

SECTION 7

INSTRUMENT INSTALLATION

LIST OF CHAPTERS OVERLEAF

SECTION 7

INSTRUMENT INSTALLATION

LIST OF CONTENTS

Note . . .

A list of contents appears at the beginning of each chapter.

- 1 General information
- 2 Not used
- 3 Not used
- 4 Flight instruments

Chapter 1 GENERAL INFORMATION

LIST OF CONTENTS

	<i>Para.</i>		<i>Para.</i>
<i>General</i>	1	<i>9000 series switches</i>	4
<i>Location of equipment</i>	3		

LIST OF ILLUSTRATIONS

	<i>Fig.</i>
<i>Location diagrams</i>	
<i>Instrument installation - pilot's station</i>	1
<i>Instrument installation - navigator's station</i>	2
<i>Instrument installation - A.E.O.'s station</i>	3
<i>Instrument installation - port fuselage</i>	4
<i>Instrument installation - starboard fuselage</i>	5-5A
<i>Instrument installation - starboard main plane</i>	6
<i>Instrument installation - port main plane</i>	7
<i>Access panels</i>	8

WARNING

The relevant safety precautions detailed on the **LETHAL WARNING** marker card must always be observed before entering the cabin or performing any operations upon the aircraft.

General

1. This section contains a description of the instrument system and information covering the servicing of the equipment. It is divided into self-contained chapters in which the equipment is described under suitable functional headings such as Engine Instruments, Flight Instruments, etc.
2. A list of equipment included in each chapter details the References of the items and the number of the Air Publication in which they are

described.

Location of equipment

3. Location of the instruments and of the access panels for servicing them are shown on the location diagrams contained in this chapter.

9000 series switches

4. Some of the 9000 series switches fitted on the aircraft, may incorporate a lever lock at the centre position only, or at the operated position, or at the operated positions and centre position. To operate any of these switches, the switch toggle must be pulled to unlock the toggle, before the next selection can be made.

KEY TO FIG. 1 (PILOT'S STATION)

- | | | | |
|----|--------------------------------------|----|---|
| 1 | E2B COMPASS | 20 | No. 2 ENGINE FUEL PRESSURE WARNING LAMP |
| 2 | MACHIMETER | 21 | No. 1 TANK FUEL CONTENTS GAUGE |
| 3 | AIR SPEED INDICATOR | 22 | No. 2 TANK FUEL CONTENTS GAUGE |
| 4 | ARTIFICIAL HORIZON | 23 | No. 3 TANK FUEL CONTENTS GAUGE |
| 5 | ACCELEROMETER | 24 | No. 1 ENGINE OIL PRESSURE GAUGE |
| 6 | OXYGEN WARNING BLINKER (PILOT) | 25 | No. 1 ENGINE FUEL PRESSURE WARNING LAMP |
| 7 | RATE-OF-CLIMB INDICATOR (V.S.I.) | 26 | GM4B COMPASS D.G. SWITCH |
| 8 | No. 1 ENGINE TACHOMETER INDICATOR | 27 | RADIO ALTIMETER |
| 9 | EXHAUST GAS TEMPERATURE INDICATOR | 28 | TURN-AND-SLIP INDICATOR |
| 10 | No. 2 ENGINE TACHOMETER INDICATOR | 29 | GM4B COMPASS GYRO UNIT |
| 11 | OXYGEN WARNING BLINKER (NAV'S) | 30 | ALTIMETER MK.29B |
| 12 | OXYGEN WARNING BLINKER (A.E.O.'S) | 31 | OMNI BEARING SELECTOR (O.B.S.) |
| 13 | OXYGEN CONTENTS GAUGES | 32 | RADIO MAGNETIC INDICATOR (R.M.I.) |
| 14 | HYDRAULIC ACCUMULATOR PRESSURE GAUGE | 33 | OXYGEN REGULATOR |
| 15 | BRAKE PRESSURE GAUGE | 34 | FLAPS POSITION INDICATOR |
| 16 | CABIN ALTIMETER | 35 | AILERON TRIM INDICATOR |
| 17 | MIXING VALVE INDICATOR | 36 | RUDDER TRIM INDICATOR |
| 18 | TACAN INDICATOR | 37 | TAIL PLANE TRIM INDICATOR |
| 19 | No. 2 ENGINE OIL PRESSURE GAUGE | | |

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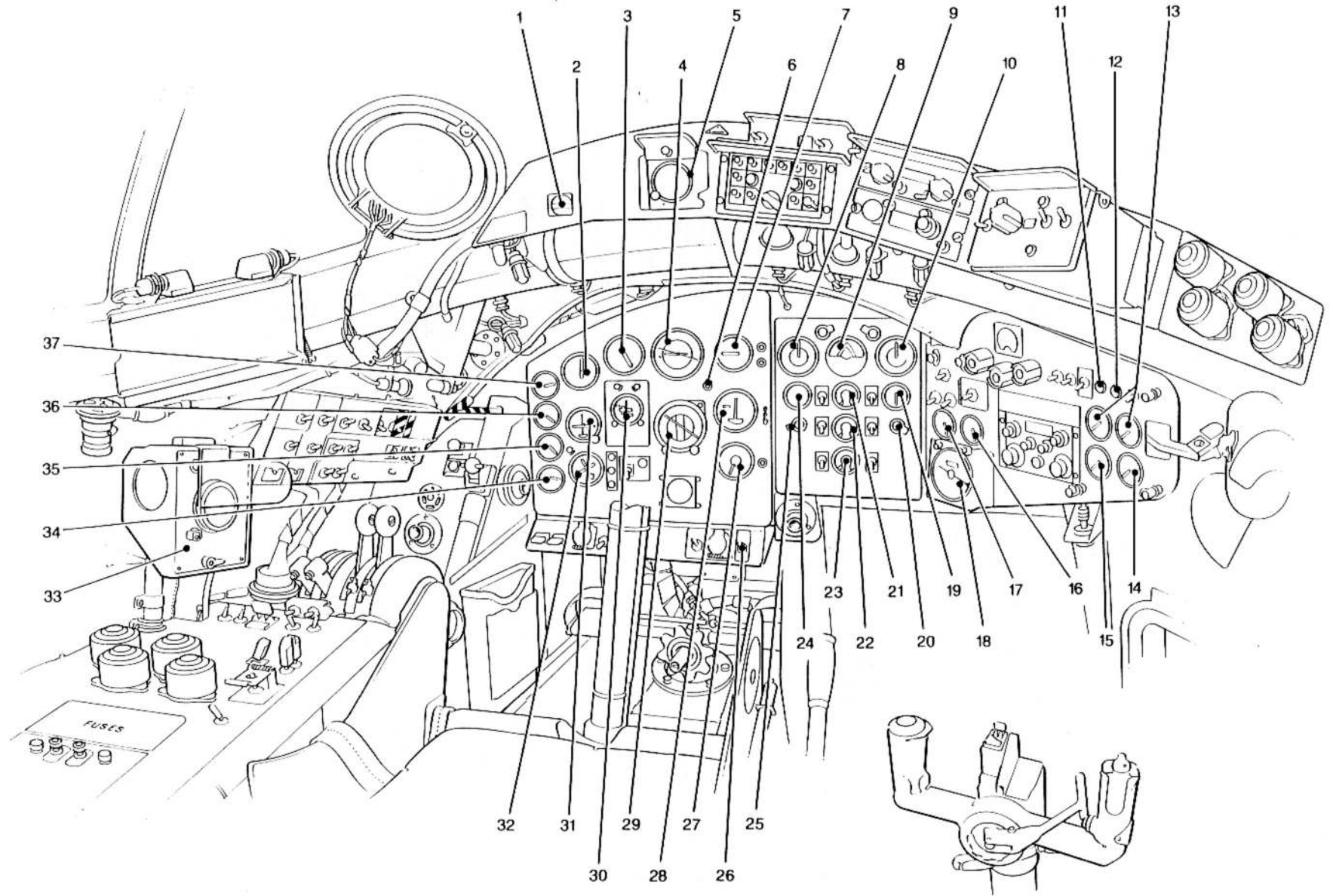


