PART 1

CHAPTER 1 — FUEL SYSTEM

Contents

DESCRIPTION

1 Tanks

(*a*) Fuel is carried in six internal tanks, one in each wing and two front and two centre tanks in the fuselage. Each wing tank consists of four cells and is fitted in the forward edge of the wing. The fuselage tanks are of the flexible bag type.

(*b*) Provision is made for carrying either two or four tanks on underwing pylons.

(*c*) The tank capacities are:

Tanks	*Gallons*	*AVTAG 7·7 lb/gall*	*AVTUR 8·0 lb/gall*
Front	202	1555	1616
Centre	72	554	576
Wing	140	1078	1120
2 × 100 gallon drop tanks	200	1540	1600
4 × 100 gallon drop tanks	400	3080	3200
Totals:			
Internal	414	3187	3312
Internal +2 × 100 tanks	614	4727	4912
Internal +4 × 100 tanks	814	6267	6512

2 Fuel Feed System — General

Fuel is fed to the engine by a booster pump in each front tank via a fuel proportioner and then through the LP and HP cocks. Fuel is transferred from the wing and centre tanks to the front tanks on the same side by air pressure from a tapping on the engine compressor. When drop tanks are carried fuel transfer is from the outer drop tank to the inner drop tank to the wing tank on the same side.

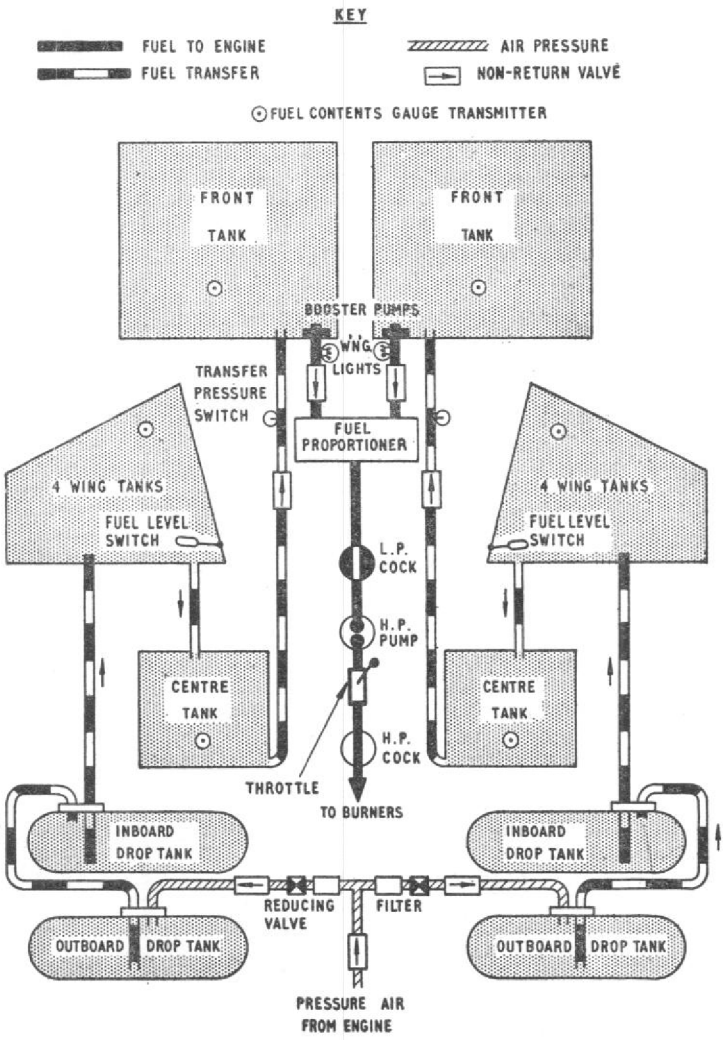
3 Booster Pumps and Negative g Fuel Traps

Each front tank contains an electrically-driven immersed booster pump fitted in a negative g fuel trap, the contents of which are used in inverted flight. The total contents of the traps are sufficient to provide for approximately 15 seconds inverted flight at full power at sea level.

4 Fuel Proportioner

(*a*) From the booster pumps fuel passes to the fuel proportioner, which should ensure a balanced flow from both sides of the fuel system when both booster pumps are working correctly.

(*b*) The proportioner consists of a matched pair of vane-type rotors, mounted on a common shaft. Two inlet ports, one for each rotor, accept fuel from the associated booster pump. A single exit port passes the metered fuel through the LP cock to the engine.


