GROUP 3A

AIR PRESSURE OPERATED INSTRUMENTS (CODE P)

LIST OF CONTENTS

Introduction

1. This group contains a description of the air pressure operated flying instruments installed in this aircraft, the majority of which are operated by the pressure head installation. For a general description of the instrument installation reference should be made to Group 1A. The location and access to all the instruments and their associated equipment is given in Group 1C. Detailed information on the standard components used will be found in the appropriate Air publications quoted in Table 1.

Equipment employed

2. The air pressure operated flying instruments employed in this aircraft are listed in Table 1, together with the appropriate Air Publications to which reference should be made for a detailed description and the necessary servicing required to maintain them in an efficient condition.

DESCRIPTION

Pressure head installation

3. This installation operates the air speed indicator, machmeter, altimeter and rate of climb indicator. The installation, which is illustrated in fig.1, consists of an electrically heated pressure head, projecting forward from the port wing tip. The pressure head contains the pressure and static pipes, together with an electric heater element. The pressure and static pipes in the head are connected to the instruments, via the pressure and static connectors, which are mounted on the port forward face of the centre instrument panel, by a system of pipe-lines. Moisture entering the pipe-lines is collected by a number of drain traps located in each pipe-line as shown in fig.1.

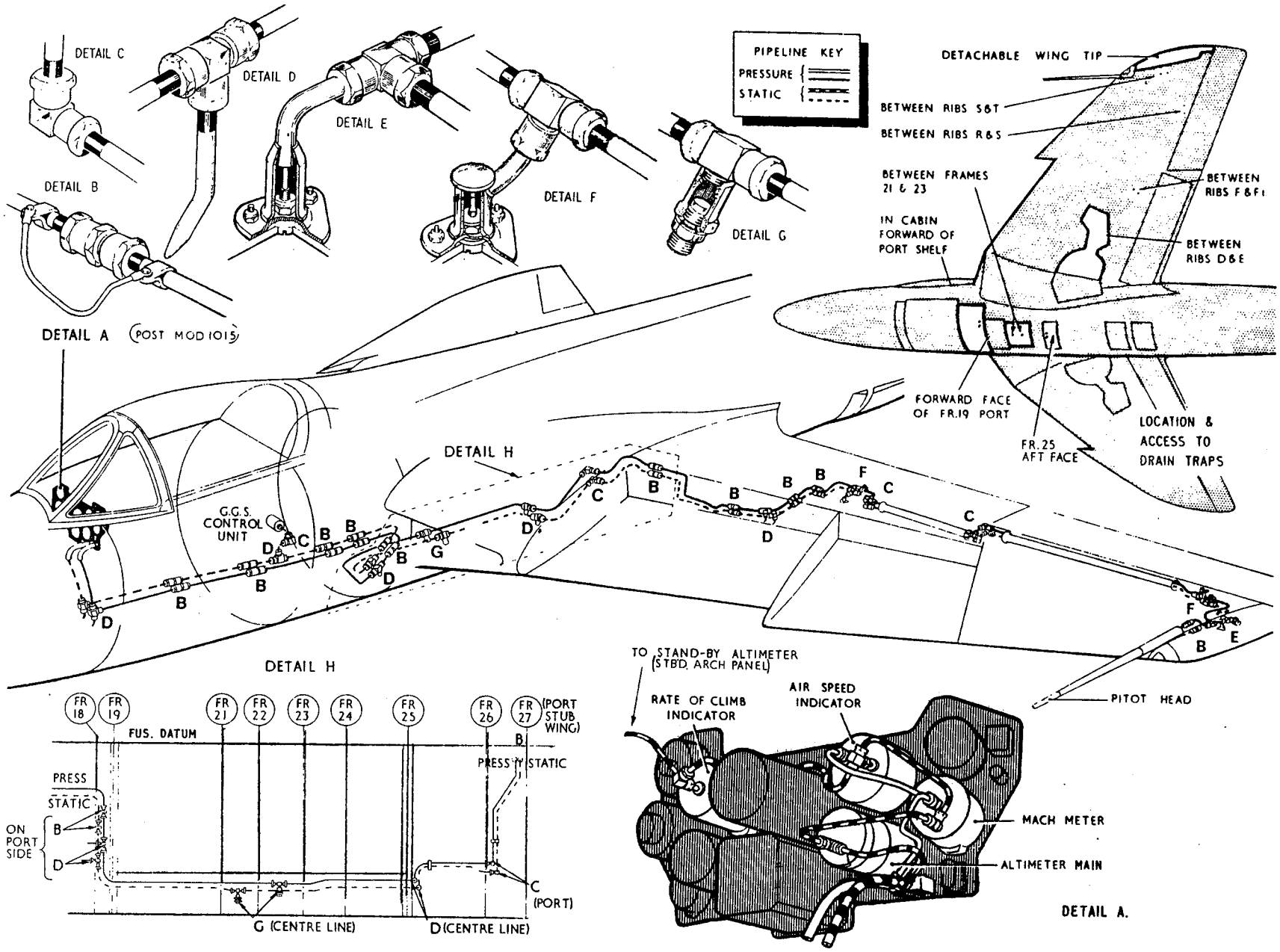

Fig. 1. Pressure head installation

◀ (General amendment) ▶

Pressure head heater

4. The electric heater element in the pressure head is controlled by a single-pole ON/OFF switch located on the leg panel adjacent to the camera master switch. A routeing and theoretical diagram of the electrical heater circuit, the operation of which will be obvious, is given in fig.2.

NOTE . . .

The pressure head heater must not be switched on before removal of the pressure head cover or damage to the cover will result. It is also important to ensure that the heater is not left switched on for any length of time, while the aircraft is on the ground, as the heater constitutes a danger to personnel should it be touched by accident.

Airspeed indicator

5. The air speed indicator is mounted on the port side of the centre instrument panel. It is a capsule type instrument operated by air pressure drawn from the pressure head installation, which is described in para.3.

Machmeter