FIG. 1. INSTRUMENT INSTALLATION - PILOT'S STATION

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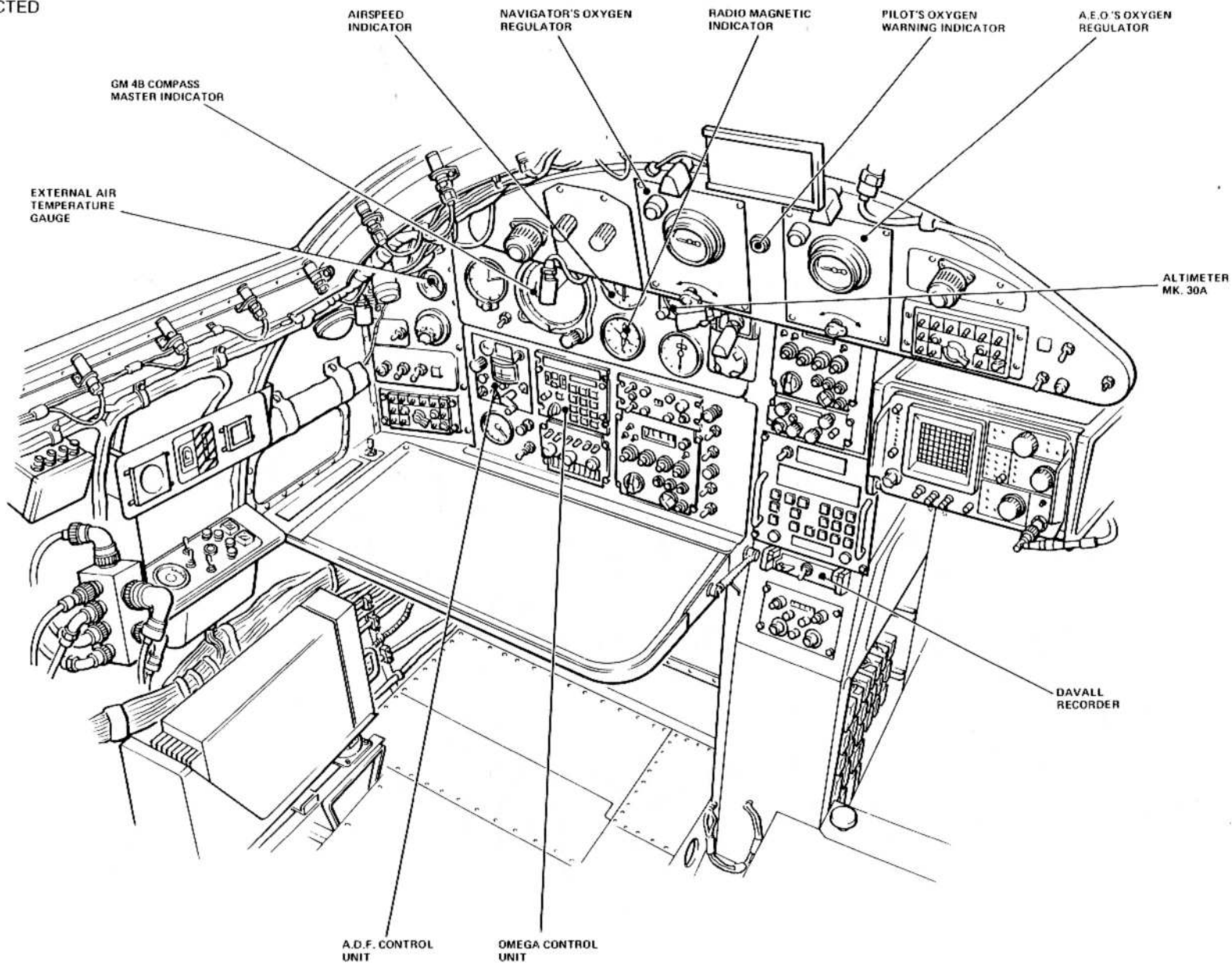


FIG. 2. INSTRUMENT INSTALLATION - NAVIGATOR'S STATION

◀ NAVIGATOR'S STATION AMENDED ▶

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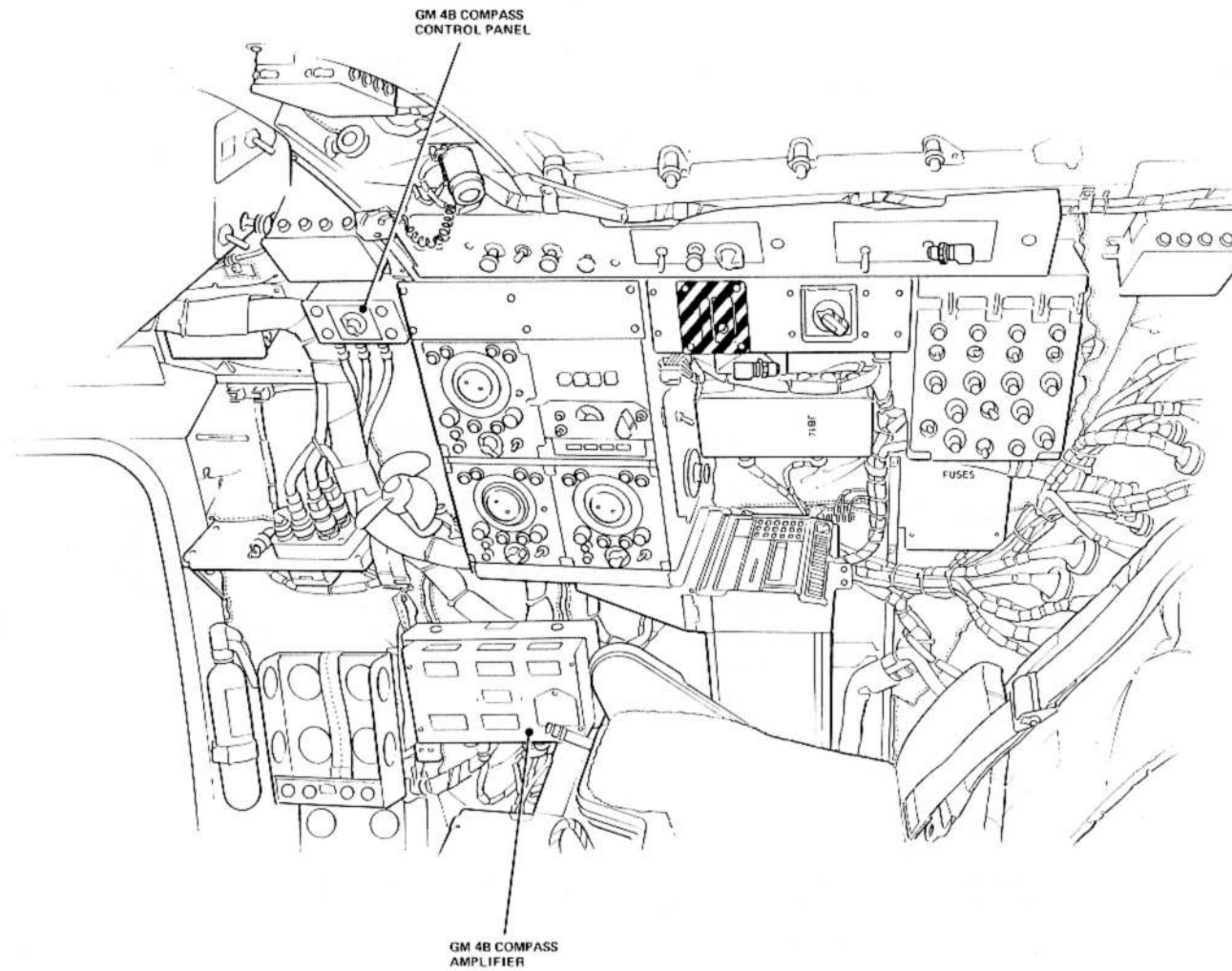


