Part I

Chapter 3B—Three-point Tanker Installation Mk. (K) 1 and Mk. (K) 1A Aircraft

List of Contents

Description, Controls and Indicators

1 Description

(*a*) The three-point tanker installation is comprised of two wing-mounted Mk. 20B flight refuelling pods and a Mk. 17 hose drum unit (HDU) carried in the bomb-bay. Each pod and the HDU are controlled from panel CI on the rear crew compartment starboard wall. The fuel system is controlled by the pilots. Both (K) 1 and (K) 1A aircraft are fitted with the Sapphire 207 engines but (K) 1 aircraft do not have top temperature control.

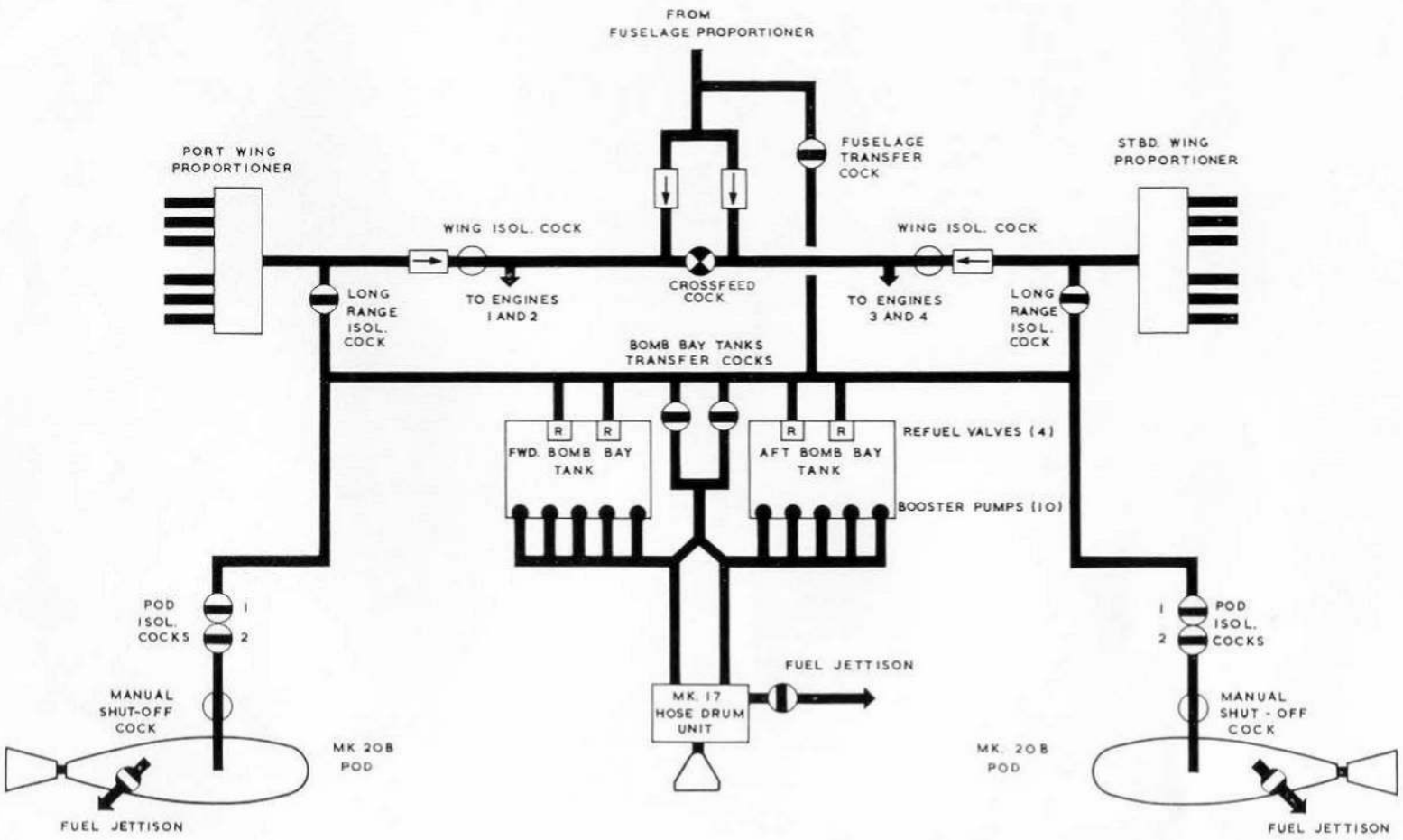

Fig. 1 Fuel system

(*b*) The pods each have a capacity of approximately 1,000 lb. of fuel. Normally each pod is supplied by the bomb-bay tanks, but it is possible to supply either or both pods from any suitable combination of tank groups by appropriate switching.

(*c*)(i) The HDU is supplied with fuel from the bomb-bay tanks. The HDU fuel pump is driven by an air turbine fed from the hot air supply to the tail anti-icing jet pumps.

(ii) The HDU hydraulic supplies, for raising and lowering the unit, and for brake applications, are obtained from the old bomb-bay doors pipelines, since bomb doors are not fitted.