6. The machmeter is installed on the port side of the centre instrument panel adjacent to the air speed indicator. It is provided to give a continuous indication of the ratio of true air speed to the speed of sound. The instrument is operated by the differential air pressure between the pressure and static pipe-lines of the pressure head installation described in para.3.

Altimeter (pre Mod. 1015 and 1183)

7. The altimeter is located just below the airspeed indicator on the centre instrument panel. It is an atmospheric pressure operated instrument provided to give a continuous indication of the aircraft's height. The instrument is connected to the static pressure pipeline of the pressure head installation, described in para.3. A vibrator is fitted to the rear end of the altimeter case in Post Mod.1054 aircraft and is used to improve the performance of the instrument, especially at the upper altitude ranges, by imparting vibrations to the altimeter mechanism. It operated on a 115V. 400c/s. single phase a.c. supply and vibrates at 3200c/s. For detailed information of these instruments reference should be made to the Air Publication listed in Table 1.

8. Two altimeters are introduced by Mods. 1015 and 1183. The main instrument, Mk.22, is located below the airspeed indicator on the centre instrument panel. The standby altimeter, Mk.19, is mounted on the starboard arch panel. The Mk.19 altimeter, previously used as described in Para.7, is now fitted without a vibrator. Both instruments give a continuous indication of the aircraft height and are operated by aneroid movements supplied with atmospheric pressure obtained from the pitot/static pressure pipe lines of the pressure head installation described in Para.3.

9. The electrically operated altimeter is driven from an amplifier unit located on starboard aft face of frame 6. The altimeter contains a transducer which comprises an aneroid capsule and a pick off unit, a motor, a gear train, a digital height counter, and a scale pointer. The information which is fed to the aneroid capsule is converted into electrical error signals by the pick off. These signals are amplified and fed to the motor which drives the gear train to operate the height counter and scale pointer. The gear train partly constitutes a servo linkage which, through a cam, drives back the main body of the pick off and cancels the error to stop the motor. The instruments operate from the 115V 400c/s single phase a.c. supply. The standby altimeter is similar to the unit fitted in pre Mod. 1015 and 1183 aircraft (Para.7). For detailed information of these instruments refer to the Air Publications listed in Table 1.

Cabin altimeter

10. This is an aneroid instrument and is located on the starboard instrument panel just above the oxygen gauge. It is not connected to the pressure head installation or to any other instrument, but is open to the air in the cabin, as it indicates the equivalent pressure cabin altitude and not the aircraft's height.

