PART 1

CHAPTER 7 — FLIGHT INSTRUMENTS

Contents

Pitot-Static System

1. A combined pitot-static pressure head is on a probe in the nose of the aircraft and supplies the following:

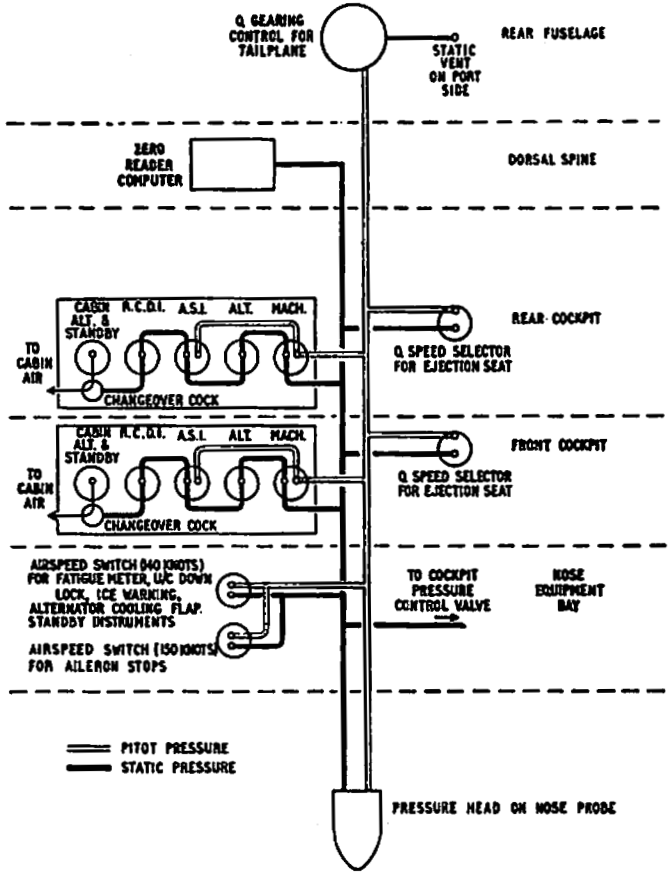
a. The pilots' ASI's, RCDI's, machmeters, servo-altimeters and, when selected, standby altimeters.

b. Tailplane q-gearing (Chapter 5). Pitot pressure only is supplied from the main system; a separate static vent is supplied on the port side of the fuselage.

c. Airspeed switch (140 ± 3 knots) for the fatigue meter, undercarriage down lock, ice warning and alternator cooling flap. This switch also connects the standby battery to the standby instruments control inverter (Chapter 1).

d. Airspeed switch (150 ± 3 knots) for the aileron stops (Chapter 5).

e. The q speed sensing for the ejection seats (Chapter 10). Zero Reader computer.



1—7 Fig 1 Pitot-Static System

2. The probe is electrically heated, the heater being controlled by a PRESS HEAD, ON/OFF switch on the front cockpit port console.

3. A ground test point in the spine of the aircraft shuts off the other services from the pitot pressure and allows the q-gearing to be tested on its own.

Pressure Operated Instruments

4. A standard ASI, RCDI and machmeter are supplied in each cockpit. The ASI has a flag which shows UC when the speed falls to 160 ± 4 knots, if the undercarriage is not locked down. An additional sector ASI is provided for the instructor above the panel coaming on the port side.

5. *Altimeters*

a. The Mk 22B servo-altimeter, one in each cockpit, reads up to 100,000 feet. On the face of the dial is a 4-aperture veeder counter; the first three apertures, reading from left to right, show feet in tens of thousands, thousands and hundreds respectively, while the right-hand aperture shows 00 or 50. The single pointer travels over a scale marked in hundreds of feet, giving more accurate readings (from 0 to 990 feet) of the figures shown in the two right hand apertures. The instrument embodies an amplifier using a 115 volt AC. If electrical supplies fail, or if the altimeter gearing is not functioning correctly, OFF (or three yellow striped flags) shows in windows above the veeder counters.

b. The Mk 22B altimeter incorporates an override switch which is designed to prevent damage to the altimeter mechanism by automatically cutting off electrical supply to the amplifier in the event of a servomotor runaway. The override switch may also operate when a large transient rise in frequency occurs, such as when changing or restoring the power supply. When the override operates, the altimeter ceases to function and the OFF flag appears. If the altimeter OFF flag appears and then does not disappear although the power supply is known to be connected to the instrument, attempt to reset the override switch by selecting up to the maximum millibar setting and then, if necessary, the minimum setting. When the override switch is

reset the OFF flag should disappear and the instrument should function as normal.

c. If the servo-altimeter fails for any reason, a cabin altimeter Mk 26 in each cockpit may be selected as a standby altimeter, by turning the adjacent control from CABIN to STATIC. This altimeter has a standard 3-needle presentation and can read up to 60,000 feet. The hairline needle indicates feet × 10,000, the short needle feet × 1000 and the long, thick needle feet × 100. The millibar setting knob is at the bottom left hand corner.