(*d*) (i) Each bomb-bay tank contains five booster pumps. Two refuelling valves in each tank permit fuel to be transferred from any combination of wing/fuselage groups.

(ii) The electrical supply to the booster pumps in the bomb-bay tanks is arranged so that single bus-bar failure does not affect all pumps in one tank. Three pumps in the forward tank and two in the aft are supplied by the port MV bus-bar, the remainder being served by the starboard MV bus-bar.

(*e*) The pods and HDU are automatic in operation once certain settings have been made by the panel operator. The panels contain indicators and lights to give visual evidence of the progress of the refuelling operation and warning of abnormal conditions necessitating special action. Such action may happen automatically or require further switch selections by the operator.

(*f*) A periscope is mounted between the two navigators for rearward and downward viewing of the receiver contacting the hose.

2 Pilots' switch panel

(*a*) *Panel AT*

(i) Panel AT for both the Mk. 1 and Mk. 1A aircraft has been similarly revised to cater for the additional switches required, as follows:

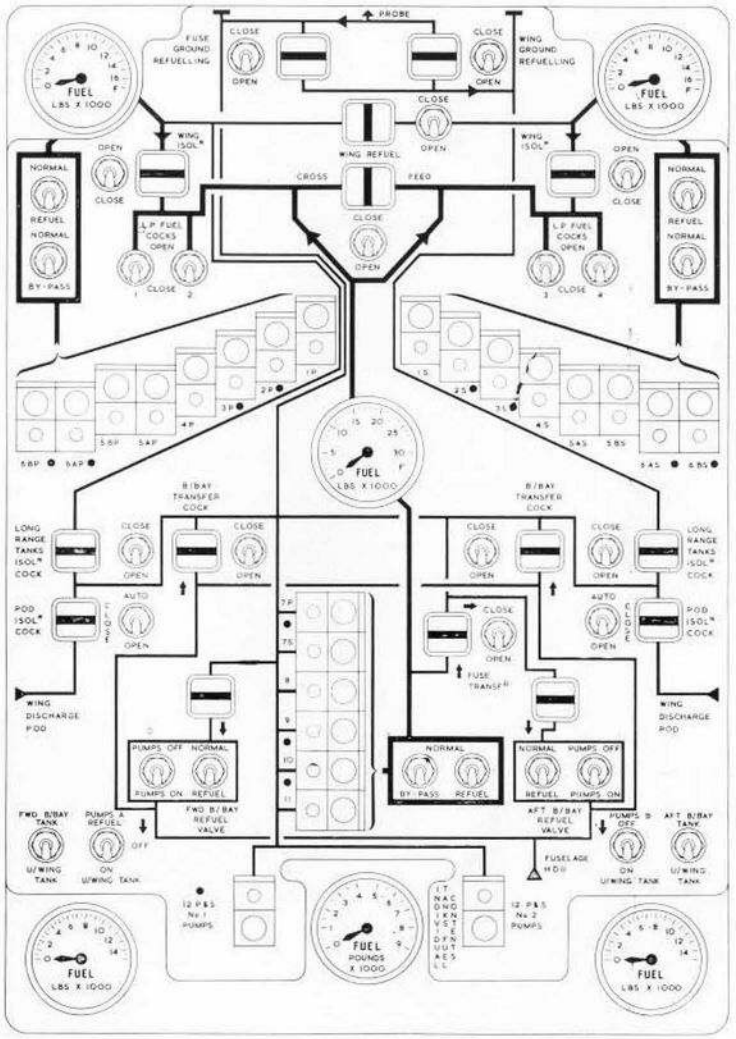

Fig. 2 Pilots' panel AT

1 Two B/BAY TRANSFER COCK, CLOSE/OPEN switches each with an adjacent magnetic indicator which gives an in-line indication when its associated cock is open. Circuit breakers are on board AJ. Either cock controls the flow of fuel from the bomb-bay tanks to the Mk. 20B pods and/or to the engines. Normally both cocks should be operated.

2 Two POD ISOLN COCK, AUTO/CLOSE/OPEN switches each with an adjacent magnetic indicator which gives an in-line indication when the two isolation cocks for the associated pod are open. The AUTO (normal) setting of the switches controls, via float switches, the pod fuel level to maintain it between mid-level and full by automatically opening and closing the cocks as necessary. Circuit breakers are on board AJ.

3 One FUSE TRANSFER OPEN/CLOSE switch with an adjacent magnetic indicator which gives an in-line indication when the transfer cock is open. A circuit breaker is on board AJ and electrical supply is from the starboard MV bus-bar. The cock controls the flow of fuel from the fuselage group to the bomb-bay tanks or to the Mk. 20B pods.

(ii) The following changes have been made to existing switches:

1 The fuselage proportioner NORMAL/BYPASS and NORMAL/REFUEL switches have been repositioned side-by-side.

2 The bomb-bay tanks PUMPS ON/OFF/REFUEL switches have been replaced by NORMAL/REFUEL and PUMPS ON/PUMPS OFF switches. Each PUMPS switch controls all five pumps in its associated tank. Electrical supplies to the REFUEL switches are from the starboard MV bus-bar.