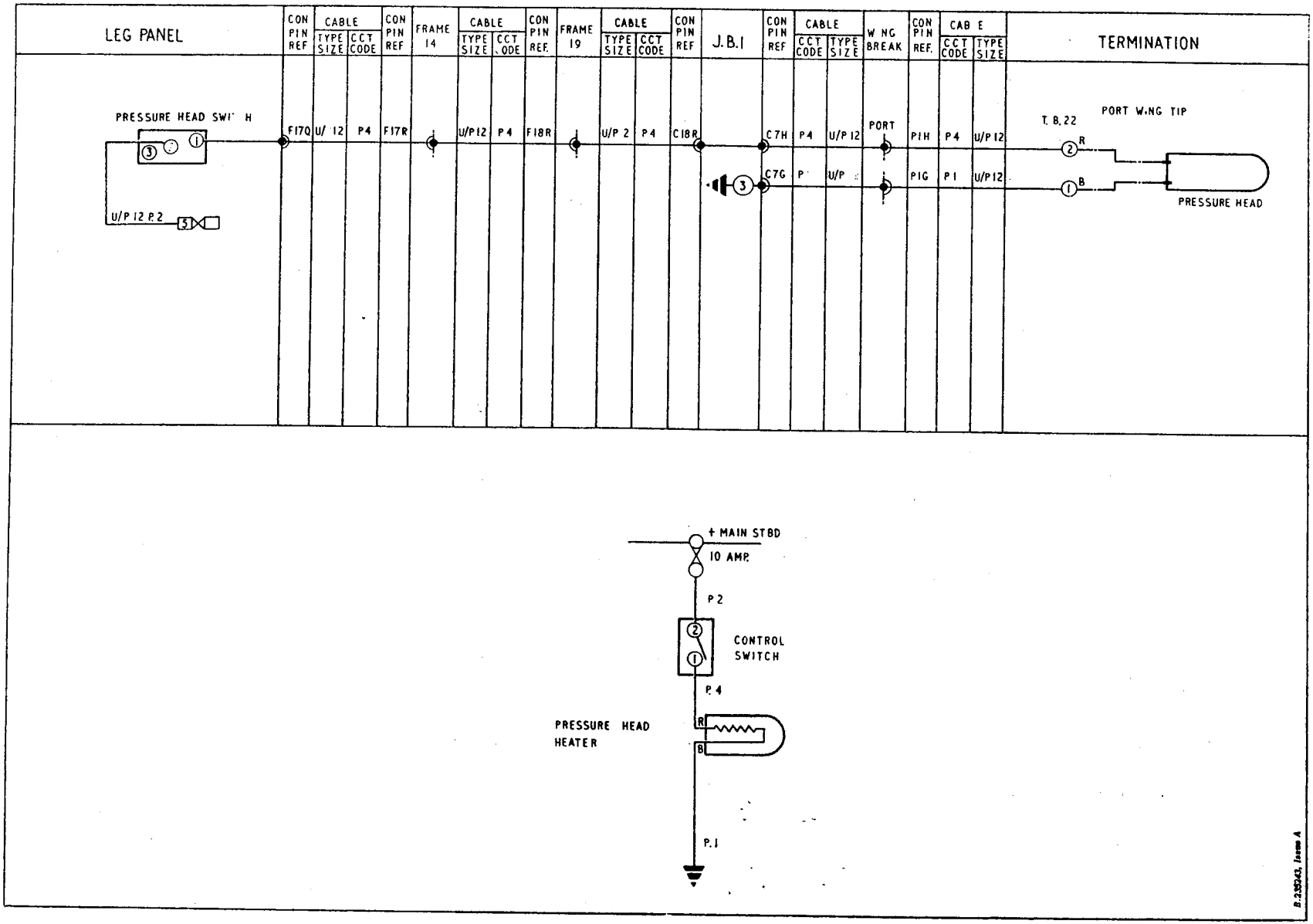

Fig. 2. Pressure head heater (routing and theoretical)

RESTRICTED

Rate of climb indicator

11. The rate of climb indicator is installed on the starboard side of the centre instrument panel adjacent to the artificial horizon. It is a sensitive differential pressure gauge giving the rate of change of the atmospheric pressure in terms of rate of climb or descent, whenever the aircraft departs from level flight. The instrument is connected to the static pressure pipeline of the pressure head installation, described in para.3.

V.G. recorder

12. Provision has been made for the installation, under the battery platform, of a Service fitted V.G. recorder, which may be tapped into the pressure and static pipe-lines of the pressure head installation *(para.3 of this group)* after the removal of two drain traps at frame 18. The recorder consists of a moving-weight accelerometer and an air speed capsule. The resultant movement of these mechanisms is transmitted to a stylus and automatically draws a graph of aircraft acceleration against air speed. A complete description of the recorder is given in Leaflet No. I.T.2031 (Issue 2), titled, Routine Measurement of Flight Acceleration, and published by the Ministry of Supply.

