SECTION 11
FLIGHT INSTRUMENTS

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1. GENERAL

The primary flight instruments, which are mounted on each pilot's instrument panel, are either electrically or pneumatically operated and are integrally illuminated. Where applicable, display functions are displaced out of view when not in use, and a warning flag covers a display in the event of a malfunction. Each pilot has an alternative source of information for each primary flight instrument. The course and heading controls and AFCS controls are located on the centre pedestal for easy access by both pilots. For further information about these controls, refer to SECTION 4, AUTOMATIC FLIGHT CONTROL SYSTEM. A standby magnetic compass and an artificial horizon are also provided.

2. PITOT-STATIC SYSTEM AND TEMPERATURE SENSING SYSTEM (Figure 1)

The pitot-static system provides the pitot and static pressures required to operate the pneumatic flight instruments, the air data computer (ADC) and the cabin pressure indicator. The system consists of the pilot's and copilot's pitot-static tubes, left and right static ports, A.D.S. HEATER CONT. panel, pilot's and copilot's PITOT HEAT fail annunciators and pilot's and copilot's STATIC PRESSURE SELECTOR VALVES. A temperature-sensing probe located on the right side of the forward fuselage provides a total-air-temperature input to the air data computer. The pitot tubes, the static ports and the temperature probe contain anti-icing heater elements which are controlled from the A.D.S. (air data sensors) HEATER CONT. panel.

On aircraft with STC No. SA99NE incorporated, the pitot-static system is also equipped with pilot's and copilot's STALL PROTECT valves.

The copilot's mach/airspeed, altimeter and vertical speed indicators are connected directly to the pitot-static system. The corresponding instruments on the pilot's side are connected to the air data computer. The controls associated with the pitot-static system are the A.D.S. HEATER CONT. panel and the STATIC PRESSURE SELECTOR VALVES.

On aircraft with STC No. SA99NE incorporated, the controls associated with the pitot-static system are the A.D.S. HEATER CONT. panel, the STATIC PRESSURE SELECTOR VALVES and the STALL PROTECT valves.

A. ADS Heater Control Panel

The A.D.S. HEATER CONT. panel contains the switches and indicators for the pitot-static anti-icing system. The application of power to the heating elements in the pitot-static tubes, the static ports and the temperature...
Pitot-Static System - Components

Figure 1 (Sheet 1)
Pitot-Static System - Components

Figure 1 (Sheet 2)

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sensing probe is controlled by the PWR & METER SELECT switch. Power is applied when the switch is set to any position except HTRS OFF.

If the amber HTR FAIL warning light on the control panel comes on, the failure of one of the static port heaters is indicated. To determine which heater has failed, rotate the PWR & METER SELECT switch through the STATIC L and STATIC R positions. The defective heater is indicated by a reading in the red zone on the % HTR CURRENT meter. After the defective heater is determined, pressing the HTR FAIL switch/light causes the warning light to go out and resets the fault detection circuits.

When the PWR & METER SELECT switch is set to HTRS OFF, the HTR FAIL light comes on and the % HTR CURRENT meter gives a red zone reading. Although power is applied to the two pitot-static tube heaters via the A.D.S. HEATER CONT. panel, a pitot-static tube heater failure is not indicated by the HTR FAIL warning light.

B. Static Pressure Selector Valve

The pilot's and copilot's STATIC PRESSURE SELECTOR VALVES each have two positions - STATIC TUBE and ALTERNATE SOURCE. The STATIC TUBE position is the normal (guarded) position. In normal operation, the static ports are used only to operate the cabin pressure indicator. When the pilot's STATIC PRESSURE SELECTOR VALVE is set to the ALTERNATE SOURCE position, static port pressure is also supplied to the air data computer instead of static pressure from the pitot-static tubes. When the copilot's STATIC PRESSURE SELECTOR VALVE is set to ALTERNATE SOURCE, the copilot's pneumatic flight instruments receive static pressure inputs from the static ports instead of the pitot-static tubes. The setting of the STATIC PRESSURE SELECTOR VALVE does not affect the cabin pressure indicator, which always operates on static port pressure.

C. Stall Protect Valve

The pilot's and copilot's STALL PROTECT valves each have STATIC NORMAL and CLOSED positions. When a valve is in the STATIC NORMAL position, the selected static source is directed to the stall transducer. When a valve is set to CLOSED position, the selected static source is shut off from the stall transducer.