3 The bomb-bay tanks/drop tanks contents gauge switches have been re-annotated FWD (AFT) B'BAY TANK/U'WING TANK.

(*b*) *Test switches*

On the forward face of Panel AJ are two lights, PORT No. 1 and STBD. No. 1, PRESS TO TEST No. 2. These are for checking the position of the pod isolation cocks. When the No. 1 cock of each pod is closed the light comes on. Pressing each light individually causes the light to go out and then come on again provided that the associated No. 2 cock is closed. Failure of a light to come on when the pod isolation cock switch is set to CLOSED means that the appropriate cock has not fully closed.

(*c*) *Fuel jettison switch* (*post-Mods.* 3997 *and* 3998)

A caged BOMB BAY TANKS FUEL JETTISON VALVE switch on panel AC when set to JETTISON enables fuel to be pumped out of the bomb-bay tanks, via the HDU fairing, at the rate of approximately 4,000 lb/min.

3 Tanker operator's pod control panels

(*a*) On each pod control panel are the following controls:

(*b*) *Switches*

(i) *Master switch*

The MASTER (ON/OFF) SWITCH controls all electrical circuits to the pod except those controlled by the turbine overspeed switch.

(ii) *Fuel jettison switch*

The FUEL JETTISON, ON/OFF controls the jettison valve in the pod. A guard on the switch must be rotated through 90° before the switch can be operated.

(iii) *Wind/trail switch*

The WIND/TRAIL switch controls the winding or trailing of the hose.

(iv) *Emergency trail switch*

The EMERGENCY TRAIL/OFF/HOSE RELEASE switch permits the hose to be extended to the full trail position from which it can be jettisoned by selecting HOSE RELEASE.

(v) *Refuelling lights switch*

The REFUEL LTS, DAY/NIGHT switch controls the choice of brightness of the signal lights in the pod.

