

GROUND TEST INSTRUCTIONS

SECTION 13

HYDRAULIC SYSTEM

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**SECTION 13**  
**HYDRAULIC SYSTEM**  
**PART 1**  
**HYDRAULIC SYSTEM**

**1. APPLICABILITY**

For all the following tests the aircraft must be in the rigging position, and jacked so that all wheels are clear of the ground

The system must be carefully primed and bled prior to commencing tests.

**SPECIAL NOTE — CLEANLINESS**

The hydraulic system will develop defects and failures if any dirt, dust, or foreign matter enters either the system, or the interior of components.

Such defects are almost impossible to diagnose, as the foreign matter re-circulates with the fluid leaving an otherwise serviceable component and no clue to the cause of failure.

To prevent this, all hydraulic system servicing, topping up, etc., must be conducted under conditions best described as 'clinical cleanliness'.

**2. PRIMING**

Prime system with hydraulic oil to D.T.D. Spec.585 (Ref.34B/159) using aircraft reservoir and hand pump.

**3. BLEEDING**

Ensure the reservoir is constantly topped up throughout all bleeding operations to avoid more air passing into system.

Bleed the system by the following operations, which must be made in the sequence given:—

- (i) Undercarriage 'DOWN': bleed undercarriage and fairing door jacks (at bleed screws on components).
- (ii) Fit locks to main and nosewheel undercarriage: select undercarriage 'UP': bleed undercarriage jacks.
- (iii) Bleed fairing door jacks (by depressing sequence valves in wings and nosewheel bay).
- (iv) Bleed flap jacks in 'UP' and 'DOWN' positions, (at bleed screws).

3. BLEEDING (Contd).

- (v) Adjust flap interconnection jacks for travel and bleed as follows:—
  - (a) Disconnect flap operating jacks from flap levers.
  - (b) Build up pressure in interconnection jacks (with hand pump).
  - (c) Bleed interconnection jacks at bleed screws (by moving flaps 'UP' and 'DOWN').

Note . . .

It is essential that interconnection jack circuit is completely free of air otherwise port and starboard flaps will be out of balance.

- (vi) Bleed wheel brake circuit as follows:—
  - (a) Fit bleed clamps (A.C.O.5928) to pressure relays at base of cylinders and adjacent to integral connection. (clamps should contact cylinders in area between two shallow grooves).
  - (b) Tighten clamp screws (use 'Allen' key or 'Un-brako' wrench measuring  $\frac{5}{32}$  ins. across the flats). Excessive torque is not necessary (normal use of correct wrenches will produce necessary clamping force).
  - (c) Slacken union in pipeline from each pressure relay at triple pressure gauge.
  - (d) Apply hand pump pressure.
  - (e) With brake 'ON' operate rudder pedals until oil free from air flows from slackened unions.
  - (f) Tighten couplings whilst flow is maintained.
  - (g) Remove clamps from relays: bleed brake units by operating rudder pedals.
- (vii) Bleed system pressure gauge line as follows:—
  - (a) Fit bleed clamp (A.C.O.5928) to pressure relay as in (vi).
  - (b) Slacken union at system pressure connection of triple pressure gauge.
  - (c) Unscrew both parts of choke not more than one half turn (to allow fluid through by-pass).
  - (d) Apply hand pump pressure until oil free from air flows from slackened union.
  - (e) Tighten union nut whilst flow is maintained.
  - (f) Tighten joint at halves of choke.
  - (g) Remove clamp from pressure relay.
- (viii) After bleeding system, check the following:—

Elevator accumulator	... ..	1575 p.s.i.
Aileron accumulator	... ..	(pre Mod 690) 1575 p.s.i.
		(post Mod 690) 900 p.s.i.
Brake accumulator	... ..	750 p.s.i.
Emergency air	... ..	2000 p.s.i.

## 3. BLEEDING (Contd).

- (ix) Undercarriage 'DOWN'; flaps 'UP'.
- (x) Top up hydraulic reservoir to correct level; replace filler cap.
- (xi) Check pressure on flap and undercarriage 'EMERGENCY' gauges.
- (xii) Check pressure on triple pressure gauge (port cabin shelf).