FIG. 3. INSTRUMENT INSTALLATION - A.E.O's STATION

◀ LIGHTING AMENDED ▶

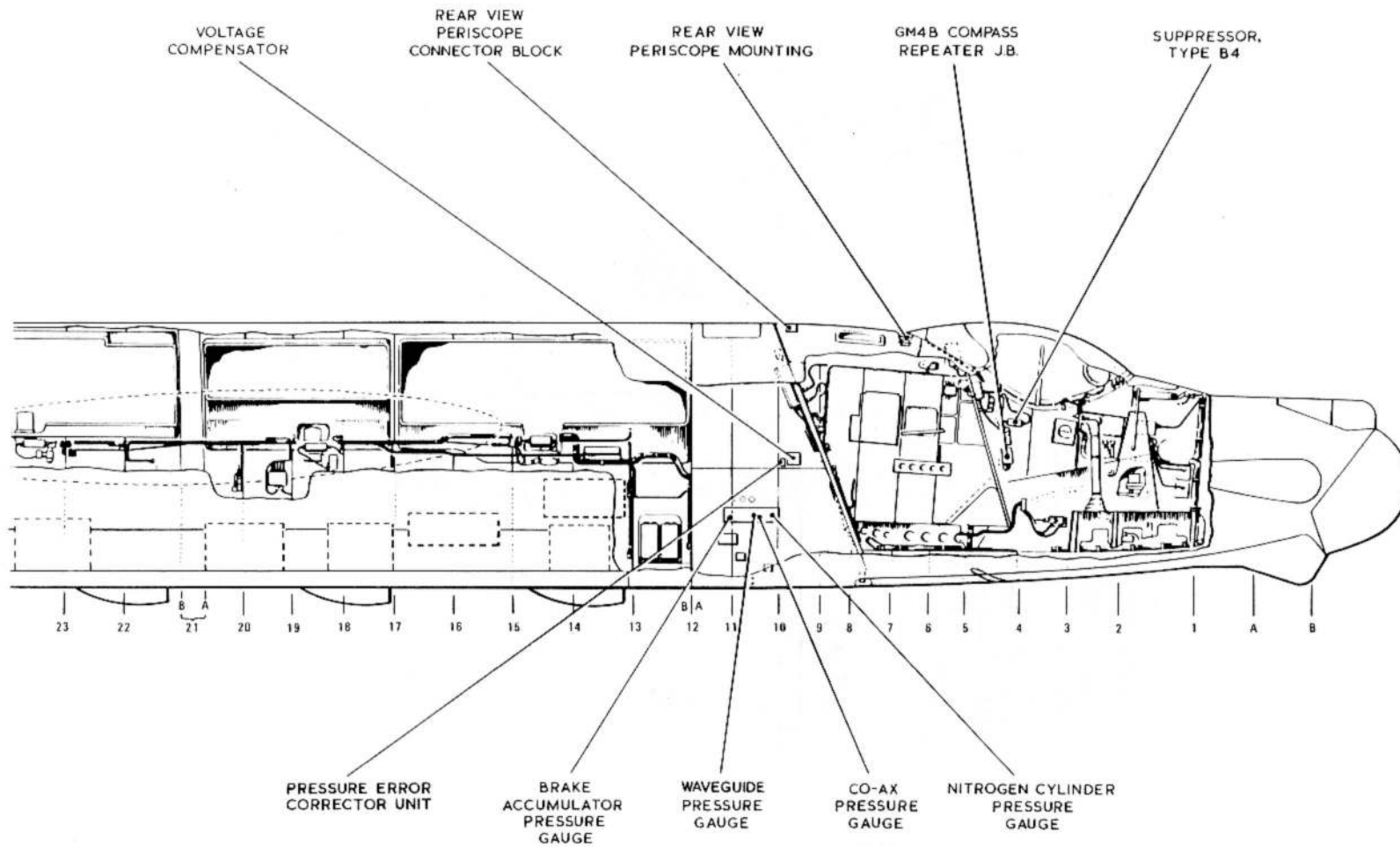


FIG. 4. INSTRUMENT INSTALLATION - PORT FUSELAGE

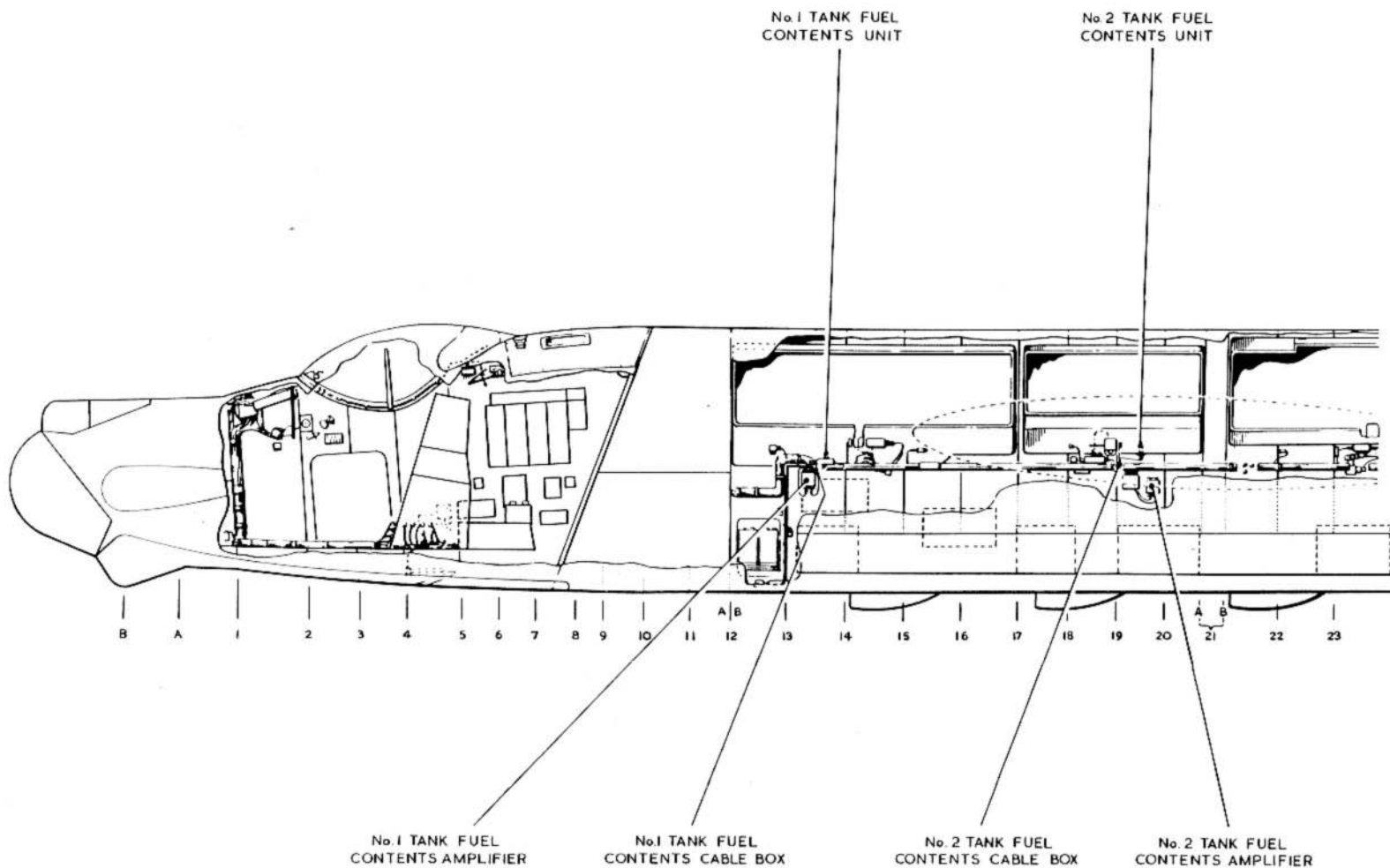


FIG. 5. INSTRUMENT INSTALLATION - STARBOARD FUSELAGE

◀ SPECIAL EQUIPMENT AMENDED ▶

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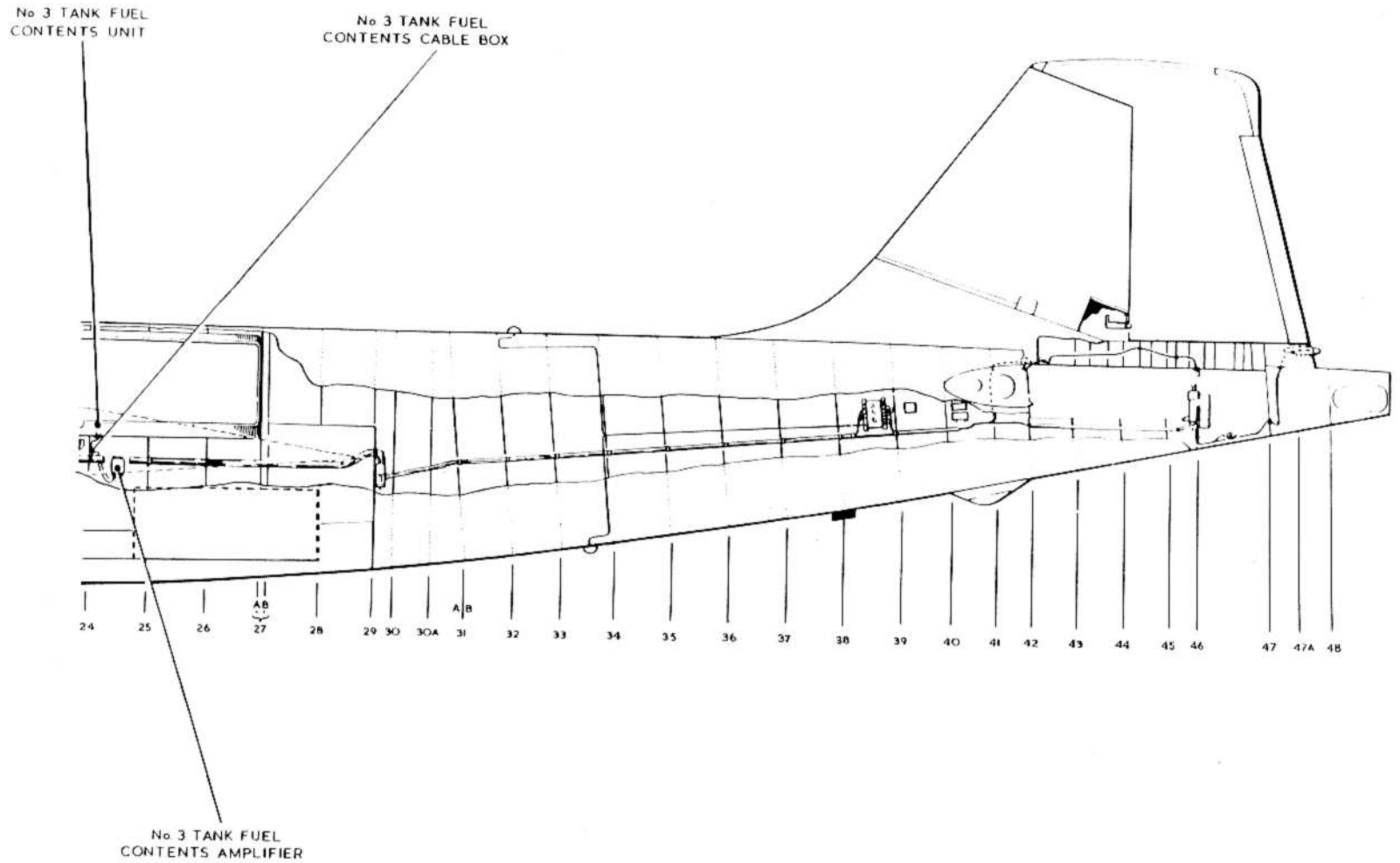