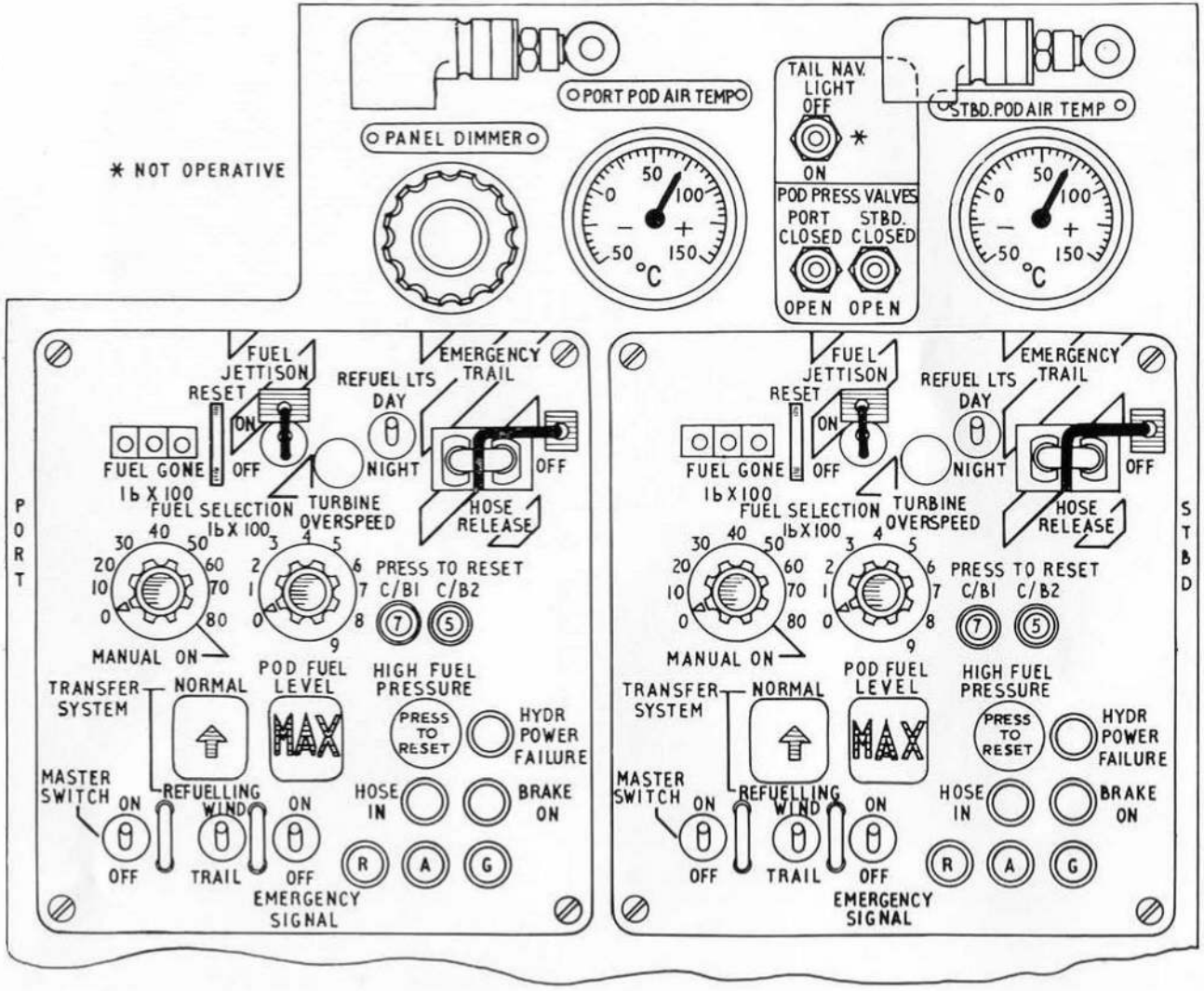

Fig. 3 Tanker operator's pod controls

(vi) *Emergency signal switch*

The EMERGENCY SIGNAL, ON/OFF switch causes the red signal lights to come on irrespective of any other lights which may be illuminated.

(*c*) *Fuel selection controls*

(i) *Fuel selector switches*

Two fuel selector rotary switches, one reading in tens of hundreds and the other reading in hundreds are preset to the amount of fuel required to be transferred. Passage of fuel causes the switches to rotate anti-clockwise giving an indication of the amount still to be transferred. At the end of transfer the fuel selector valve automatically closes. However, the left-hand switch has a MANUAL ON position and with the switch thus set an unrestricted amount of fuel may be transferred without preset limitation.

(ii) *Fuel totaliser*

A veeder counter is mounted above the selector switches giving a reading of FUEL GONE in hundreds of pounds.

(*d*) *Magnetic indicators*

(i) *Refuelling indicator*

An arrow indication points either to NORMAL or REFUELLING. The REFUELLING indication is given whenever the pod isolation cocks are open. The NORMAL indication is given when the cocks are closed. The indicator shows black when the aircraft power supplies are off and is independent of the master switch.

(ii) *Fuel level indicator*

The POD FUEL LEVEL indicator shows MIN or MAX according to the amount of fuel in the pod. The indicator shows black at intermediate conditions.

(*e*) *Warning lights*

(i) Warning lights are fitted to provide indication of HIGH FUEL PRESSURE (amber) HYDR POWER FAILURE (red), HOSE IN (white), BRAKE ON (blue) and TURBINE OVERSPEED (red). Additionally the HOSE IN light pulsates while the hose is being trailed or wound in.

(ii) Three signal lights operate automatically once a refuelling operation has commenced. The red light comes on when the hose is being trailed or wound in, but not at full trail. The amber light comes on when the hose is at full trail. The green light comes on when the receiver aircraft has engaged the drogue, the hose has wound in by six feet and the necessary components have functioned to permit passage of fuel.

(*f*) *Circuit breakers*

Two PRESS TO RESET circuit breakers protect the normal (CB1) and emergency (CB2) circuits in the pod.

(*g*) *Pod air pressure valves*

The PORT and STBD. POD PRESS VALVES, OPEN/CLOSE switches control the supply of air from the engine compressors to pressurise the refuelling pods. Additionally an AIR TEMP. gauge is provided for each pod; the air temperature must not exceed 100°c in use.

4 Tanker operator's HDU control panel

(*a*) The HDU control panel at the bottom of panel CI has the following controls.

(*b*) *Switches*

(i) *Master switch*

The MASTER, ON/OFF switch controls the turbine pump and the hose circuits.

(ii) *Retraction switch and indicator*

The RETRACTION, UP/DOWN switch controls the raising and lowering of the HDU. Above the switch is a RETRACT INDicator which shows:

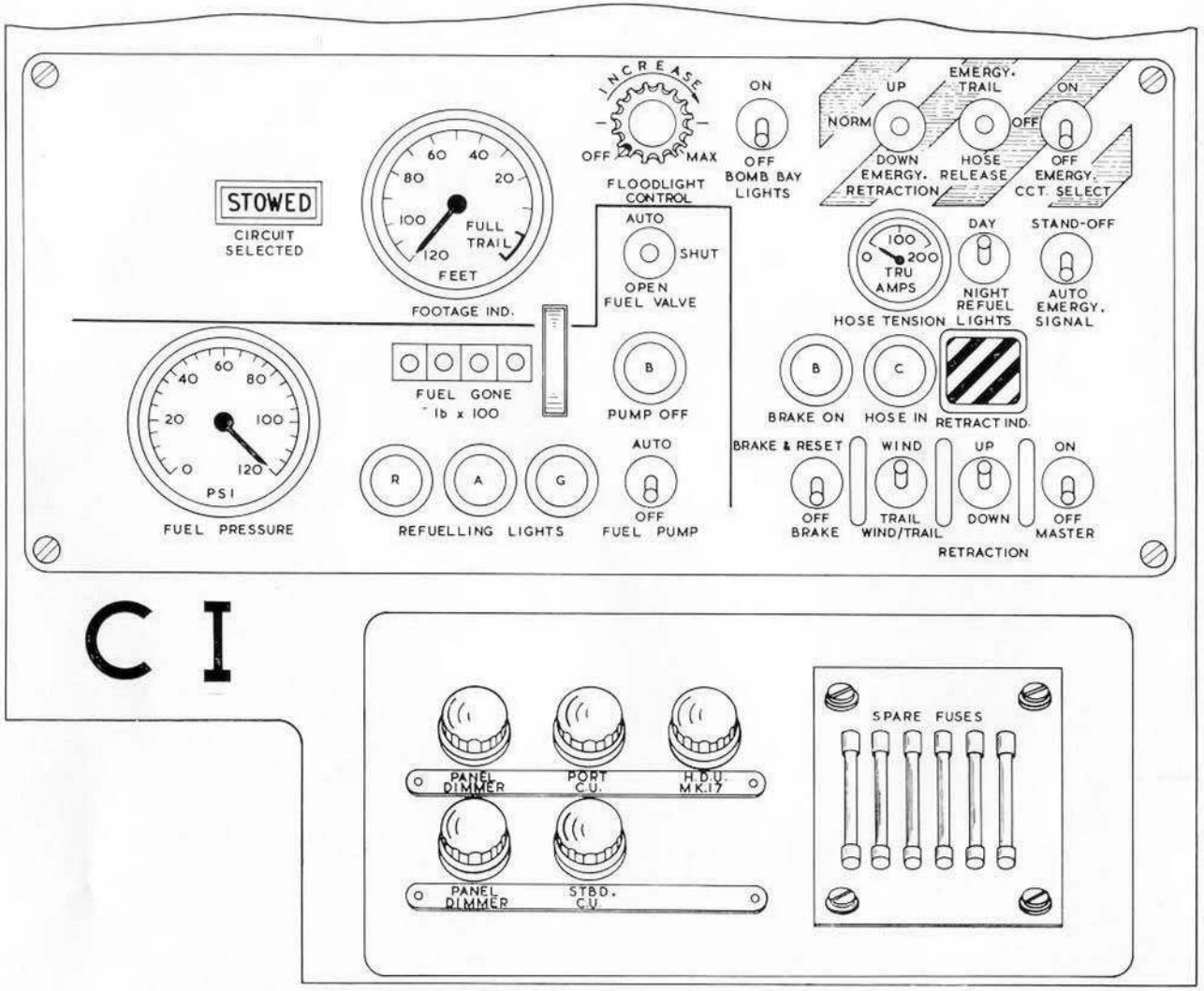

Fig. 4 Tanker operator's HDU controls

UP	HDU raised
Striped	Circuit de-energised or HDU at an intermediate position
DOWN	HDU lowered

(iii) *Wind/Trail switch and light*

The WIND/TRAIL switch controls the hose to be trailed or wound in. Above the switch is a HOSE IN white warning light which comes on when the hose is fully stowed.

(iv) *Brake switch and light*

The BRAKE, OFF/BRAKE & RESET switch can be used to apply the HDU brake if necessary or to reset the brake to off if it has been applied by the overspeed control unit. The blue warning light comes on when the brake is applied.

(v) *Fuel pump switch and warning light*

The FUEL PUMP, AUTO/OFF switch controls the air turbine driven delivery pump. With the switch at AUTO the pump runs when the receiver is in contact, provided that 6 feet of hose has wound in and the fuel valve switch is set to AUTO. Above the pump switch is a blue warning light which comes on when the pump is not running. The fuel pump is automatically switched off if fuel pressure exceeds 75 PSI.

(vi) *Fuel valve switch*

The FUEL VALVE, AUTO/SHUT/OPEN switch controls the valve in the fuel delivery line. With the switch at AUTO the valve opens after the receiver is in contact and about 6 feet of hose is wound in.

(vii) *Emergency circuit selector*

The EMERGENCY CCT SELECT ON/OFF switch enables the next circuit to be selected if this does not occur automatically.

(viii) *Hose jettison switch*

The EMERGY TRAIL/OFF/HOSE RELEASE when set to EMERGY TRAIL causes the hose to trail fully, from which position it may be jettisoned by selecting HOSE RELEASE.

(ix) *Emergency retraction switch*

The EMERGY RETRACTION, UP/NORM/DOWN switch enables the HDU to be operated UP or DOWN if the normal circuit fails.

(*c*) *Indicators*

(i) *Circuit selection indicator*

A seven-position CIRCUIT SELECTED indicator shows the following indications according to the progress of the operation: TRAIL, GEAR H (high), REFUEL, GEAR L (low) WIND, PRE-STOW, STOWED.

(ii) *Footage indicator*

The FOOTAGE IND, marked in FEET from 120 clockwise to FULL TRAIL indicates the amount of hose wound on the drum.

(iii) *Fuel gone indicator*

The FUEL GONE, lb × 100, veeder counter indicates the total amount of fuel passed to the receiver. A knurled wheel is provided to reset the counters to zero.

(iv) *Fuel pressure indicator*

The FUEL PRESSURE indicator shows the fuel pressure in PSI at the venturi throat.

(v) *Hose tension indicator*

The HOSE TENSION indicator shows the current in amps being consumed by the torque drive to the hose drum. It is calibrated 0, 100, 200 with a red mark at the 150 amp position. This position indicates the maximum torque to be applied to the motor. With the hose trailed the reading is normally 120 amps. A lower (50-60 amps) reading is indicated when the hose is being trailed. Hose tension is controlled automatically.