SERVICING

General

13. The necessary servicing to maintain the instruments in an efficient condition and the standard serviceability tests, which should be applied, together with the equipment to be used and the method of conducting the tests is contained in the appropriate Air Publications listed in Table 1.

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
Pressure head, Mk.9A or 10B, *(Mod.1317)*	A.P.112G-0102-1
Air speed indicator, Mk.12A	A.P.112G-0927-1
Machmeter, Mk.3A	A.P.1275A, Vol.1, Sect.21
Altimeter *(Main)*, Mk.22D or 22F Amplifier, Mk.1A	A.P.112G-1023-1
Altimeter *(Standby)* Mk.19A, 19B, 19C or 19F Vibrator, Type KVC-0101	A.P.112G-1011-16
Cabin altimeter Mk.18 or 21	A.P.112G-1022-1
Rate of climb indicator, Mk.3A (P) or Mk.3 (P) or Mk.3P* or Mk.3Q	A.P.112G-1007-1
V.G. recorder	Instruction Leaflet I.T.2031 Issue 2 *(M.O.S. Publication)*

Pressure head drain traps

14. Drain traps are provided in the pressure head installation to collect any moisture which may enter this installation. The drain traps, which are of three different types, are connected into the installation by tee-pieces and are located in pairs as illustrated in fig.1. Each type of drain trap is illustrated in the details given on the illustration and the means of access to the traps is also indicated. All the moisture etc., in the drains, should be removed periodically as follows:–

(1) The drain traps illustrated in detail D of fig.1 should be disconnected from the system and any moisture removed. When refitting the drains new rubber sealing rings should be inserted in the union nuts and after the nuts are tightened, an examination should be made to ensure that the unpainted ends of the drain traps do not show below the heads of the union nuts.

(2) The drain traps illustrated in detail E and F of fig.1 should be opened by unscrewing the slotted plugs in the wing skin until any moisture in the traps drains away.

(3) The drain traps illustrated in detail G of fig.1 should be opened by inserting a suitable length and diameter of hose into each drain in turn after removing