## 4. SYSTEM TESTS

Test complete hydraulic system by following operations which must be made in the sequence given:—

- (i) Connect hydraulic test rig to external supply valves (frame 34).
- (ii) Test rig 'ON'.
- (iii) Aircraft electrics 'ON'.
- (iv) When system pressure is 2800—3000 p.s.i. test rig 'OFF'.
- (v) Check system pressure falls (due to inherent leak at flaps circuit inter-connection valve).
- (vi) Check hydraulic low pressure warning light and audio warning (Post Mod. 327) comes 'ON' at 600—500 p.s.i. on falling pressure.
- (vii) Test rig 'ON'; run at 3000 and 2000 r.p.m. (approx.).
- (viii) Check system pressure gauge (3000 p.s.i.).
- (ix) Check all system joints (front and centre fuselage, wings and centre fuselage, flexible hoses between centre and rear fuselage) and system generally for leaks.

## 5. UNDERCARRIAGE TESTS

Figures quoted for these tests are an average from many production aircraft.

Before commencing tests, check (with fairing doors 'OPEN') that ample clearance exists between tyres and adjacent pipes and structure when legs are housed. Retract undercarriage completely and check all fairings and doors fit correctly on to landings and do not foul one another.

Test undercarriage by following operations, which must be made in the sequence given:—

- (i) Test rig 'ON'; run at 3000 and 2000 r.p.m. (approx.).
- (ii) Operate undercarriage through 15 to 20 retractions.
- (iii) Record time taken for each 'UP' and 'DOWN' operation (base timing on indicator lights change).
- (iv) Check correct functioning of indicator lights and mechanical indicators at each operation.
- (v) Record working pressures during each 'UP' and 'DOWN' operation.

## 5. UNDERCARRIAGE TESTS (Contd).

(vi) Check figures obtained conform (approx.) to following:—

Test rig speed (approx.).		3000 r.p.m.	2000 r.p.m.
Time	'UP'	6¼ secs. (average)	8 secs. (average)
	'DOWN'	9½ secs. (average)	13½ secs. (average)
Working Pressure	'UP'	2200–2300 p.s.i.	1,300 p.s.i.
	'DOWN'	1200–1250 p.s.i.	1,150 p.s.i.

## 6. FLAPS TESTS

Test flaps by the following operations, which must be made in the sequence given:—

- (i) Check flap jacks, interconnection circuits and flap position indicator correctly adjusted.
- (ii) Connect test circuit and pressure gauges (see SK.22080).
- (iii) Flaps 'DOWN' (using hand pump)
- (iv) Check gauges indicate 2,000–2,350 p.s.i.
- (v) Flaps 'UP' (using hand pump).
- (vi) Check pressure in both gauges drops to 450–550 p.s.i.
- (vii) If either gauge still shows high pressure (2,000–2,350 p.s.i.) with flap fully 'UP', adjust selector valve tappet (see Drg.No. C.203754) until pressure drops.

Note . . .

Port flap selector valve relieves pressure in starboard gauge and vice versa.

All flap movements must be made using hand pump, until adjustments are complete.

- (viii) Upon completion of adjustments, remove test equipment; replace blanking caps.
- (ix) Test rig 'ON' (3,000 r.p.m. approx.).
- (x) Operate flaps through 15 to 20 retractions.
- (xi) Record time taken for each 'UP' and 'DOWN' operation.
- (xii) Check functioning of flap position indicator at each operation.
- (xiii) Record working pressures during each 'UP' and 'DOWN' operation.
- (xiv) Check (xi) and (xiii) conform (approx.) to following:—

Test rig speed (approx.).		3000 r.p.m.
Time	'UP'	8½ secs (average)
	'DOWN'	9 secs. (average)
Working Pressure	'UP'	2700–2750 p.s.i.
	'DOWN'	2700–2800 p.s.i.

## 6. FLAPS TESTS (Contd).

- (xv) During (x) check the following:—
- (a) Synchronisation between port and starboard flaps over complete travel.
  - (b) Synchronisation at all angular selections.
  - (c) Correct angular movement of flaps in relation to selector switch (see Sect. 10, Part 1, for settings).