KEY
FUEL TO ENGINE
FUEL TRANSFER
AIR PRESSURE
NON-RETURN VALVE
FUEL CONTENTS GAUGE TRANSMITTER
FRONT TANK
FRONT TANK
BOOSTER PUMPS
WNG. LIGHTS
TRANSFER PRESSURE SWITCH
FUEL PROPORTIONER
4 WING TANKS
FUEL LEVEL SWITCH
4 WING TANKS
FUEL LEVEL SWITCH
L.P. COCK
H.P. PUMP
CENTRE TANK
CENTRE TANK
H.P. COCK
THROTTLE
TO BURNERS
INBOARD DROP TANK
INBOARD DROP TANK
REDUCING VALVE
FILTER
OUTBOARD DROP TANK
OUTBOARD DROP TANK
PRESSURE AIR FROM ENGINE

Fuel System

(*c*) Should the proportioner rotors jam, fuel bypasses them via spring-loaded non-return valves.

(*d*) Unequal feeding is only likely to occur if inlet pressures to the proportioner differ by more than 2 PSI; the greater the pressure difference, the greater the amount of unequal feeding.

5 Fuel Filter De-Icing

(*a*) Since fuel contains a small amount of water an automatic de-icing system is fitted to ensure that the fuel filter is not blocked by ice crystals at low OAT. When icing occurs, the increasing pressure drop through the filter switches on an electric pump to supply alcohol to the filter. When the pressure drop returns to normal, the system automatically switches off.

(*b*) The de-icing fluid tank, of one gallon capacity, is in the engine bay; a filler access and contents indicator are on the starboard side of the fuselage.

(*c*) Post-mod 1396 (Mk 8B only), the fuel filter de-icing system is rendered inoperative.

CONTROLS AND INDICATORS

6 LP Fuel Cock

The LP fuel cock control is on the port shelf and is moved forward from OFF to ON. It controls the fuel flow to the engine via the HP cock.

7 Booster Pump Controls and Indicators

(*a*) Each booster pump is controlled by an ON/OFF switch on the centre panel; a circuit breaker for each pump is on the coaming above the centre panel. The engine master switch must be on and the starter circuit breaker and booster pump circuit breakers made to complete the electrical circuits to the booster pumps.

(*b*) Adjacent to the switches are two amber warning lights, one for each pump, which come on if the associated booster pump is switched off or fails.

(*c*) A red FUEL LOW PRESSURE warning light above the pump warning lights comes on if fuel delivery pressure from the booster pumps falls to about 3·5 PSI.

(*d*) A test switch and an ammeter socket on the starboard wall are provided for servicing purposes.

8 Fuel Contents Gauges

(*a*) Two electrical fuel contents gauges at the top of the centre panel indicate the total weight of fuel in the PORT and STBD tanks (front, centre and wing). The contents of the 100 gallon drop tanks are not gauged.

(*b*) When all internal tanks are full (front, centre and wing) each gauge should read approximately full provided that transfer pressure is available; if transfer pressure is not available, the gauges read the front tank contents only (800/800 lb).

(*c*) A fuel contents check switch on the coaming above the centre panel has two positions ENGINE ON and ENGINE OFF; it is spring-loaded to the ENGINE ON position. By selecting and holding ENGINE OFF, the total internal fuel contents can be checked with the engine shut down on the ground, or in conditions of transfer pressure failure in the air.

9 Fuel Transfer Indicators

All internal fuel is gauged, and the contents reading should fall when fuel is being used from these tanks. When transfer from the 100 gallon drop tanks (which are ungauged) is taking place the fuel contents gauges should show a constant reading. Should the air pressure fail, no fuel transfers from the drop, wing or centre tanks and the TRANSFER FAILURE indicators on the centre panel indicate failure by showing white. At the same time the contents gauge transmitters in the centre and wing tanks become inoperative and the gauges should only indicate the contents of the front tanks, ie the amount of fuel available to the engine. If only one side of the air pressure system fails, the appropriate indicator shows white and the associated gauge indicates the available fuel contents.

10 Fuel Level Indicators

Two OUTBD DROP TANKS magnetic indicators, one for each outboard tank, are below the contents gauges. Each shows white when all fuel has transferred from its associated outboard drop tank.

11 Drop Tank Jettison Controls

(*a*) The inboard drop tanks can be jettisoned by pressing the INBD STORES jettison button, on the armament control panel beneath the port coaming, provided that the bomb fuzing switch is selected off.

(*b*) The outboard drop tanks can be jettisoned by pressing the OUTBD STORES button, on the armament control panel. The setting of the fuzing switch is immaterial.

(*c*) All four drop tanks can be simultaneously jettisoned by pressing down the CLEAR A/C switch bar, above the jettison buttons. The bomb fuzing switch must be selected off to allow the inboard drop tanks to jettison.

(*d*) The drop tanks can also be jettisoned by means of the bombing switches (see Part 1, Chapter 10).

12 Pressure Refuelling and Defuelling Controls

(*a*) Refuelling is via a coupling in the port wheel bay. As each set of tanks is filled, refuelling valves automatically cut off the fuel being supplied to them. During refuelling the LP cock and the defuelling cock must be off. The defuelling cock is accessible through the engine starter access door on the underside of the fuselage. The battery master switch (or an external DC supply) and a time switch adjacent to the coupling must be on in order to energise the refuelling circuit. Post-mod 1381, the aircraft can be refuelled with the battery master switch off and without external power.