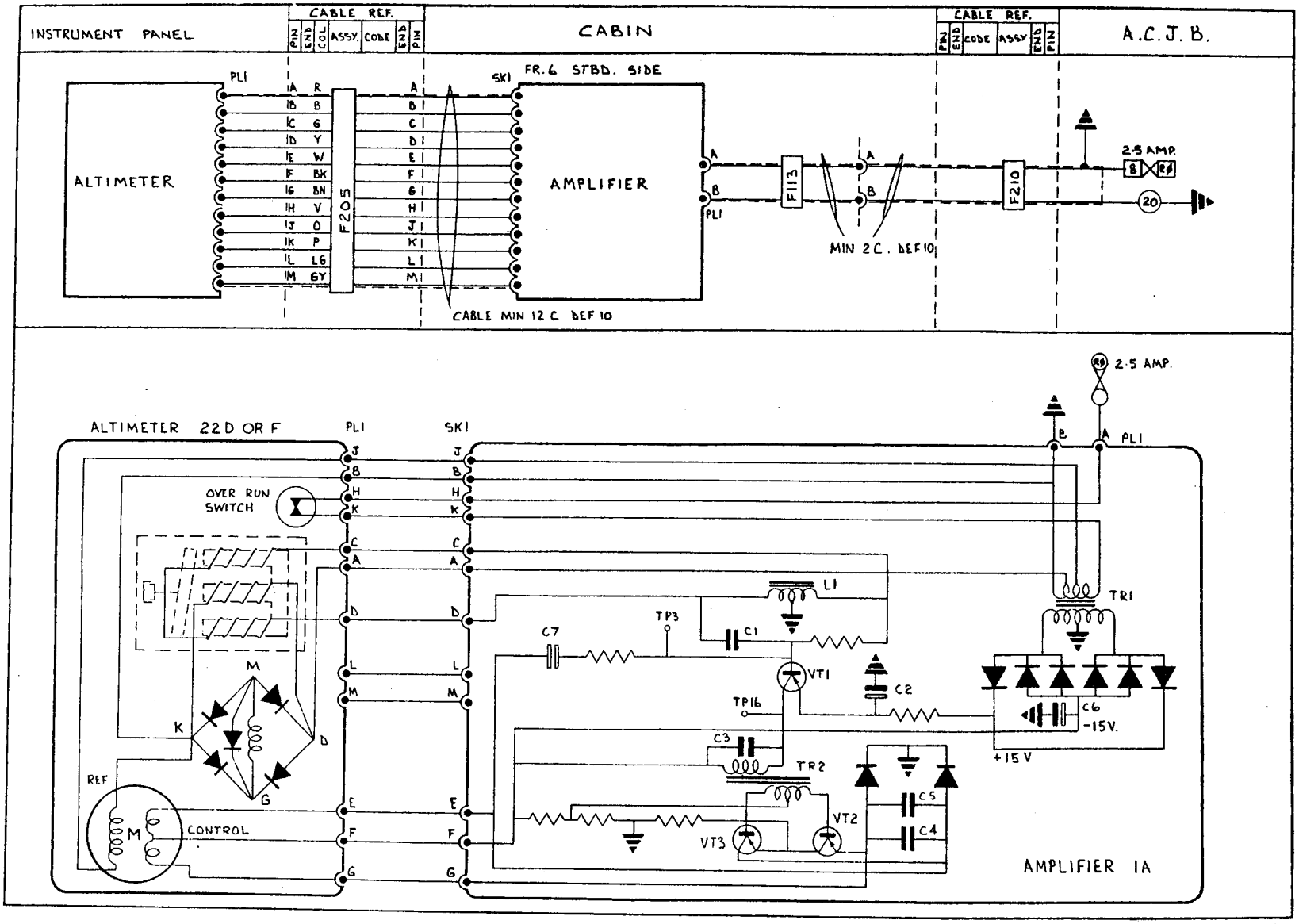

Fig. 3 Main Altimeter

the small access doors, Insertion of the hose pushes open the valve and allows any moisture to escape down the hose.

Pressure head leak tests

15. The pressure and static systems are as leak-tight as possible and every care must be taken to maintain the system in this condition since even a moderate leak may develop into a more serious leak and cause instrument failure. To ensure that the leakage rate is within the required tolerances, the system must be tested in accordance with the instructions given in A.P.1275A, Vol.2, Leaflet A.9 whenever the system is suspect or its pipeline joints and connections to instruments are disturbed.

REMOVAL AND ASSEMBLY

General

16. The removal of the instrument panels carrying the flying instruments is fully described in Group 1.B of this chapter. The removal of the pressure head is covered in Sect.3, Chap.2 and once access has been obtained, the removal of the remaining items of equipment should present no difficulties.

APPENDIX 1 – MOD. 1375
(HEIGHT ENCODING ALTIMETER)

LIST OF CONTENTS

TABLE 1

Equipment type and Air Publication reference

Equipment Type	Air Publication
Altimeter servo encoding Mk.30B Kollsman	A.P. 112G - 1031 - 1
Inverter Type 375	A.P. 113D - 0300 series

Introduction

1. This appendix contains the description of the Kollsman Mk.30B servo encoding altimeter, introduced by Mod.1375, together with information on the testing and servicing required to maintain the equipment in an efficient condition. A routeing diagram of the circuit is included and further information on the standard items of equipment used in the installation will be found in the Air Publications