D. Pitot Heat Failure Indicator

The pilot's and copilot's instrument panels each contain an amber PITOT HEAT warning light. If the heater element in the pilot's or copilot's pitot-static tube becomes defective, the associated PITOT HEAT warning light comes on. The pitot-static tube warning circuits cannot be reset. The PITOT HEAT warning lights also come on when the PWR & METER SELECT switch on the A.D.S. HEATER CONT. panel is set to HTRS OFF.
3. ATTITUDE REFERENCE SYSTEM (Figure 2)

Primary attitude reference is provided by two, electrically driven vertical gyros. Gyro VG-1 supplies pitch and roll attitude data to the pilot's ADI and flight director computer. VG-2 supplies pitch and roll attitude data to the copilot's ADI and flight director computer. Each vertical gyro also produces a validity signal which, if lost, causes the red ATT flag to come into view on the associated ADI.

A. Gyro Fast Erect

The pilot and copilot each have a GYRO FAST ERECT switch/light for use when a gyro is suspected of toppling or drifting. When the switch/light is pressed, and the aircraft is within 6 degrees of level flight, the gyro erects in 3 minutes.

B. Flight Director Switching Panel

The flight director switching panel has a CAPT FLT DIR switch with two positions - NORM and NAV 2:

(1) NORM Position

Navigational information for the pilot's flight director is supplied from the NAV 1 receiver.

(2) NAV 2 Position

Navigational information for the pilot's flight director is supplied from the NAV 2 receiver.

4. HEADING REFERENCE SYSTEM (Figure 3)

The compass system provides primary heading data to the horizontal situation indicators (HSIs), the radio magnetic indicators (RMIs), and the automatic flight control system (AFCS). The data is provided by two flux valve/directional gyro systems, corrected for the aircraft magnetic fields. The output of gyro DG-1 supplies the pilot's HSI and the copilot's RMI, and gyro DG-2 supplies the pilot's RMI and the copilot's HSI. This arrangement ensures that both pilots receive heading information, even if one gyro system is inoperative.

A. Compass Control Panels

Two compass control panels are provided, one for each system. Each panel contains a mode switch and a slew switch. The compass control panel is shown in Figure 3 (Sheet 1).

For aircraft 1021 and subs, the compass control panel is shown in Figure 3 (Sheet 2).
PILOT'S SWITCH/LIGHT
When pressed, erects gyro within 3 minutes, if aircraft is within 6-degree level flight.

COPILOT'S SWITCH/LIGHT
When pressed, erects gyro within 3 minutes, if aircraft is within 6-degree level flight.

Flight Director Switching Panel
Figure 2
**MODE SWITCH**
Controls mode of operation of the system.

DG — Directional gyro in free mode.

SLAVED — Directional gyro controlled by flux valve.

**NULL METER**
Displays synchronization error between the flux valve heading and the gyro heading. When system is synchronized, the pointer is in the central position.

**SYNCH SWITCH**
Switch is slewed to synchronize gyro with the flux valve.

**EFFECTIVITY: A/C 1004 TO 1020**
MODE SWITCH

Controls mode of operation of the system.

DG - Directional gyro in free mode.

SLAVED - Directional gyro controlled by flux valve.

SYNCH SWITCH

Switch is slewed to synchronize gyro with the flux valve.

EFFECTIVITY: A/C 1021 & SUBS

Compass Control Panel
Figure 3 (Sheet 2)
(1) Mode Switch

The mode switch has two positions - DG and SLAVED. In the SLAVED position, the flux valve determines the magnetic heading and the gyro is slaved to follow. The compass is normally operated in the SLAVED mode in non-polar regions.

In the DG position, the heading data is provided by the gyro alone. Operation in this mode applies in polar regions, where the earth's magnetic field is too concentrated for the flux valves to resolve accurate directional readings.

(2) Slew Switch

The slew switch is used to slew the gyro in either direction until it is synchronized with its flux valve. This is indicated by a null reading on the compass control panel null meter.

On aircraft 1021 and subs, this is indicated by a cross-dot alignment on the HSI compass sync annunciator.

5. INSTRUMENT COMPARATOR (Figure 4)

The INSTRUMENT COMPARATOR monitors the dual instrument system for correct pitch and roll. It also monitors the difference in localizer signals between NAV-1 and NAV-2, after capture. If a predetermined difference between the pilot and copilot systems is exceeded, the appropriate ROLL, PITCH, HDG, GS or LOC amber warning light comes on.