(*d*) *Lighting*

(i) *Floodlight control*

The floodlight OFF/INCREASE/MAX rheostat switch although on the HDU control panel is to control the brilliance of the underwing floodlights.

(ii) HDU *floodlights*

The BOMB BAY LIGHTS, ON/OFF switch controls the two floodlights on the HDU fairing which illuminate the hose drum and serving unit.

(iii) *Signal lights*

A row of coloured lights, two red, two amber and two green, on the HDU are used for signalling to the Receiver aircraft. The duplication is simply a safeguard against failure. The red lights warn the Receiver not to attempt contact, or to break away if in contact. They are controlled by an EMERGY SIGNAL AUTO/STAND-OFF switch. When set to AUTO the red lights go out at full trail and the amber lights come on to indicate that the aircraft is ready for contact to be made. When the fuel valve is open, the lights change from amber to green. The green lights then remain on all the time that the fuel valve is open. The STAND-OFF position switches on the red lights irrespective of the progress of the operation. The three pairs of signal lights each have a REFUELLING LIGHTS repeater on the Tanker panel, and their intensity is controlled by a DAY/NIGHT REFUEL LIGHTS switch.

(iv) At the top of Panel CI is a TAIL NAV LIGHT, OFF/ON switch by means of which the tail navigation light may be switched off when necessary.

(*e*) *Circuit breakers*

NORMAL SUPPLY and EMERGENCY SUPPLY circuit breakers control the 28v supplies and are on Panel BB.

Normal Procedures and Handling

5 Taxying

A careful watch must be kept for obstructions as the wing pods are 85 feet apart and have a small ground clearance.

6 Take-off and landing

(*a*) Care must be taken to keep the wings level during take-off and landing, particularly in gusty cross-wind conditions; with the main wheels close to the ground, approximately 10° of bank can cause the appropriate wing pod to touch the ground.

(*b*) When raising the flaps, after take-off at maximum AUW, slight pre-stall buffet may occur in turbulence until speed is increased above 200 knots. Under these conditions, turns and abrupt nose-up changes of attitude are to be avoided.

7 In flight

(*a*) *Preparing for contact and trailing the hose*

(i) The operator should carry out the pre-contact checks contained in the Operators Check List and keep the pilot informed of the progress of all in-flight refuelling operations.

(ii) Before a wing hose is trailed, when non-feathering turbine blades are fitted to the pod, speed must be reduced to 200 knots and then increased to the flight refuelling speed to overcome the hysteresis of this type of turbine.

(iii) After the initiation of a refuelling operation, a wing hose will take approximately 20 seconds, and the centre hose 32 seconds, to reach the trail position. When a wing hose is trailed, small directional and lateral trim changes occur; trailing the centre hose has little noticeable effect on the aircraft. Before a receiver makes contact, the tanker should be accurately trimmed at the flight refuelling speed. The optimum speed range for flight refuelling is 250-270 knots.

(iv) When ready for contact, the tanker must be flown as steadily as possible to create a stable platform for the benefit of the receiver. Abrupt control movement and coarse use of the throttle should be avoided. Particular care is required when handling the elevators since short period pitching oscillations can be induced, so causing the hose to oscillate.

(*b*) *Approach and contact*

(i) When a receiver approaches and contacts a wing hose, the tanker tends to roll away from the hose in use. When a receiver approaches and contacts the centre hose, the tanker experiences a nose-down change of trim which must be counteracted by very careful, progressive use of the elevators. In both cases, the speed of the tanker increases slightly and power should be reduced by 1 to 3% RPM to maintain the refuelling speed after contact is established.

(ii) As fuel is transferred to the receiver, power should be reduced to maintain level flight and the refuelling speed.

(iii) To reduce the effects of cold soaking, the hose should be wound in and the HDU raised as soon as the transfer of fuel to a receiver is complete and the pod master switches should be selected ON for 5 minutes in every half hour.

Management of the Aircraft Fuel System

8 Fuel loading

(*a*) *Transfer flights*

(i) Load the amount of fuel to be transferred into the bomb-bay tanks. If this exceeds the capacity of the bomb-bay tanks, they should be filled.

(ii) Load 16,000 lb. of fuel into the fuselage tanks.

(iii) Load the remaining fuel required into the wing tanks. When the wing tanks are full, load any further fuel required into the fuselage tanks up to the maximum AUW of the aircraft.

(iv) Fill the pods from the wing tanks.

(*b*) *Transit flights*

(i) Fill the wing and fuselage tanks as required.

(ii) When the wing and fuselage tanks are full, load any further fuel required into the bomb-bay tanks up to the maximum AUW of the aircraft.

(iii) Fill the pods from the wing tanks.

(*c*) *Wing relief limitations*

The total contents of the fuselage and bomb-bay tanks must not exceed:

(i) 44,000 lb. when the wing tanks are empty.

(ii) 52,000 lb. when the wing tanks are half full.

9 Internal transfer of fuel

(*a*) *Wing tanks to bomb-bay tanks*

To transfer fuel from the wing tanks to the bomb-bay tanks select:

(i) All wing and fuselage pumps ON.