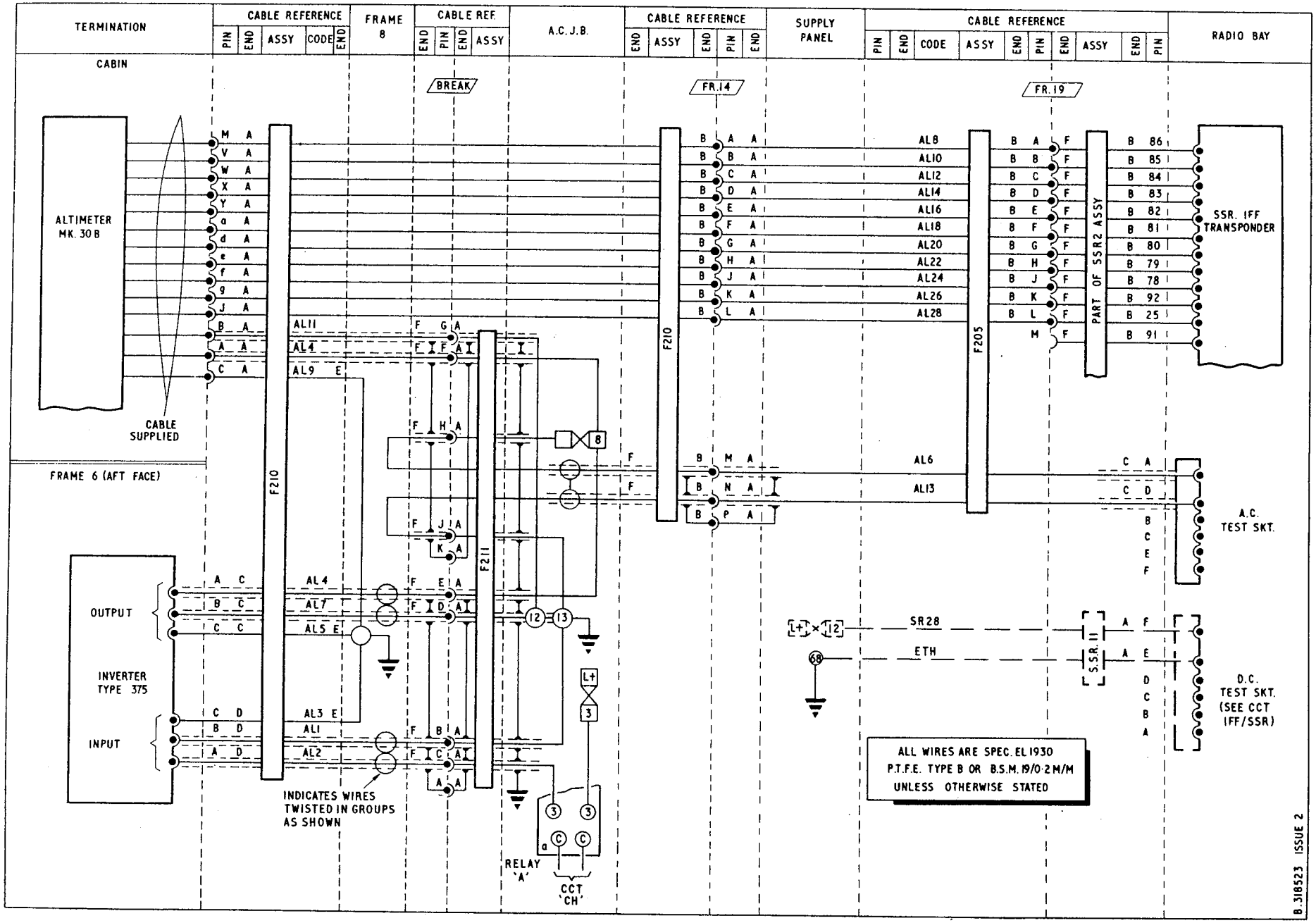

Fig. 1 Height encoding altimeter (routeing)
◀ (Mod. 1405 added) ▶

listed in Table 1. Refer to Groups A1, A2 and A3 for a description of the aircraft electrical system. The Mk.30B altimeter replaces the main altimeter Mk.22D or 22F. The standby Mk.19 altimeter remains as described in Para.8, Group 3.A.

DESCRIPTION

Altimeter Mk.30B

2. The Mk.30B servo encoding altimeter is mounted on the centre instrument panel below the air speed indicator. The altimeter mechanism is housed in a sealed case and connected to the static line of the aircraft pitot/static system. The indicator face of the instrument has a circular dial marked to 1,000 feet altitude in 100 feet divisions with a pointer rotating once for each 1,000 feet. Inset in the dial is a five figure digital readout. The hundred digit changes by one unit every 100 feet moved by the sweep hand and the thousand feet digit moves one unit for every complete revolution of the sweep hand. A serrated knob projecting from the lower left of the instrument, is used to adjust the millibar setting to compensate for varying atmosphere conditions. The power requirement is 115V 400 Hz, single-phase a.c. supplied from a Type 375 inverter. The altimeter has no integral illumination but the dial markings are ultra-violet fluorised. Power failure is indicated by a flag dropping in front of the altitude digits on the dial. A brush encoder is incorporated in the altimeter and transmits an encoded output related to the aircraft indicated height to the IFF/SSR transponder (Sect.6, Chap.2, App.1). This height encoding facility enables the aircraft altitude to be instantly and automatically established upon interrogation by a suitably equipped ground station.