## 7. WHEEL BRAKES TESTS

Test wheel brakes by the following operations, which must be made in the sequence given:—

- (i) Test rig 'ON' (3000 r.p.m. approx.).
- (ii) Check brake pressure on gauge (3000 p.s.i.).
- (iii) With rudder bar 'NEUTRAL' check pressure at each brake (1500 p.s.i.).
- (iv) Check differential action of rudder bar ensuring that at extreme movement of rudder:—
  - (a) Braked wheel pressure is 1500—1650 p.s.i.
  - (b) Unbraked wheel is free to rotate.
- (v) Brake 'OFF'; check both wheels free to rotate.
- (vi) Test rig 'OFF'.
- (vii) With rudder bar 'NEUTRAL' check and record number of brake applications before pressure gauge drops to 750 p.s.i. (30 to 40 applications).

## 8. AIR BRAKE TESTS

Testing of 'full travel' must be made with aircraft on jacks with wheels clear of ground and undercarriage 'UP'.

On NO account is 'full travel' on ground to be obtained by fitting undercarriage locks and selecting undercarriage 'UP'.

Air brake must NOT be extended at the same time as flaps.

Full extension and retraction is obtained on selection; no INTERMEDIATE position is normally obtainable.

Due to limited ground clearance, operation of air brake test switch is partial (enough to prove system functioning correctly).

Test the air brake by the following operations which must be made in the sequence given:—

- (i) Air brake 'OUT' (on throttle lever); check full travel at high speed (2½ secs.); air brake 'IN'.

## 8. AIRBRAKE TESTS (Contd).

- (ii) Check high speed control valve as follows:—
  - (a) Short out pressure switch (link across terminals AB6 and AB8 at T.B.47 on frame 45).
  - (b) Air brake 'OUT'; check low speed extension is obtained; air brake 'IN'.
  - (c) Remove shorting link after test.
- (iii) Check pressure switch as follows:—
  - (a) Connect voltmeter (0—30 V.) across terminals AB6 and AB8 at TB.47 on frame 45.
  - (b) Air brake 'OUT'; apply pressure by hand pump.
  - (c) Check pressure at which switch operates (2550—2650 p.s.i.) indicated by voltmeter to 'ZERO'.
- (iv) Check 'GROUND TEST' switch as follows:—
  - (a) Operate cabin switch to 'OUT'.
  - (b) Check air brake extends 15 deg. (approx.) and magnetic indicator (in cabin) functions.
  - (c) Return switch to 'IN'; check air brake retracts immediately.

## 9. UNDERCARRIAGE AND FLAPS EMERGENCY 'DOWN' TESTS

Test undercarriage and flaps emergency 'DOWN' system by the following operations which must be made in the sequence given:—

- (i) Connect length of pipe to jettison valve outlets (by suitable rubber coupling).
- (ii) Arrange receptacle to receive jettisoned hydraulic fluid (undercarriage 3 pints, plus flaps  $1\frac{3}{5}$  pints—approx.).
- (iii) Test rig to Max. r.p.m. (post Mod.428).
- (iv) Check emergency air pressure (2000 p.s.i.).
- (v) Check normal operation switches (in cabin) are set to 'UP' position and remain at this throughout test (post Mod.428).
- (vi) Operate undercarriage 'EMERGENCY DOWN' control.
- (vii) Record time for complete lowering cycle and residual pressure in undercarriage emergency air cylinder.
- (viii) Operate flaps 'EMERGENCY DOWN' control.
- (ix) Record time for complete lowering operation and residual pressure in flaps emergency air cylinder.

## 9. UNDERCARRIAGE AND FLAPS EMERGENCY 'DOWN' TESTS (Contd.)

(x) Check (vii) and (ix) conform (approx.) to the following:—

	Time	Residual Pressure
Undercarriage 'DOWN'	11½ secs.	700 p.s.i.
Flaps 'DOWN'	4½ secs.	1200 p.s.i.