(ii) All proportioners NORMAL.

(iii) Long range isolation cocks OPEN.

(iv) Pod isolation cocks CLOSED.

(v) Bomb-bay tanks refuelling switches REFUEL.

(vi) Appropriate bomb-bay tank refuelling switch NORMAL or REFUEL as required to maintain equal amounts of fuel in the two bomb-bay tanks.

(vii) Fuselage proportioner BYPASS and wing isolation cocks CLOSED when the wing contents fall to 5,000 lb. each.

(viii) Pumps in tanks 8 and 9 ON or OFF as required to control any out of balance condition.

(ix) Wing proportioners BYPASS when the wing contents fall to 2,000 lb. each.

(x) Individual wing tank pumps OFF as the tanks empty.

(xi) Wing isolation cocks OPEN when all the wing tanks are empty.

The long range isolation cocks must remain open when all the wing tanks are empty.

(*b*) *Wing pods to bomb-bay tanks*

To transfer fuel from the wing pods to the bomb-bay tanks select:

(i) Wing and fuselage pumps and proportioners as required.

(ii) Long range isolation cocks CLOSED.

(iii) Pod isolation cocks OPEN.
(iv) Bomb-bay refuelling switches REFUEL.
(v) Pod pressure valves OPEN.
(vi) Pod isolation cocks and pressure valves CLOSED when the pod fuel level indicator shows MIN.

After transferring pod fuel to the bomb-bay tanks, a small amount of fuel must be transferred from the wing tanks to the bomb-bay tanks to purge the fuel lines of air.

(*c*) *Wing tanks to wing pods*

To transfer fuel from the wing tanks to the wing pods select:
(i) Wing and fuselage pumps ON and proportioners NORMAL.
(ii) Long range isolation cocks OPEN.
(iii) Pod isolation cocks AUTO.

(*d*) *Bomb-bay tanks to wing pods*

To transfer bomb-bay fuel to the wing pods select:
(i) Wing and fuselage pumps and proportioners as required.
(ii) Long range isolation cocks CLOSED.
(iii) Bomb-bay tanks transfer cocks OPEN.
(iv) Pod isolation cocks AUTO.
(v) Bomb-bay tank pumps ON.

(*e*) *Bomb-bay tank to bomb-bay tank*

To transfer fuel from one bomb-bay tank to the other select:
(i) Wing and fuselage pumps and proportioners as required.
(ii) Long range isolation cocks CLOSED.
(iii) Bomb-bay tanks transfer cocks OPEN.
(iv) Refuelling switch of bomb-bay tank to receive fuel REFUEL.
(v) Pump switch of the other bomb-bay tank ON.

(*f*) *Fuselage tanks to bomb-bay tanks*

To transfer fuel from fuselage tanks to bomb-bay tanks select:
(i) Wing and fuselage pumps ON and proportioners NORMAL.
(ii) Fuselage transfer cock OPEN.
(iii) Bomb-bay tanks refuelling switches REFUEL.
(iv) Appropriate bomb-bay tank refuelling switch NORMAL or REFUEL as required to maintain equal amounts of fuel in the bomb-bay tanks.

10 Bomb-bay tanks feeding the engines

(*a*) To feed fuel from the bomb-bay tanks to the engines select:
(i) Fuselage pumps ON and proportioner NORMAL.
(ii) Wing proportioners to BYPASS and pumps OFF.
(iii) Long range isolation cocks OPEN.
(iv) Bomb-bay tanks transfer cocks OPEN.
(v) Bomb-bay tank pumps ON.
(vi) Fuselage proportioner to BYPASS.
(vii) Fuselage pumps OFF.

(*b*) When feeding fuel from the bomb-bay tanks to the engines after the pod fuel and wing fuel has been transferred to the bomb-bay tanks, the fuselage pumps should be ON and the fuselage proportioner should be at BYPASS.

11 Transferring to a receiver

(*a*) *Transfer from the* HDU

To transfer fuel from the bomb-bay tanks to a receiver through the HDU select:
(i) Wing and fuselage pumps and proportioners as required.
(ii) Long range isolation cocks as required.
(iii) Bomb-bay tank pumps ON when ready for contact, after trailing the hose.

When transferring more than 25,000 lb. of fuel, as soon as fuel is flowing to the receiver, commence transferring wing fuel to the bomb-bay tanks (see para. 9(*a*)). If contact is broken during transfer, stop the internal transfer of fuel from the wing tanks to the bomb-bay tanks until contact is re-established.

(*b*) *Transfer from the wing pods*

To transfer fuel from the bomb-bay tanks to a receiver through the wing pods select:
(i) Wing and fuselage pumps and proportioners as required.

(ii) Long range isolation cocks CLOSED.
(iii) Bomb-bay tanks transfer cocks OPEN.
(iv) Pod isolation cocks AUTO.
(v) Pod pressure valves OPEN.
(vi) Bomb-bay tank pumps ON when ready for contact, after trailing the hose.

If it is necessary to transfer more than 25,000 lb. of fuel, wing tank fuel should be transferred to the bomb bay tanks between receiver transfers.