Inverter Type 375

3. The inverter is mounted on the aft face of frame 6. A 28V d.c. input is supplied from a 5 amp fuse, F3 in the A.C. junction box via relay A. The inverter supplies 115V, 400 Hz single-phase a.c. to the Mk.30B altimeter and to the a.c. test set supply socket on the underside of the battery mounting in the radio bay. The 28V d.c. test set supply socket situated adjacent to the a.c. socket is supplied from fuse 12 in the supply panel.

SERVICING

GENERAL

4. Information on the full servicing procedures for the Mk.30B altimeter is given in the Publications listed in Table 1. Units suspected of being defective should first be checked in situ and then, if necessary, removed from the aircraft for servicing.

Altimeter system tests

5. The following ground tests may be carried out to check the condition of suspect units. Associated equipment and test equipment is also listed.

Associated equipment

6. IFF/SSR, Type 1520, A.R.1.23134/3.

Test equipment and diagrams

7. Routeing diagram - fig 1
Aircraft pitot/static testset 6C/2048 or similar
Transponder testset Type CRM 544 ref 10S/1950883
Height encoding readout testset Type 2600 or 2600 - 1 (ref. A.P. 112T - 0618-1)
Insulation tester 500V
Voltmeter to read 115V, 400 Hz a.c.
Test lamp 28V

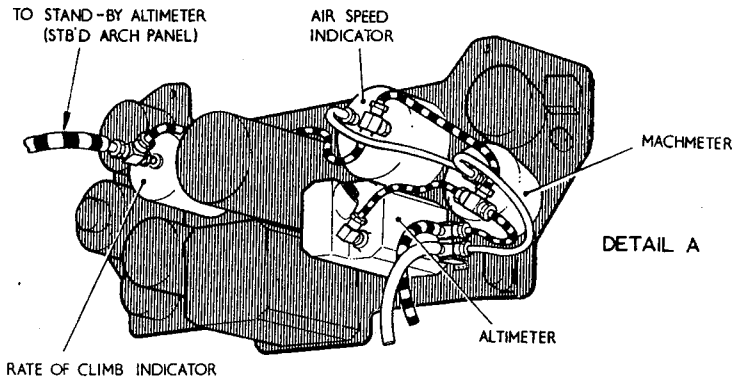

Fig. 2. Altimeter connections.

Leak test

8. Carry out aircraft pitot/static pressure leak test to the appropriate test schedule/publication. Ensure that the test set is connected to the aircraft in a way that damage to other instruments will be prevented during altimeter checks.

Electrical checks

9.

(1) Ensure that BATTERY and ENGINE MASTER switches are OFF.

(2) Disconnect cable F.210 from the altimeter flying lead and the static inverter Type 375 and the F.205/SSR connector at frame 19.

(3) Remove fuses 3 and 8 from the A.C. junction box.

(4) Carry out continuity and insulation checks on altimeter installation wiring.

(5) Reconnect the cables disconnected at (2) and replace fuses 3 and 8 in the A.C. junction box.

(6) Trip the circuit breakers to render the flight instrument inverters inoperative.

(7) Connect an external 28V supply to the aircraft.

(8) Check for 28V d.c. across pins E and F (+ve) of the d.c. test socket. Connect transponder test set CRM 544 into the socket.

(9) Set the ENGINE MASTER switch to ON. The Type 375 inverter should start and the power failure flag on the altimeter should move out of sight. Check that fuse 3 controls the d.c. and fuse 8 controls the a.c.

(10) Check for a.c. at pins A (line) and D of a.c. test socket (HERTS test set supply).

Encoder-transponder system test.

10. Adjust the barometric pressure setting knob on the altimeter to 1,013·25 mb. Adjust the static pressure in the aircraft system to obtain the altitude readings on the altimeter given in Table 2. The information transmitted by the transponder and indicated on the transponder test set should be as indicated.

Note . . .

Local ambient pressure conditions may preclude checks at zero feet.

Encoding altimeter test

11.

(1) At frame 19 disconnect cable F.205 from the transponder cable 5421/1. Connect one end of the HERTS cable to SKT 8 on the HERTS and the other end to cable F.205.

(2) Ensure that the HERTS POWER ON/OFF switch is set to OFF and connect the power supply cable between PL9 on the HERTS and the a.c. test socket, located on the underside of the battery mounting in the radio bay.