FIG. 5A. INSTRUMENT INSTALLATION - STARBOARD FUSELAGE

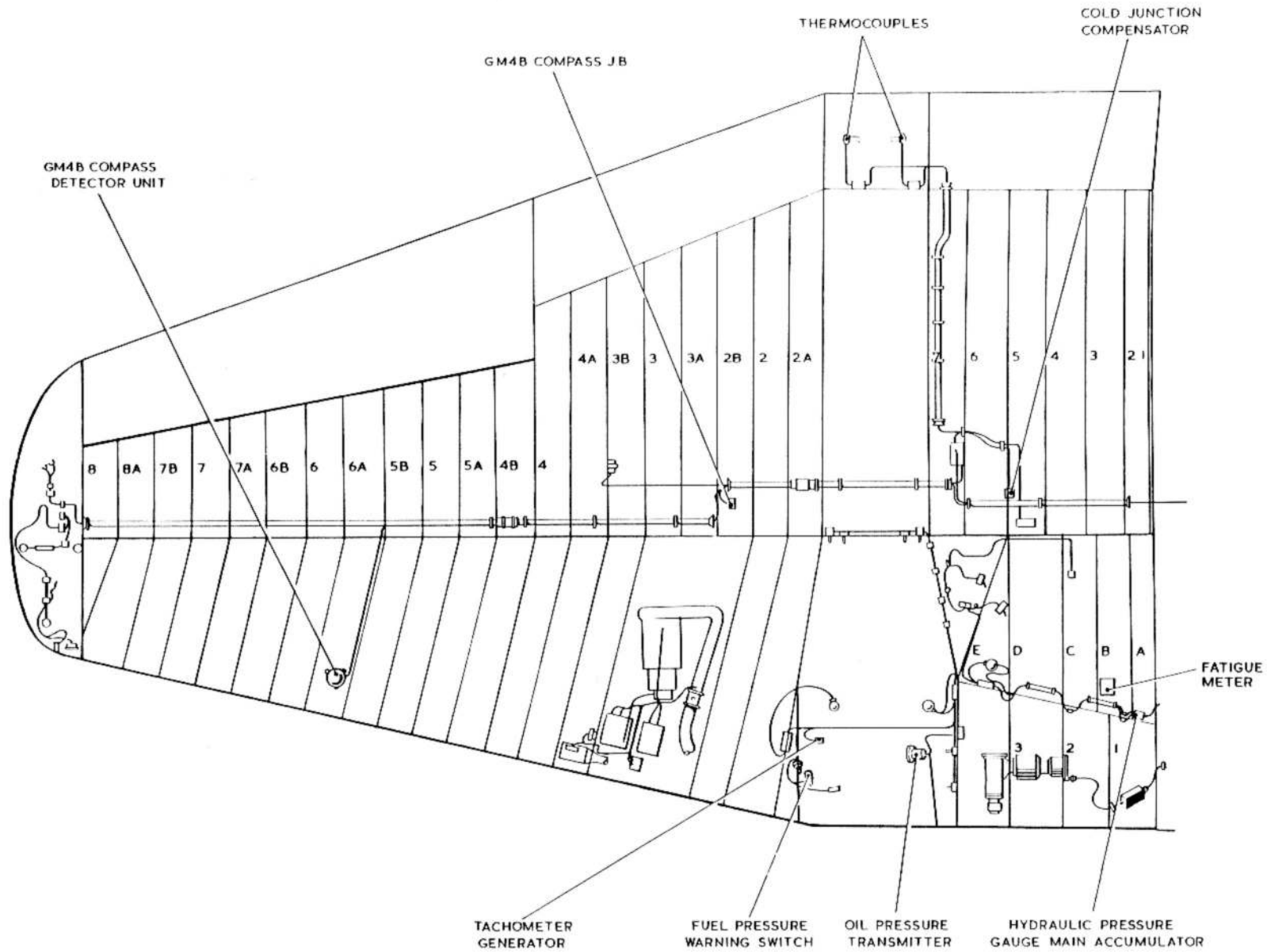


FIG. 6. INSTRUMENT INSTALLATION - STARBOARD MAIN PLANE

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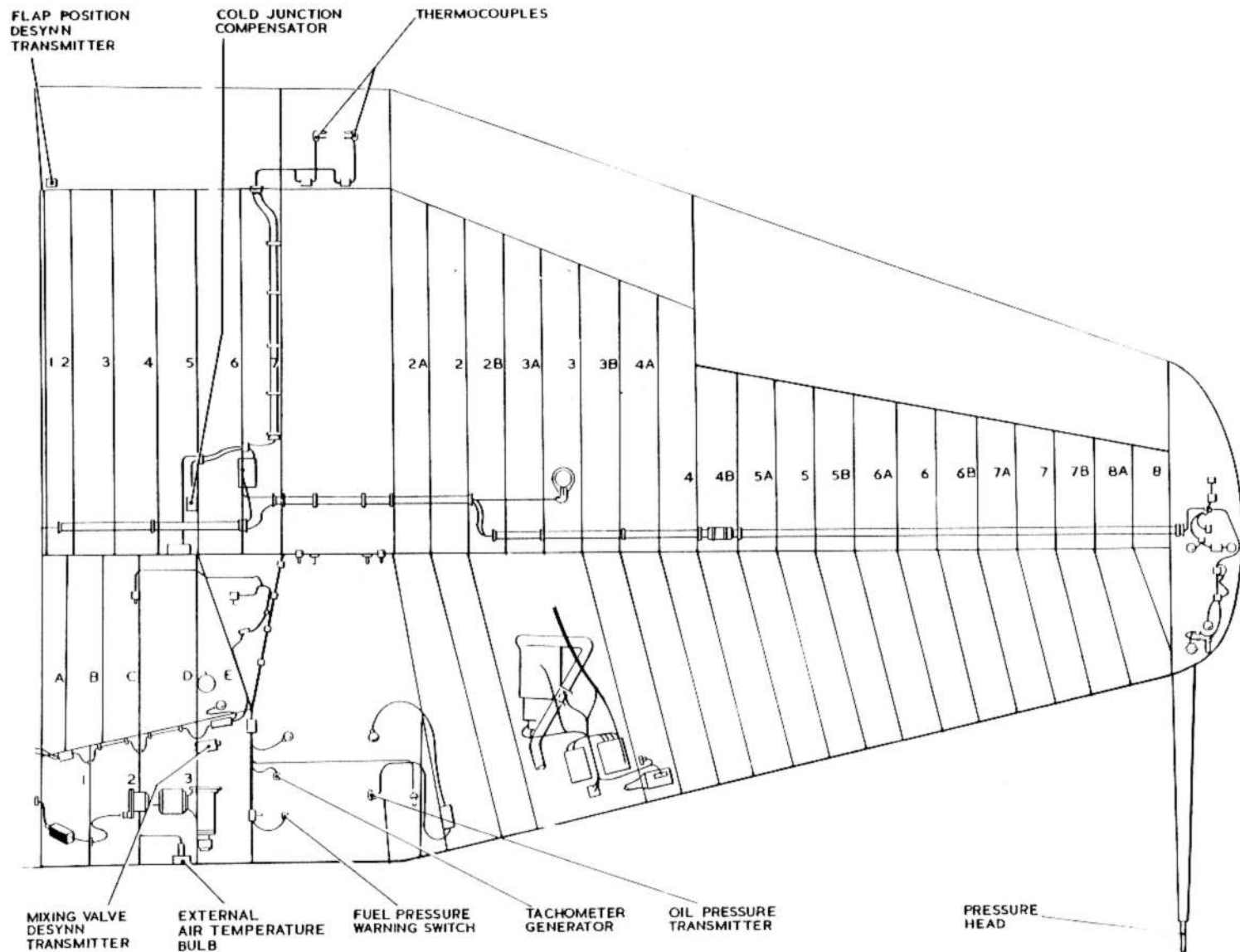


FIG. 7. INSTRUMENT INSTALLATION - PORT MAIN PLANE

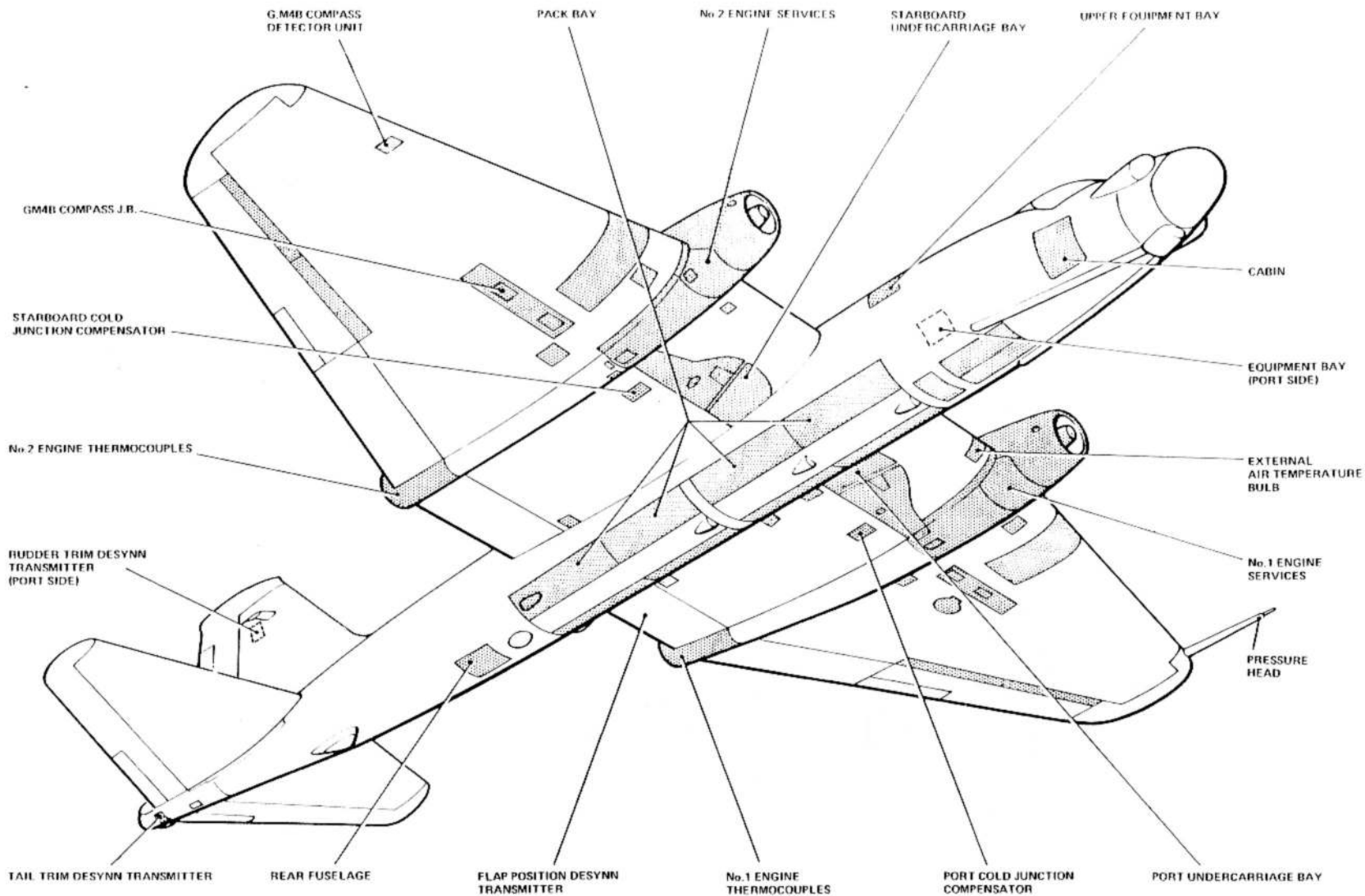


FIG. 8. ACCESS PANELS

Introduction

1. This chapter includes descriptive and servicing information for the pitot and static system and the flight instruments. Table 1 lists the main components together with their reference numbers and their relevant Air Publication. The location of the main items of equipment can be found by referring to the location diagrams in Sect. 7, Chap. 1, Supplement.