The TEST/RESET switch/light is provided to test the comparator circuits and the warning lights. All lights should come on when the TEST/RESET switch/light is pressed. The TEST/RESET switch/light also resets any previously disabled channel.

The MNTR light monitors the unit power supply, and comes on if the output voltage drops below a predetermined level.

The WARN DISABLE switch/light is used to disable a warning light until the fault is corrected or the circuit reset.

If a power supply fault develops, the MNTR light cannot be disabled by the WARN DISABLE switch/light. The fault must be cleared before the MNTR light can be reset.
OPERATING MANUAL

PITCH LIGHT
Comes on when a difference exists between the dual pitch channels.

ROLL LIGHT
Comes on when a difference exists between the dual roll channels.

LOCALIZER LIGHT
Comes on when a difference exists between the two localizer signals.

TEST/RESET SWITCH
Tests the internal electronics and annunciator lights. Resets any prior disabled channel.

HEADING LIGHT
Comes on when a difference exists between the two heading signals.

VOLTAGE MONITOR LIGHT
Comes on when the internal power supply voltage drops below a predetermined level.

WARN/DISABLE SWITCH/LIGHT
Amber light comes on when one or more drive signals from the above six functions produce a master warning drive signal. Pressing the button disables all monitoring functions except the voltage monitor.

GLIDE SLOPE LIGHT
Comes on when a difference exists between the two glide slope signals.
6. PRIMARY FLIGHT INSTRUMENTS

A. Electrically Operated Flight Instruments

The electrically operated flight instruments are:

- Instrument Comparator (Figure 4)
- Pilot's Mach/Airspeed Indicator (Figure 5)
- Pilot's Altimeter (Figure 6)
- Pilot's Vertical Speed Indicator (Figure 7)
- Radio Altimeter (Figure 8)
- Horizontal Situation Indicator (Figure 9, Sheet 1 - A/C 1004 to 1020)
- Horizontal Situation Indicator (Figure 9, Sheet 2 - A/C 1021 and subs)
- Attitude Director Indicator (Figure 10, Sheet 1 - A/C 1004 to 1020)
- Attitude Director Indicator (Figure 10, Sheet 2 - A/C 1021 and subs)

B. Pneumatically Operated Flight Instruments

The pneumatically operated flight instruments are:

- Copilot's Mach/Airspeed Indicator (Figure 11)
- Copilot's Altimeter (Figure 12)
- Copilot's Vertical Speed Indicator (Figure 13)

7. STANDBY FLIGHT INSTRUMENTS

An artificial horizon and a magnetic compass, both self-contained and completely independent of other systems, are provided as standby instruments.

A. Artificial Horizon (Figure 14)

The artificial horizon indicator displays pitch and roll aircraft attitude information. Vertical attitude is maintained by a mechanical erection system. The indicator continues to provide attitude information for a minimum of 9 minutes after loss of power.

The dual-function PULL TO CAGE knob is pulled to cage the indicator, and rotated to adjust the miniature airplane for varying pitch attitudes.

The OFF flag is normally out of view, but comes into view to indicate a caged condition, an open internal motor winding, or loss of power.
B. Standby Magnetic Compass (Figure 15)

The standby magnetic compass is aligned with the aircraft longitudinal axis and is the self-contained, dry type. A miniature aircraft pointer displays the heading against a rotating vertical compass card.
Pilot's Mach/Airspeed Indicator
Figure 5
Pilot's Altimeter
Figure 6

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Pilot's Vertical Speed Indicator
Figure 7
OPERATING MANUAL

EFFECTIVITY: A/C 1004 TO 1020

AMBER LIGHT
Illuminate at DH

TEST SWITCH
Pointer indicates 50 ft.
DH light comes on with
DH set at 50 ft.

RED FLAG
Loss of power
Invalid signal

DH INDEX

DH SETTING KNOB

Radio Altimeter
Figure 8

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Horizontal Situation Indicator

Figure 9 (Sheet 1)
Horizontal Situation Indicator
Figure 9 (Sheet 2)
Attitude Director Indicator

Figure 10 (Sheet 2)

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MACH NUMBER
OFF flag displayed if no power

Copilot's Mach/Airspeed Indicator
Figure 11
Copilot's Vertical Speed Indicator
Figure 13
Standby Artificial Horizon
Figure 14
Standby Magnetic Compass
Figure 15