(3) Set the POWER ON/OFF switch on the HERTS to ON.

(4) Adjust the barometric pressure setting knob to 1,013·25 mb.

(5) Set the ENGINE MASTER switch to ON.

Note . . .

The test set checks three functions of the encoder. These are logic 1 (turn on) and logic 0 (turn off) functions and the correspondence error between indicated and encoded altitude.

TABLE 2

Altitude output code

Altitude (ft)	Output D	A	B	C	CRM 544 setting A	B	C	D
0	00	000	011	010	0	6	2	0
1,600	00	000	111	011	0	7	6	0
2,700	00	000	100	001	0	1	4	0
5,300	00	001	011	100	4	6	1	0
10,000	00	011	101	010	6	5	2	0
25,000	00	101	110	010	5	3	2	0
31,000	01	100	000	010	1	0	2	4

(6) Set the HERTS functional switch to TURN ON.

(7) Set the HERTS 1,000 ft. TONE switch to ON.

(8) Adjust the static pressure in the aircraft system until the altimeter indicates - 1,000 feet. Check that the HERTS read-out display is - 001.0 and that the input code sequence is :-
0 0 0 0 0 0 0 0 0 0 1 0 (lamp C2 lit)

(9) Adjust the static pressure in the aircraft system to obtain the altitude readings listed in Table 3. At each altitude stop check that the readout on the HERTS corresponds to the figures in Table 3.

Note 1...

The audible tone can be used as a secondary check as it sounds at each 1,000 feet change of altitude.

Note 2...

The input code lamps indicate if a fault is present in a particular line of the encoder. For example, the code for 10,000 feet altitude is 00 011 101 010. If lamps A2, A4, B1, B4 and C2 are lit the encoder is functioning correctly. If, for example, B1 was extinguished, this would indicate a fault in input line B1.

(10) Set the HERTS functional switch to TURN OFF. With the static pressure adjusted to give the maximum altitude listed in Table 3, check that the HERTS read-out corresponds to the figures in the read-out column.

(11) Repeat sub-para (10) to check the read-out against each altitude setting listed, checking in descending order. If there is a fault in the encoder logic, this will be indicated by an additional lamp being lit.

(12) Set the 1,000 feet TONE switch to OFF, the POWER ON/OFF switch to OFF, the ENGINE MASTER switch to OFF and disconnect the HERTS from the altimeter. Reconnect cable 5421/1 to cable F.205 at frame 19.

TABLE 3

Altitude/encoding read-out

Altitude (feet)	Altitude/encoding read-out			
	D	A	B	C
0	00	000	011	010
1,600	00	000	111	011
2,700	00	000	100	001
5,300	00	001	011	100
10,000	00	011	101	010
25,000	00	101	110	010
31,000	01	100	000	010

Altimeter power failure test.

12.

(1) Adjust the static pressure to obtain a reading of 10,000 feet on the Mk.30B altimeter.

(2) Check that the ENGINE MASTER switch is set to OFF and that the power failure flag shows.

(3) Reduce the static pressure in the aircraft system to atmospheric. Set ENGINE MASTER switch to ON. Check that the power failure flag clears and that the instrument aligns to the ambient pressure altitude.

(4) Reset the flight instrument inverter circuit breakers if tripped (see Para.9 (6)) and function a.c. supplies circuit.

(5) Set the ENGINE MASTER switch to OFF, disconnect transponder test set CRM 544 from the test socket and fit protective caps to a.c. and d.c. sockets.

(6) Remove external 28V supply and pitot/static test set.

REMOVAL AND ASSEMBLY

Altimeter Mk.30B

13. The procedure for removing this altimeter from the centre instrument panel is as follows:-

(1) Render the aircraft electrically safe (Sect. 5. Chap.1 Group A.1)

(2) Disconnect altimeter flying lead from its connection with cable F.210 behind the instrument panel and fit blanking covers.

(3) Disconnect static connector from rear of altimeter and fit blanking plugs.

(4) Remove four screws securing altimeter to instrument panel and withdraw the instrument complete with flying lead.

Note . . .

The flying lead is part of the Mk.30B altimeter and must not be removed from it.

Inverter Type 375

14. Removal of this component from the mounting bracket on the aft face of frame 6 is self evident once access is gained.

Pitot/static leak test

15. After replacing the Mk.30B altimeter check the aircraft pitot/static system for leaks in accordance with relevant servicing instructions.