DESCRIPTION

Pitot and static system

General

2. Two static vents, located between frames 10 and 11, supply static pressure to the navigator's altimeter, and the pressure error corrector unit. The remaining instruments are supplied with pitot and static pressure from a Mk. 8T pressure head located on the port wing tip. To prevent icing, a heater unit, which is controlled by a switch on the pilot's take-off panel, is embodied with the pressure head. The main instruments which depend on the pitot and static system for their operation are the A.S.I.'s, altimeters, true airspeed unit (T.A.S.), pressure error corrector unit, machmeter, and the rate of climb indicator. The cabin pressurization system which is described in A.P. 101B-0417-1A, Sect. 3, Chap. 8A, employs an independent static system.

Drain traps (fig. 1)

3. Moisture in the pipelines is collected by twenty drain traps located at various points in the system as shown in fig. 1.

Bonding

4. The pipelines are bonded to the aircraft structure by first scraping the pipes at the point of attachment and wrapping with wire gauze before fitting the clips. Flexible bonding leads are also used at various points to complete the earthing of the pipelines where the runs are broken by the fitting of unions and tee-pieces.

Turn and slip indicator

5. The Mk. 2A turn and slip indicator, mounted on the instrument flying panel, is provided to indicate the lateral attitude of the aircraft in straight flight, the direction and rate of turn and the amount of sideslip,

if any, during a turn. A power failure indicator is incorporated in the instrument and takes the form of a flag visible through an aperture in the dial; no indication is given when the power is on but the word OFF appears when the speed of the gyro rotor is reduced to the extent when accurate turn indications are no longer provided. The instrument is basically an electrically-driven rate gyroscope which normally operates from one of the two duplicated d.c. supplies controlled by the engine MASTER STARTING switches. A further supply from the emergency battery is connected via the turn and slip EMERGENCY switch, adjacent to the indicator. The power supplies to the instrument are fully described in Sect. 6, Chap. 4, main section of this publication.

Artificial horizon

6. Indication of the attitude of the aircraft in pitch and roll is given by a Mk. 3C or D artificial horizon mounted on the pilot's instrument panel. The instrument is a gyroscopic unit operating from the 115-volt, 400 Hz, 3-phase a.c. power supplies described in Sect. 6, Chap. 4, main section of this publication.

Air speed indicators

7. Two Mk. 9M air speed indicators, one mounted on the pilot's instrument panel and the other on the navigator's instrument panel, are installed in the aircraft. Both instruments are connected to the common pitot and static pipelines.

Automatic height encoding

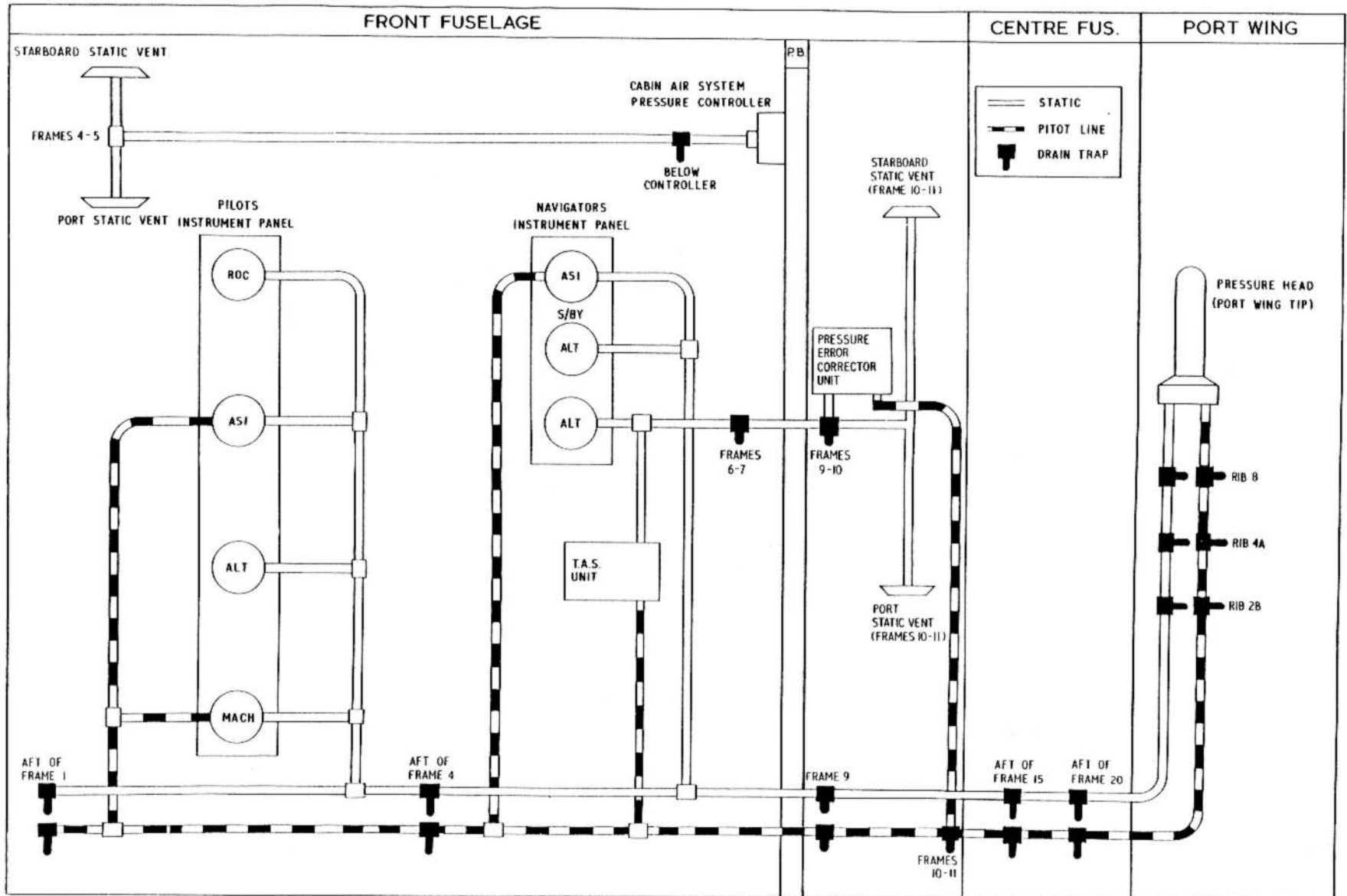
General

8. A Mk. 30A and Mk. 29B altimeter and a pressure error corrector unit provide corrected height indications to the pilot and navigator, and a height encoded signal for the I.F.F. system (Sect. 9, Chap. 2, Supplement).

Mk. 30A altimeter

9. This altimeter, which is the master altimeter of the system, is located on the navigator's instrument panel and is connected to the aircraft static system and the pressure error corrector unit. Monitor signals from the pressure error corrector are routed to the altimeter which contains a brush encoder, to provide an encoded height output for the I.F.F. system, and a synchro output to drive the Mk. 29B altimeter.