(*b*) Defuelling is via the same coupling. During defuelling the LP cock must be off, and the defuelling cock on. An air pressure of 10 PSI is necessary to transfer fuel to the front tanks, from where it is either sucked out by the bowser pump or pumped out by the booster pumps. The air pressure connection is on top of the centre fuselage.

NORMAL USE OF THE SYSTEM

13 Pre-Flight Checks of the System

(*a*) The HP and LP cocks must be on and the booster pumps should normally be on when the engine is running.

(*b*) Before starting, check that the booster pump circuit breakers are made and switch the booster pumps on.

(*c*) After starting, test the booster pump warning lights by switching off and on each booster pump in turn.

14 Use of the System in Flight

(*a*) Correct functioning of the system is shown by:

(i) Fuel contents gauges indicating equal fuel levels.

(ii) The LP warning light out.

(iii) Booster pumps warning lights out.

(iv) Fuel transfer indicators showing black.

(v) The two outboard drop tank magnetic indicators showing white when the *outboard* drop tanks are empty or not fitted.

(*b*) The proportioner maintains accurate fuel balancing with both booster pumps on or off, provided that the pressures at which the fuel enters the proportioner from the booster pumps do not differ by more than 2 PSI. If unequal emptying occurs with all indicators normal, either the proportioner has failed or the inlet differential pressures are greater than 2 PSI in which case fuel balancing must be controlled manually by switching off the pump on the 'low' side until the levels become equal and then switching it on again.

15 Unusable Fuel

At low fuel states, ie below 200/200 lb, excessive attitudes or accelerations may cause fuel in the tanks to move away from the booster pumps, resulting in fuel starvation and possible flame extinction.

MALFUNCTIONING OF THE SYSTEM

16 Booster Pump Failure

(*a*) A booster pump failure is indicated by its amber warning light coming on and, providing the drop tanks

have emptied, by the corresponding fuel gauge reading higher than the other. No fuel will be used from the failed side if the *serviceable* pump is left on.

(*b*) (i) If both warning lights come on, check that the starter circuit breaker is made and that the engine master switch is on; then check that the booster pump circuit breakers are made. If the failure is confirmed, reduce to idling RPM, switch off the failed pump(s), and descend to a maximum height of:

25,000 feet ... Clean aircraft or with empty drop tanks

20,000 feet ... Two or four drop tanks containing fuel.

If maximum range is vital, these heights can be increased by a maximum of 10,000 feet accepting the risk of possible damage to the HP fuel system.

(ii) Then, switch off the serviceable pump and accept the fuel feed provided by tank pressurisation and gravity. RPM thereafter must not exceed 7600. With both pumps off the LP warning light may illuminate, depending on altitude and power setting.

(*c*) With both booster pumps off, negative g manoeuvres must be avoided. It is vital to land while both sides still contain fuel, because the flow proportioner maintains any fuel imbalance at the time of failure and the engine will not run with one side empty unless the booster pump in the side containing fuel is running. The serviceable pump should be switched on before landing if the fuel state on that side of the system permits, but it should be remembered that with the pump on, fuel is only used from that side.

(*d*) With both booster pumps off and with less than 600/600 lb there is a possibility of engine flame-out at low RPM. To prevent this, engine RPM must be kept above 6000 until a booster pump is switched on for landing.

(*e*) The engine must subsequently be examined for damage to the HP fuel system.

17 Transfer Failure

(*a*) If one or both transfer indicators show white, transfer pressure failure has occurred and steep dives should be avoided due to the possibility of collapsing the tanks. Should an indicator show white before fuel transfer is complete, any fuel remaining in the centre, wing and drop

tanks is unusable and the associated contents gauge only indicates the usable fuel in the front tanks (800 lb maximum per tank). In these circumstances if the gauge registers more than 800 lb a faulty gauge should be suspected and only the front tank fuel should be relied upon as being available to the engine.

(*b*) If air transfer fails on one side, the booster pump on the side with transfer failure should be switched off until the contents gauge of the other side indicates an equal amount; the pump should then be switched on.

18 Fuel Gauge Errors

The fuel contents gauges have been found to give erroneous indications due to temperature effects on the electrical gauging system. The magnitude of the error depends on both temperature and flight conditions. Low temperatures at high altitude give gauge under-reading; high temperatures at high speeds at low altitude give gauge over-reading. During a descent from altitude, if the assessed inaccuracy is a gauge under-reading, the gauges progressively become more accurate and may eventually tend to over-read.

19 Proportioner Malfunction

A malfunctioning proportioner can cause unbalanced fuel flow. The aircraft should be landed whilst both sides contain fuel. An attempt can be made to correct any fuel imbalance by selective switching of the booster pumps.