(xi) On completion of tests carry out the following:—

- (a) Reset air release valves to 'NORMAL' position.
- (b) Bleed undercarriage and flaps circuits (as detailed in Para.2).
- (c) Make 5 cycles of undercarriage and flaps 'UP' and 'DOWN' (using test rig) to ensure satisfactory operation.
- (d) Top up hydraulic reservoir to correct level; replace filler cap.

## 10. UNDERCARRIAGE EMERGENCY 'UP' TESTS

Test undercarriage emergency 'UP' system by the following operations, which must be made in the sequence given:—

- (i) Check undercarriage selector switch (normal) 'DOWN'.
- (ii) Remove fuse No.2 from port rear cabin shelf fuse box (to simulate electrical failure for normal 'UP').
- (iii) Rotate knurled ring on undercarriage 'UP' button clockwise.
- (iv) Select undercarriage 'UP'.
- (v) After test reset undercarriage 'UP' switch as follows:—
  - (a) Insert Dowty resetting tool (S.T.1657 or C.2524.Y/59) into small hole in 'UP' button.
  - (b) Press lightly and rotate knurled ring back to original position.
- (vi) Replace fuse No.2 into fuse box.

## 11. COMPLETION OF TESTS

Upon completion of all tests on hydraulic system carry out the following:—

- (i) Disconnect test rig; blank off all apertures.
- (ii) Ensure all blanking plugs removed from aircraft and original connections re-made.
- (iii) Remove aircraft hydraulic filter element. Replace with new element (see Sect.1, Para.14); refit and lock filter.

**SECTION 13**  
**HYDRAULIC SYSTEM**  
**PART 2**

**DUNLOP HYDRAULIC ACCUMULATORS AC.12810 AND 14010**

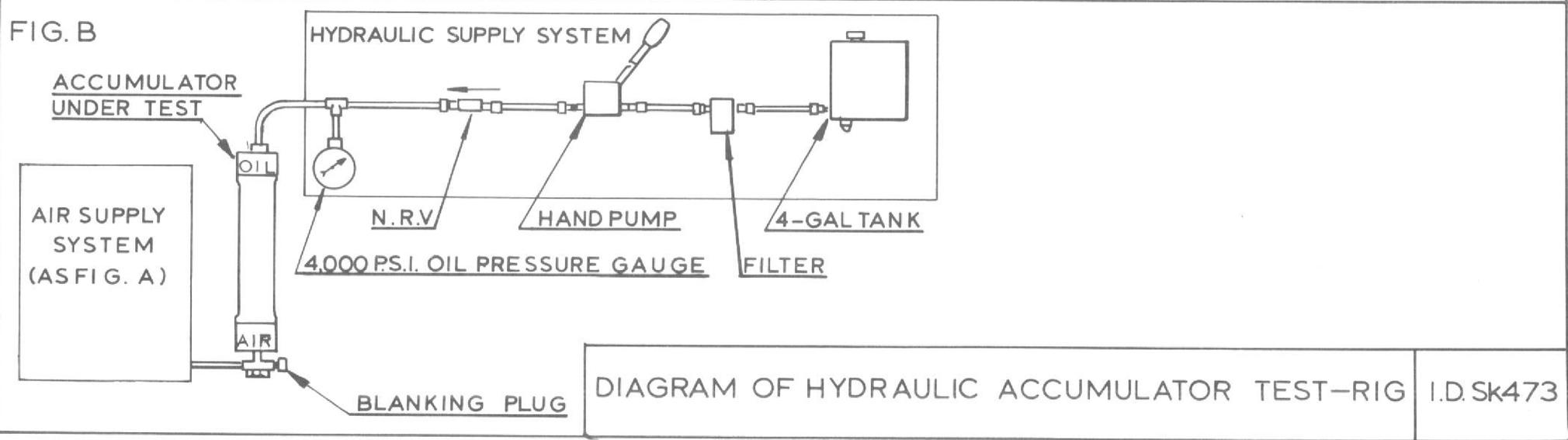
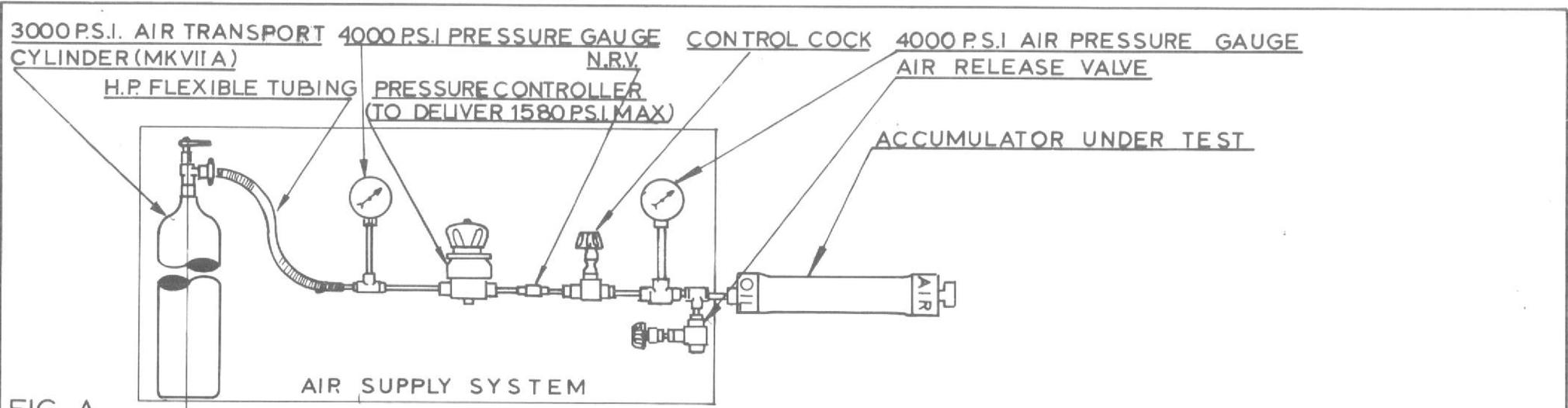
**I.D. INSTRUCTION H07/1 (Issue 2)**