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E G7 80 10021 1 155 2
E G7 80 5073 1 4 155 1

FIG. 1. PITOT AND STATIC SYSTEM

10. Height indications are presented on a dial, calibrated in feet x 100, and indicated by a pointer and digital counter. A knurled knob, on the lower left of the instrument, is used to select the barometric pressure which is displayed in a cut-out on the right of the dial.

Warning flags

11. Two warning flags are embodied in the instrument, one, which appears in a cut-out in the top centre of the dial, is annotated PE, and will appear if a fault occurs in the pressure error corrector unit. Under these conditions both altimeters continue to operate but will indicate uncorrected height only. The second flag falls to mask the digital counter of the height display of the instrument if a system power failure occurs.

Mk. 29B altimeter

12. This altimeter, which is located on the pilot's instrument panel, is fundamentally a servo operated instrument, the servo inputs being derived from the synchro output of the Mk. 30A altimeter, but includes the facility to revert to normal barometric operation in the event of a system power failure.

13. Height indication and barometric pressure selection is identical to the Mk. 30A altimeter and is described in para. 10.

14. A knurled knob, on the lower right of the instrument, provides a manual selection to stand-by, S, or reset, R, operation. When the knob is selected to 'S' the altimeter reverts to normal barometric operation, a vibrator, incorporated in the instrument, is energized and the STBY flag appears in the cut-out above the digital counter. When the knob is selected to 'R' the altimeter will reset to synchro operation providing that the system power supplies are functioning correctly.

Automatic reversion

15. Should a power failure occur the altimeter will automatically revert to barometric operation, the STBY warning flag will appear and the vibrator will commence to operate.

Pressure error corrector unit

16. The pressure error corrector unit, which is located in the upper equipment compartment, contains pitot and static capsule assemblies which convert the pitot and static pressures present in the aircraft pipe-

lines to electrical signals. These signals are corrected by a pressure error module and are used as a monitor signal for the Mk. 30A altimeter.

17. The pressure error correction module is a plug-in unit located in the rear portion of the unit casing. The Part No. of the module, which is specific to the aircraft type to which the unit is fitted, is visible through a small window in the rear of the casing.

Power supplies

18. The height encoding system operates from 115-volt, 400 Hz, single phase a.c. and 28-volt d.c. described in Sect. 6, Chap. 4, main section of this publication.

Machmeter

19. A Mk. 2 machmeter, fitted on the pilot's instrument panel, is operated from the pitot and static system.

Rate of climb indicator

20. This is a Mk. 3Q instrument which is mounted on the pilot's instrument panel and connected into the static pipeline.

External air thermometer

21. The temperature of the air outside the aircraft is shown by a thermometer on the navigator's instrument panel. The thermometer indicator functions in conjunction with a Type A temperature sensing unit which protrudes from the leading edge of the inboard end of the port main plane.

22. Access to the temperature sensing unit is attained by removing the inboard detachable panel on the top side of the port main plane between the fuselage and the engine.

GM4B compass

General

23. The Mk. 4B gyro-magnetic compass combines the functions of a directional gyro and a magnetic compass and possesses the particular advantages of each. The indications shown by the compass are stabilized by means of a gyro and synchronized with the earth's magnetic field by a remote detector unit and a monitoring system.

24. The installation consists of a detector unit, amplifier, control panel, gyro unit and master indicator. The detector unit is fitted in the leading edge between ribs 5B and 6A, the amplifier and control panel at the A.E.O.'s station and the gyro unit and master indicator on the pilot's and navigator's instrument panels respectively. A switch labelled G-M COMP/D-GYRO, mounted on the starter panel below the main instrument panel, permits the pilot to operate the gyro unit as either a compass or directional gyro as required.

Power supplies

25. The compass system operates from the 28-volt d.c. and 115-volt, 400 Hz, 3-phase a.c. power supplies described in Sect. 6, Chap. 4, main section of this publication.

Standby altimeter (S/BY ALT) Mk. 19F

26. The standby altimeter Mk. 19F is housed in the navigator's instrument panel. This instrument enables the navigator to monitor the altitude of the aircraft when the loss of the aircraft power supply renders the main altimeters inoperative. An altimeter vibrator is fitted to this instrument to enhance the performance, by eliminating stiction. ►

Radio compass

27. Information concerning the radio compass indicators is contained in Sect. 8, Chap. 6, Supplement.

Radio altimeter

28. The radio altimeter is described in Sect. 8, Chap. 7, main section of this publication.

Tacan

29. Information covering the indicators associated with the Tacan system will be found in Sect. 9, Chap. 3, Supplement.

VOR/ILS

30. The omni bearing selector/indicator associated with the VOR/ILS is described in Sect. 8, Chap. 5, Supplement.

True airspeed unit (T.A.S.)

31. The true airspeed unit is mounted behind the navigator's instrument panel. It provides true airspeed information for the Omega long range navigation (A.R.I. 23314) system.

Magnetic compass, Type E2B

32. In addition to the GM4B compass system an emergency magnetic compass, Type E2B is installed on the canopy coaming above the instrument flying panel. It is illuminated by an integral non-magnetic lamp the brilliance of which is controlled from the cockpit starboard red flood light dimmer switch under normal conditions, and the emergency lighting switch on the pilot's coaming panel during emergency conditions.

SERVICING

WARNING

The relevant safety precautions detailed on the **LETHAL WARNING** marker card must always be observed before entering the cabin or performing any operation upon the aircraft.

Pitot and static system

General

33. When flying instruments that function by pitot and static pressure operate from common pipelines, any faults in the lines will normally affect them all. Any single instrument giving suspect readings should be checked by reference to the relevant A.P. and renewed if necessary. The procedure for testing the cabin air system static line is outlined in para. 37. The drain traps should be periodically removed and drained; after refit, the system must be tested for leaks and recalibrated.

Note . . .

Static vent plates are NOT to be painted or polished.

Leakage tests

34. The following tests are to be made on the pitot and static system in accordance with the aircraft Servicing Schedule and after any operation that involves disturbing joints or connections to the pipelines.

Test Equipment

35. The leak test set, Ref. No. 6C/4360548, described in A.P.112T-01244-I, is to be used when making tests on the pitot and static system in accordance with A.P.1275A, Vol.2 Leaflet A9. ►

Note . . .

The pump embodied in the tester must not be operated too vigorously as such action may cause damage to the instrument capsules. When carrying out the leak test, pressure or suction should be applied to bring the reading on the test meter to a value a small amount above that of the test value. This action allows the temperature difference, due to compression or expansion, to settle. If this action is not taken, the consequent temperature change will give rise to an initial spurious fall or rise in pressure indication.

Method of testing

36. Disconnect the pressure head pipes at the wing-tip joint and check the pitot and static pipelines separately as follows:-

Note . . .

During the tests, check that all indicator pointers move in the correct direction and that there is no undue lag between the aircraft instruments and the test indicator in reaching a similar indicated value. Undue lag is generally due to constrictions in the pipelines.

(1) To check the pitot line, couple the pitot line, by means of the appropriate adapter, to the pitot connector on the tester and set the selector valve to 'Pressure to Pitot'. Apply pressure by using the pump until the test indicator reads just over 130 knots. Check the time taken for the indicator reading to fall to 125 knots, this must be greater than 3 minutes.

(2) Couple the static line by means of an adapter, to the static connector on the tester and set the selector to 'Suction to Static'. Using the pump, apply suction until the tester indicator reads just over 130 knots and check the time taken for the indicator reading to fall to 125 knots. This should exceed 3 minutes.

(3) Reconnect the pressure head at the wing-tip joint and test the complete installation by using the appropriate adapter at the pressure head. Connect the adapter to the static connector on the tester and set the selector valve to 'Suction to Static'. Apply suction by means of the pump until the test indicator reads just over 130 knots. Time the fall from 130 knots to 125 knots. This time should be greater than 3 minutes.

