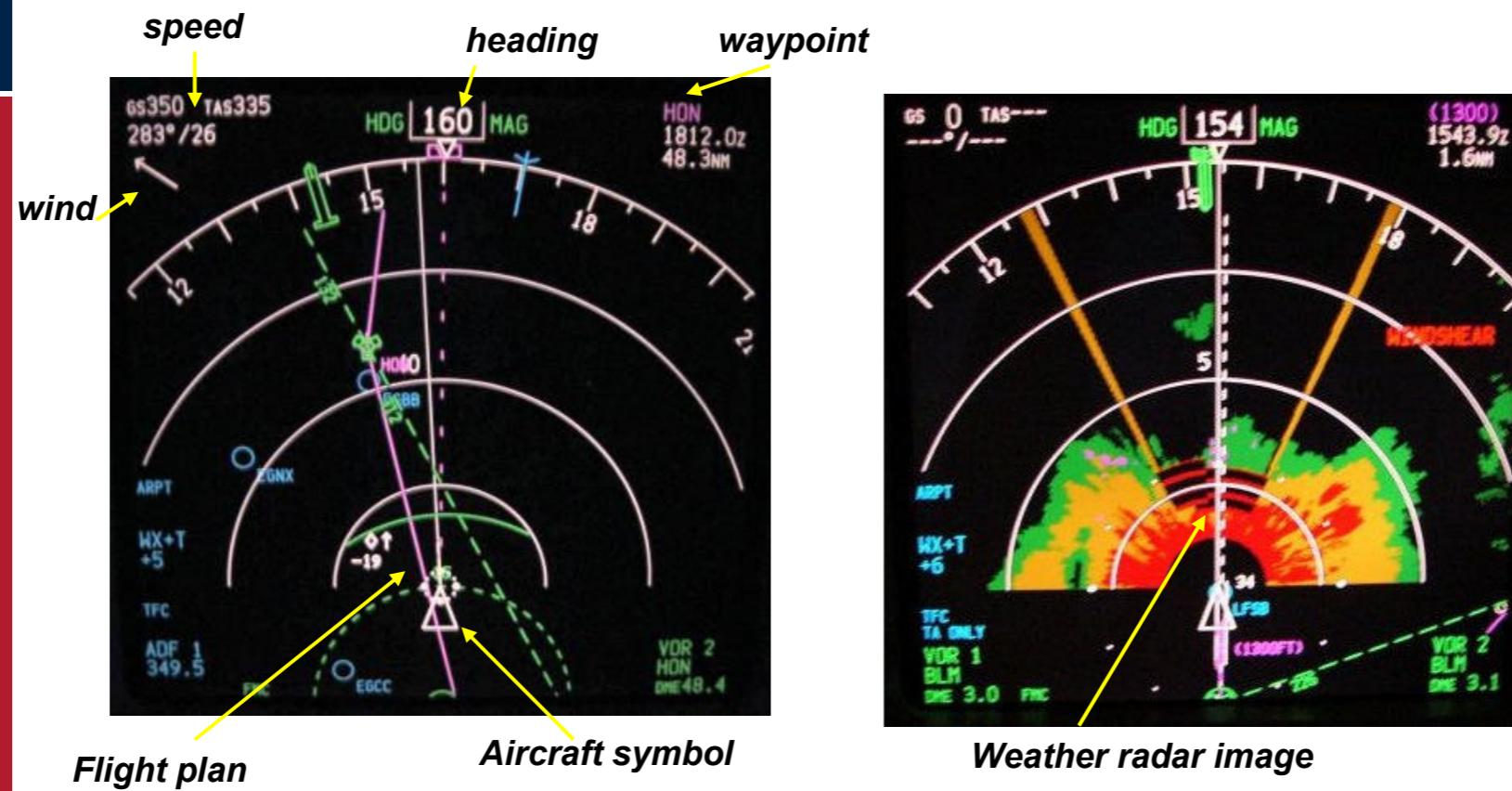
A380 large area LCD



Primary flight display



Navigation display



- The navigation display can show map and weather radar data

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A380 navigation and primary flight display



Integrated Standby flight display

- The standby flight display is a back-up instrument providing an independent display of primary flight data.
- It is also uses differing sensors and processors to the main displays, which provides redundancy



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A380 ECAM



- The Electronic Centralised Aircraft Monitor provides information on many of the aircraft's systems.
- The system can reduce pilot workload by automatically displaying important information.

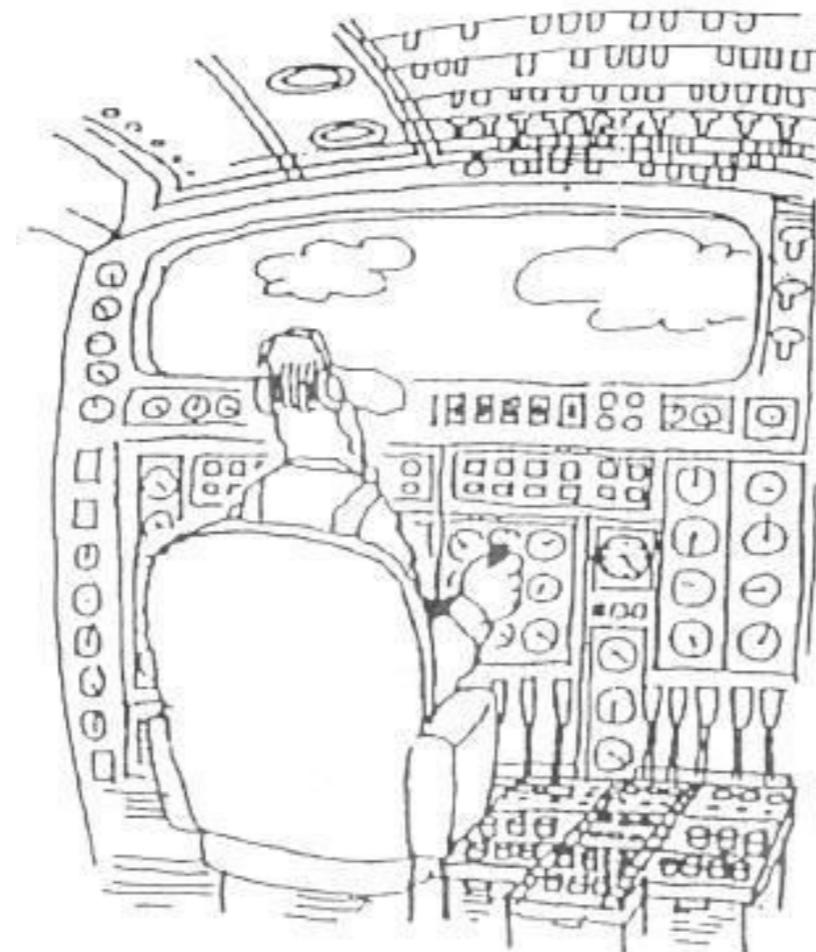
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787 / Concorde



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DC9



A320