**1. TESTS**

- (i) The equipment required is shown diagrammatically on Drg.No. ID.SK.473.
- (ii) Connect the air supply to the oil connection of the accumulator, as in fig.A on the drawing, leaving the air connections open to atmosphere.
- (iii) Close the air release valve, apply an air pressure of 1000 p.s.i. and close the control cock. Test for leaks at the oil and air connections with soap solution. Release air pressure.
- (iv) Disconnect the air supply and connect to one of the air connections of the accumulator. Blank off the second air connection. Connect the hydraulic supply to the oil connection, as in fig.B.
- (v) Close the air release valve, apply 1550 p.s.i. air pressure and close the control cock.
- (vi) Apply an oil pressure until both gauges read 2700 p.s.i. and check for leaks. Maintain pressure for 15 minutes.
- (vii) Open the air release valve slowly and check that no oil sprays out with the released air.
- (viii) Disconnect accumulator, drain and fit blanking plugs.

Note . . .

The accumulator must always be correctly charged with air before oil is introduced under pressure.



**SECTION 13**  
**HYDRAULIC SYSTEM**  
**PART 3**

DOWTY HYDRAULIC ACCUMULATORS – D.4133Y Mks.E & F,  
D.7376Y, D.7513Y, C.8394Y, D.8691Y, 08394YA02, 08692YA03,  
08692YA04, and 08692YA05.

I.D. INSTRUCTION H07/2 (Issue 3).

1. APPLICABILITY

This instruction applies to Accumulators on Mk.1, 2, 4, 5, 6, 7, 50 and 51 aircraft pre- and post- Mods. H.416, H.497.