WARNING: Unless the CABIN/STATIC control is turned *fully* in the required direction, all pressure instruments in both cockpits may misread.

Integrated Flight Instrument System

Note: One fuse protects the DC circuit for the gyro erection coils, fast erection and compass changeover. Failure of this fuse results in false indications from the attitude indicator without direct evidence of failure. The fuse may be tested before flight, by pressing the navigation display fast erection button and noting that the amber light comes on; if the light does not come on, a further check can be made by selecting the compass from FRONT to REAR and noting that the front compass ceases to annunciate.

6. *General.* The integrated flight instrument system (IFIS) comprises a flight director, a navigation display and the electrically-operated servo-altimeter. The presentation is duplicated in the front and rear cockpits. Standby instruments are provided (para 10). The system uses 115 volt AC.

7. *Attitude Indicator and Flight Director*

a. The attitude indicator type F4 has a roller blind presentation; it gives continuous indication of pitch and roll on the roller blind and of bank by a pointer at the bottom of the blind frame. The blind is half black and half pale grey, the dividing line representing the natural horizon. At the zenith and nadir positions of the blind are cruciform markings; each has a long arm pointing towards the horizon. On the face of the instrument are two circles, representing 20° and 40° of pitch and, in the vertical plane only, the further

markings to indicate 10°, 30° and 50°. Roll markings on the instrument casing show 10°, 20°, 30°, 60° and 90° to port and starboard.

b. An orange disc, bearing two arrows, indicates power failure. The disc is normally covered by a black disc, which lifts up to show the orange disc if power fails. One arrow on the orange disc points to the attitude indicator and one to the navigation display, for which no separate warning device is provided.

c. A fast erection button close to the indicator enables the gyro to be erected rapidly.

d. A slip indicator is above and integral with the instrument.

e. A Zero Reader computer enables the system to act as a flight director. The flight director index, a small circle on the presentation, moves in accordance with signals from the computer, to give attitude demands. A parking facility is provided for the flight director indices, controlled by a PARK/NORMAL switch in the front cockpit, outboard of the ASI. With this switch at PARK, the indices are parked in the 2 o'clock position. On some aircraft, the switch is marked ON (free)/OFF (parked). The Zero Reader controller is on the starboard console of the front cockpit; attitude selection is made on this controller and course selection is made on the navigation display.

f. A canvas screen is provided to cover the attitude indicator after failure, to prevent disorientation. The screen is held in position by velcro strips and stowed on the cockpit fairing when not in use.

8. *Navigation Display*

a. The navigation display consists, basically, of a roller blind presentation, framed with a compass ring, the compass ring rotating about the roller blind. Around this display are grouped the following:

(1) A RANGE NM veeder counter (only operative when Tacan in use).

(2) A COMP/DG pushbutton, with a window which shows DG when this is selected.

(3) A compass monitoring annunciator, showing a dot and cross of the conventional type.

(4) A HDG (heading) selector knob, which is pressed in and turned to select compass headings and pulled out and turned to select ILS QDM.

(5) An ILS marker light.

(6) A SYN (synchronising) knob. A ratchet device allows movement of this knob in the correct direction only. A mode selector switch, allowing selection of COMP, ILS, TAC and DL.

(7) BEAM and GLIDE windows which show OFF except when ILS beam and glidepath signals are being received. Alternatively, yellow flags, labelled B and G, are visible whenever signals are not being received. An aircraft heading datum, consisting of an arrowhead at the top of the presentation.