(4) Seal the upper static vent, on one side of the aircraft between frames 10 and 11, with a Mk. 2 plug Ref. No. 6C/1059239.

(5) Connect the opposite upper vent, between frames 10 and 11, by means of the appropriate adapter, to the static connector on the tester and set the selector to 'Suction to Static'. Using the pump, apply suction until the tester indicator reads just over 130 knots and check the time taken for the indicator reading to fall to 125 knots. This must exceed 3 minutes.

Cabin air system static line

37. To check the cabin air system static line carry out the following procedure:-

(1) Disconnect the static pipe to the pressure controller at the joint and blank off.

(2) Blank off either the port or starboard static vent between frames 4 and 5 with a Mk. 2 protective plug, Ref. No. 6A/2679.

(3) Using the leak test set, couple the appropriate adapter between static connector on the test set and the aircraft static vent between frames 4 and 5.

(4) Set the test set selector valve to the 'Pressure to Pitot' position and apply pressure by means of the pump until the indicator reads just over 130 knots. The fall from 130 to 125 knots should take a time of over 3 minutes.

(5) Remove the test set and the blanking plug, reconnect the pipes ensuring that all joints are fully tightened and leak proof.

Drying out the system

38. When aircraft have been dispersed for any length of time under adverse weather conditions that have caused moisture to collect in the pitot and static system, it is necessary to empty all drain traps and dry the systems out to prevent icing at high altitude. The procedure given in the following paragraphs is to be carried out at the following times:-

(1) Whenever the system is suspect.

- (2) When called for in the relevant Servicing Schedule.
- (3) When the aircraft has been out of service for more than 4 weeks.
39. The drying-out operation calls for the use of an instrument and auto-control testing trolley Ref. No. 4F/1510, a pitot head test adapter Ref. No. 4F/1502, and a static vent test adapter Mk. 1, Ref. No. 6C/499.
40. The procedure to be adopted is as follows:-
- (1) Disconnect the pitot/static system at the drain traps between Ribs 2 and 26 in the port outer main plane.
 - (2) Connect the test trolley supply, by means of rubber hose and the pressure head adapter, to the pressure head and secure the clip.
 - (3) Start the motor of the trolley and allow the air supply, when completely warm, to circulate through the system for at least 15 minutes.
 - (4) Remove the trolley air supply hose from the pressure head and reconnect to one of the static vents by means of the Mk. 1 static vent adapter. Repeat the previous sub-para. (3).
41. On the conclusion of the operation, remove the test trolley, reconnect all instruments and carry out the leak test detailed in para.34. If the aircraft is not for immediate use, fit and tape up a pressure head cover and refit the static vent plugs to prevent ingress of moisture into the system.
42. It is essential that during servicing which involves the removal and replacement of pipelines, bonding should be efficiently maintained by cleaning the pipelines and their clip attachment points and also that all bonding leads are refitted where necessary.

GM4B compass

General

43. The compass installation should be checked in accordance with the current Servicing Schedule. During a visual examination, particular attention should be paid to the security of the connector plugs and sockets and the amplifier mountings.

Servicing periods

44. These are laid down in A.P.100A-01, Leaflet 330. For functioning tests and detailed routine servicing of the equipment refer to A.P. 112B-0333-1.

Calibration

45. The compass system should be calibrated periodically using the procedure outlined in A.P. 112B-0333-1.

Functional test

46. To check the functioning of the compass:-

- (1) Switch on the d.c. and a.c. power supplies to the compass by operating the No. 2 engine MASTER STARTING switch on the starter panel. Allow at least two minutes for the inverter to run up and check that the compensator lamps in the amplifier are alight, these are visible through small holes on the front of the amplifier case. Failure of either lamp will cause the value of the current flowing through the compensator coil to alter, thus introducing compass errors. Set the variation scale on the Master Indicator to read '0'.
- (2) Turn the selector switch on the control panel to GYRO COMPASS and allow the precession amplifier to warm up. Verify that the dot (.) or the cross (x) is shown in the annunciator window of the gyro unit and that a similar indication is shown by the annunciator in the master indicator on the navigator's panel.
- (3) Press in the synchronizing knob and turn it in the direction shown by the flag in the annunciator window (i.e. clockwise when the dot (.) is showing and counter-clockwise when the cross (x) is showing). When the indication in the annunciator window changes to the opposite sign, slowly turn the synchronizing knob back until the window is cleared, or a dot and cross appear alternately. The gyro unit is now synchronized. Check that the indications shown in the master indicator annunciator window are similar to those shown by the gyro unit. Note the compass card heading against the lubber line; this reading should agree approximately with the stand-by compass.
- (4) Offset the compass card 5 deg from the indicated heading by means of the synchronizing knob and note the time taken for it to return to

the original heading within ± 0.5 deg. The time taken should not exceed 3 minutes. Check that the master indicator follows the compass card and agrees within ± 1 deg.

(5) Set the pilot's switch to D-GYRO and verify that D.G. is shown in the annunciator windows of the gyro unit and the master indicator.

(6) Alter the heading shown by the compass card by means of the synchronizing knob and check that the master indicator pointer follows the movement of the card and agrees within ± 1 deg.

(7) Having synchronized the gyro, set 10 deg of westerly variation on the master indicator. Check that the new card indication after the synchronizing is 10 deg less than the previous reading. Return the variation scale to zero.

Automatic height encoding

General

47. The height encoding system should be serviced in accordance with the details given in the relevant servicing schedule and in A.P. 112G-1028-1 and A.P. 112G-1031-1.

TABLE 1
Flight instruments

Ref. No.	Equipment	Quantity	Relevant A.P. Vol. 1
6A/3953	Turn and slip indicator, Mk. 2A	1	A.P. 112G-0302-1
6A/3489 or	Artificial horizon, Mk. 3C	1	A.P. 1275A, Vol. 1, Sect. 13
6A/6102	Artificial horizon, Mk. 3D	1	A.P. 1275A, Vol. 1, Sect. 13
6A/3384	Machmeter, Mk. 2	1	A.P. 112G-0910-1
6A/4339155	Rate of climb indicator, Mk. 3Q	1	A.P. 112G-1007-1
6A/4333459	Pressure head, Mk. 8T	1	A.P. 112G-0102-1
6A/1037475	Air thermometer, Mk. 4, Type B	1	A.P. 112G-0504-16
6A/1037398	Temperature sensing unit, Type A	1	A.P. 112G-0601-1
6B/1048857	Compass, Type E2B	1	A.P. 1275B, Vol. 1, Sect. 10
6A/4337742	Air speed indicator, Mk. 9M	2	A.P. 112G-0926-1
	GM4B compass system		
6B/4343681	Detector unit, Type A	1	} A.P. 112B-0333-1
6B/3831	Master indicator, Type E5	1	
6B/4343640	Gyro unit, Type B	1	
6B/4343641	Amplifier, Type B	1	
6B/4343607	Mounting tray, Type A	1	
6B/408	Control panel, Type A	1	
	Automatic height encoding		
6A/6201976	Altimeter, Mk. 29B, Pt. No. L82621-04-010	1	A.P. 112G-1028-1
6A/1146374	Altimeter, Mk. 30A, Pt. No. L83261-04-010	1	A.P. 112G-1031-1
6A/4339363	Altimeter, Mk. 19F	1	A.P. 112G-1011-13A6
◀ 6A/4338811	Vibrator (fitted to Altimeter, Mk. 19F)	1	A.P. 112G-1011-13A6 ▶
5CW/1483808 or 5CW/22468	True airspeed unit, Penny and Giles 60071	1	
6A/6203321	Pressure error corrector unit, Pt. No. L83271-00-000	1	A.P. 112G-1031-1



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