2. TEST

- (i) The equipment required is shown diagrammatically in Drg.No. ID.SK.473.
- (ii) Connect the air supply to the oil connection of the accumulator, as in fig.A on the drawing, leaving the air connection open to atmosphere. Blank the 2nd oil connection where a double banjo is fitted.
- (iii) Close air release valve, apply an air pressure of 1,000 p.s.i. and close control cock. Test for leaks at the oil and air connections with soap solution. Release air pressure.
- (iv) Disconnect the air supply and attach to the air connection. Connect the hydraulic supply to the oil connection, as in fig.B. Blank off spare connections where double banjos are fitted.
- (v) Apply 1,575 p.s.i. air pressure and close the control cock.
- (vi) Apply an oil pressure of 2,700 p.s.i. and check for leaks. Maintain pressure for 15 minutes.
- (vii) Open the air release valve slowly, and check that no oil sprays out with the released air.
- (viii) Disconnect accumulator, drain, and fit blanking plugs.

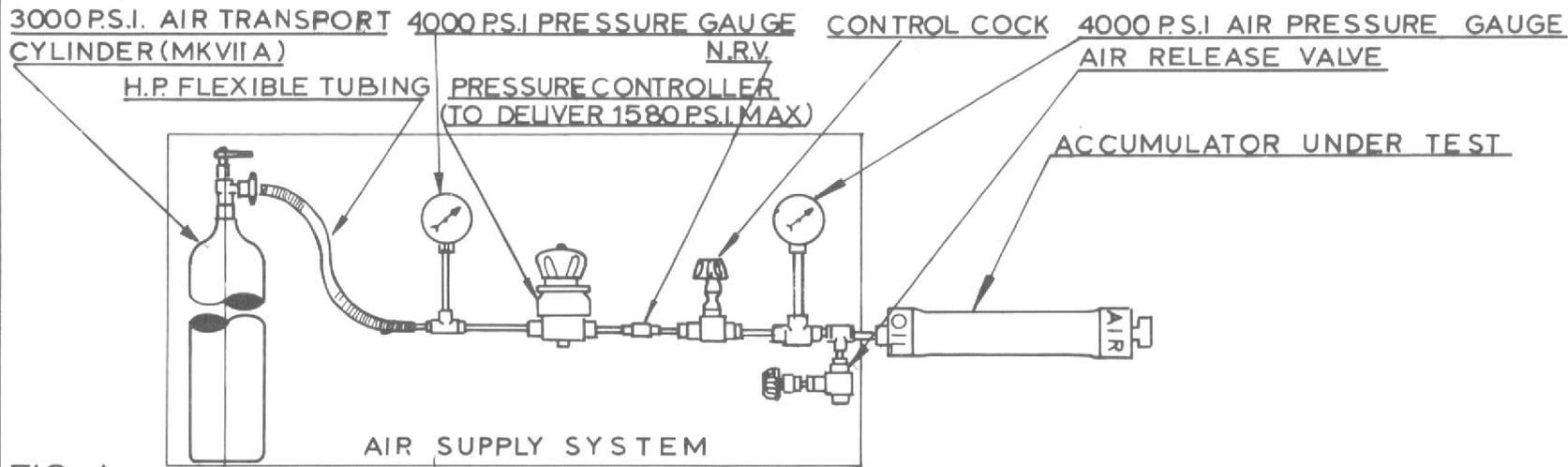


FIG. A

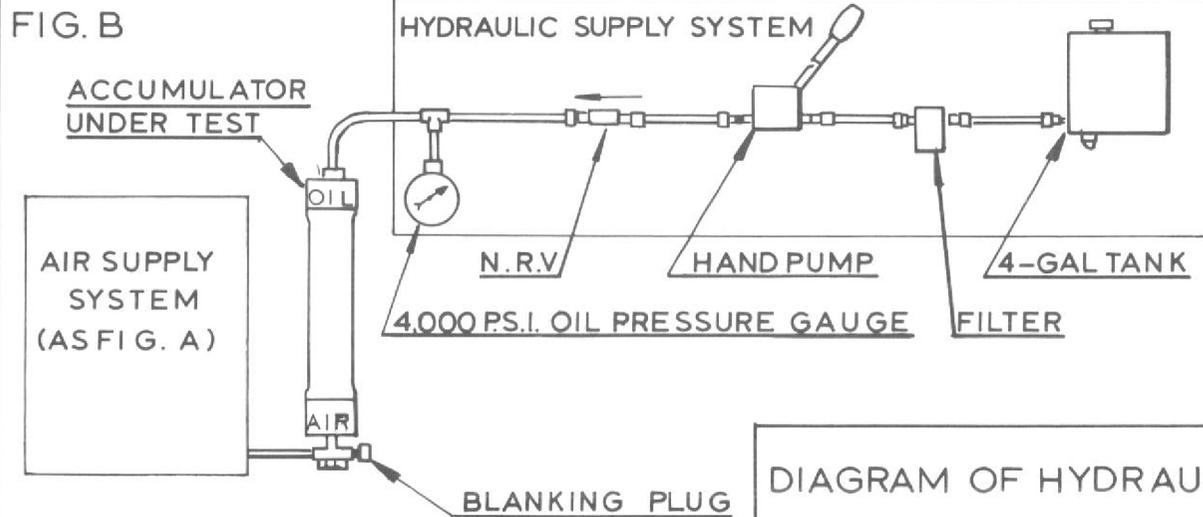


DIAGRAM OF HYDRAULIC ACCUMULATOR TEST-RIG I.D. SK473

**SECTION 13**  
**HYDRAULIC SYSTEM**

**PART 4**

**HYDRAULIC PRESSURE SWITCH TP.5555**

**I.D. INSTRUCTION H07/3 (Issue 4)**

**1. TESTS**

- (i) Connect a hydraulic supply, with pressure gauge, and a 24 v. electrical supply, with warning lamp, to the switch.
- (ii) Apply a fluid pressure of 5,000 p.s.i. to the switch for not less than one minute; check for leaks.
- (iii) Lower pressure slowly and check that the warning lamp lights between 650 and 550 p.s.i.
- (iv) Slowly increase pressure and check that the lamp goes out within 50 p.s.i. of the pressure recorded in op.(iii).
- (v) Disconnect hydraulic and electrical supplies. Using a 250 volt megger, test the insulation between each Breeze plug pin and the switch casing. The resistance must exceed 20 megohms.