(8) In addition, a FAST ERECT NAV pushbutton, embodying an amber light, is beside the display. The amber light comes on when the button is pressed and remains on if erection is not within 12°; it goes out when erection is within 12°. In the front cockpit there is a COMPASS CONTROL, FRONT/REAR switch, which enables the compass to be controlled from the selected cockpit; only the selected compass annunciates.

b. With the mode selector at COMP, the roller blind shows a black presentation. A white arrow inside the compass ring shows the selected heading and a white lubber line shows the actual aircraft heading, in conjunction with the heading datum.

c. With the mode selector at ILS, the roller blind presents ILS information within the compass ring. The localiser beam is shown as a double bar painted on the blind, while the glidepath indicator consists of a single horizontal bar moving vertically across the dial. These bars should cross beneath the index circle in the centre of the presentation, if the correct path is followed. If the glidepath indicator moves above the index, the aircraft is below the glidepath. The localiser is set, using the heading knob (see a. (4) above). Lateral movement of the bar indicates that the aircraft is to right or left of the beam, while rotational movement of the bar indicates deviation from the runway heading.

d. With the mode selector at TAC, offset Tacan signals are fed into the display and the roller blind displays a series of concentric arcs bisected by a straight line. The end of the line where the arcs bear

smaller numbers shows the heading of the point selected and the centre index shows the distance of the aircraft from the point. At the same time, the range is repeated (to the nearest nautical mile), on the veeder counter above the display. The Tacan controller is on the starboard console in the front cockpit. The offset computer, adjacent to the navigation display, is set with the distance and bearing of the selected point from the Tacan beacon.

e. With the mode selector at DL, the same roller-blind presentation is given but shows range and bearing of the Tacan beacon itself, regardless of any selections on the offset computer.

9. A switch in the rear cockpit, on the starboard console, enables the instructor to cut off electrical supplies to the FIS and the altimeter in the front cockpit. The switch is marked FIS FRONT DISPLAYS, ON/OFF; in the OFF position, monitoring is lost on the rear compass also, regardless of the position of the FRONT/REAR selector. The altimeter continues to indicate the altitude at which it was switched off and the failure flags show.

Standby Instruments

10. A standby artificial horizon, with a fast erection button, is provided in each cockpit.

11. A standby direction indicator, with a combined fast erection button and setting knob, is provided in each cockpit. The knob is pushed in for fast erection and turned in its normal position, for synchronisation of the DI with the E2B compass. When the knob is pushed in, a blue light at the top right-hand corner of the instrument comes on. The light goes out immediately the knob is released, unless the gyro is more than 15° from erection, when the light remains on while fast erection is taking place.

12. The standby altimeter is described in para 5 c.

13. An E2B compass is on the port coaming of the front cockpit and is visible from the rear cockpit.

14. The standby artificial horizons and the direction indicators normally operate on 115 volt AC but changeover automatically to DC operation if AC supplies fail. See Chapter 1, para 26.

Miscellaneous Instruments

15. *Accelerometers.* The accelerometer in the front cockpit is to the right of the instrument panel. That in the rear cockpit is above the instrument panel coaming. The front cockpit instrument may be reset in flight.

16. *Aileron Position Indicator and Yaw Indicators.* An aileron position indicator and two yaw indicators are provided above the instrument panel in each cockpit.

a. *Aileron Position Indicator.* This consists of a desynn type indicator. When the needle is vertical, the ailerons are central. Any movement of the needle to the left, for example, shows that the stick is to left of centre.

b. *Yaw Indicators.* These consist of two magnetic indicators, one on either side of the aileron indicator, operated by a gyro in the fuselage spine. If, say, the left-hand indicator shows white, the aircraft is yawing to the left. A label is provided below each indicator, stating the direction of yaw, ie LEFT and RIGHT. A test button is provided beside each indicator in the front cockpit; when a button is pressed, its indicator should show white. For a full functional check, the test must be done with AC on line, ie engine running.

17. *Feel Trim Position Indicator*

a. A feel trim position indicator is provided in each cockpit, outboard of the standard warning panel in the front cockpit and above the coaming, beside the accelerometer, in the rear cockpit. Each instrument has two sectors marked on it, a hatched segment between the 8 o'clock and 10 o'clock positions, known as the 'safe' sector and a solid segment between the 10 o'clock and 11 o'clock positions, known as the 'ideal' sector. The instrument is also marked NOSE UP/NOSE DOWN.

b. If hydraulic failure occurs, the feel trim should immediately be operated to bring the needle into the ideal sector, to ensure that full elevator control is available for landing. In the safe sector, reduced but adequate control is available for all except steep approaches.

18. *Stop Watch.* A retractable stop watch in the coaming above the front cockpit instrument panel is on a pivoting bracket and can be folded flat when not in use. A stop watch holder is provided above the coaming in the rear cockpit.

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