**SECTION 13**  
**HYDRAULIC SYSTEM**  
**PART 5**

HYDRAULIC PRESSURE SWITCH TP.5300/2 and TP.1300.

I.D. INSTRUCTION H07/4 (Issue 4)

1. TESTS

- (i) Connect a hydraulic supply with pressure gauge and a 24 volt electrical supply, with warning lamp, to the switch.
- (ii) Apply a fluid pressure of 4,000 p.s.i. to the switch for not less than one minute; check for leaks.
- (iii) Reduce pressure to zero: increase to 3,000 p.s.i. and reduce to zero again. Then progressively increase pressure and check that warning lamp lights at 2,525 to 2,675 p.s.i. Reduce pressure and check that lamp goes out within 400 p.s.i. (TP 5300/2) or 200 p.s.i. (TP 1300) of the above recorded pressure.
- (iv) Disconnect hydraulic and electrical supplies. Using a 250 volt megger, test the insulation between each Breeze plug pin and the switch casing. The resistance must exceed 20 megohms.

**SECTION 13**  
**HYDRAULIC SYSTEM**

**PART 6**

**HYDRAULIC PRESSURE SWITCH TP.5560 and TP.5566**

**I.D. INSTRUCTION H07/5 (Issue 2)**

1. **APPLICABILITY**

This instruction covers switches introduced by modifications H.686 and 687.

2. **PROCEDURE**

- (i) Connect a hydraulic supply, with pressure gauge, and a 24 v. electrical supply, with warning lamp, to the switch.
- (ii) Apply a fluid pressure of 5,000 p.s.i. to the switch for not less than one minute; check for leaks.
- (iii) Lower pressure slowly and check that the warning lamp goes out between 650 and 550 p.s.i.
- (iv) Slowly increase pressure and check that the lamp lights within 50 p.s.i. of the pressure recorded in Op. (iii).
- (v) Disconnect hydraulic and electrical supplies. Using a 250 volt megger, test the insulation between each Breeze plug pin and the switch casing. The resistance must exceed 20 megohms.

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