12 Bomb-bay tank contents

(*a*) The contents of the two bomb-bay tanks should normally be kept equal but, when both tanks are delivering fuel at the same time, one tank feeds faster than the other, i.e. one tank still contains up to 3,000 lb. of fuel when the other tank becomes empty.

(*b*) To keep the contents equal:

(i) When transferring fuel from the bomb-bay tanks through the HDU, transfer fuel from the wing tanks to the appropriate bomb-bay tank.
(ii) When feeding the engines from the bomb-bay tanks, switch the bomb-bay tank pumps selectively.
(iii) Transfer fuel from one bomb-bay tank to the other when transfer to a receiver is not being carried out.

13 Fuel jettison

(*a*) *Via wing pods*

(i) To jettison pod fuel only, select the pod isolation cocks CLOSED, pod pressure valves OPEN and the pod fuel jettison switches ON.
(ii) To jettison aircraft fuel, select transfer to the pods as required, pod isolation cocks AUTO, pod pressure valves OPEN and pod fuel jettison switches ON.
(iii) When jettisoning from the wing groups, fly on the fuselage group with its proportioner at BYPASS. When jettisoning from the bomb bay tanks, fly on the wing or fuselage groups as required. After jettisoning is complete, revert to the appropriate normal fuel handling drill.

(*b*) *Via Mk.* 17 HDU

(i) In emergency, fuel may be jettisoned from the bomb bay tanks, or from the wing tanks by transfer to the bomb bay tanks, via the Mk. 17 HDU.
(ii) Jettisoning may be carried out at all altitudes at speeds up to 300 knots.
(iii) As some fuel contamination of the rear fuselage may occur, the Green Satin and Mk. 6 altimeter must be switched off while fuel is being jettisoned.
(iv) To jettison fuel from the bomb bay tanks only, fly on the wings or fuselage groups as required, select the bomb bay tank pumps on and open the bomb bay tanks jettison valve.
(v) To jettison fuel from the wing tanks, fly on the fuselage group with its proportioner at BYPASS, establish fuel transfer from the wing groups to the bomb bay tanks and jettison fuel from the bomb bay tanks. Careful consideration is required before jettisoning wing fuel in an emergency that involves the failure of an MV busbar (see Chapter 2, para. 27(*b*)).
(vi) When the required amount of fuel has been jettisoned, revert to the appropriate fuel handling procedure; jettisoning must be stopped before landing.
(vii) If a landing has to be made with the HDU down, the jettison pipe is likely to contact the runway.

14 Wing isolation cocks

(*a*) The wing isolation cocks should normally be open at all times, except as in para. 9(*a*)(vii).

(*b*) If a wing isolation cock fails to open, it may be bypassed by opening the wing refuelling cock.

15 CG and wing relief limits

If, at any time, the CG or wing relief limitations should inadvertently be exceeded, internal transfer of fuel or selective switching of fuel pumps must be carried out to regain normal conditions.

16 Fuel handling procedure

The fuel handling procedure is designed to keep as much fuel as possible in the wing tanks at all times and to reduce the total contents of the fuselage and bomb-bay tanks to a minimum before the remaining wing fuel is transferred to the bomb-bay tanks.

(*a*) *Transfer flights*

(i) Start and taxy as normal.

(ii) Take-off with all wing and fuselage booster pumps ON and all proportioners NORMAL.

(iii) After take-off:

1 If the fuselage tank contents have fallen to 14,000 lb., select the fuselage proportioner to BYPASS and the fuselage booster pumps OFF.

2 If the fuselage tank contents are more than 14,000 lb. select the wing proportioners to BYPASS and the wing booster pumps OFF.

(iv) When the fuselage tank contents fall to 14,000 lb. select the wing booster pumps ON, wing proportioners NORMAL, fuselage proportioner BYPASS and the fuselage booster pumps OFF.

(v) During transfer to a receiver, fly on the wing or fuselage groups as in (iii) or (iv), above. When either wing group contents fall to 5,000 lb. select the wing proportioners to BYPASS and leave the wing booster pumps ON. Select the fuselage proportioner to NORMAL and the fuselage booster pumps ON. Switch off all the booster pumps in one wing group to prove that the fuselage proportioner is working ; then switch the pumps on again. When the fuselage group starts to feed, select the fuselage proportioner to BYPASS.

(vi) Whenever fuel is transferred from the wing tanks to the bomb-bay tanks proceed as in para. 9(*a*).

(vii) After all transfers to receivers are complete, where necessary, reduce the contents of each bomb-bay tank to 2,000 lb. and then reduce the contents of each wing group to 5,000 lb.

(viii) Transfer the pod fuel and then the wing tank fuel to the bomb-bay tanks.

(ix) When the wing tanks are empty, leave the fuselage pumps ON and the proportioner BYPASS and, at the same time feed the bomb-bay tank fuel to the engines. Maintain balance by the selective switching of the pumps in tanks 8 and 9.

(x) If a flight has to be continued when the total contents of the fuselage and bomb-bay tanks are below 8,000 lb., maximum engine RPM, extreme attitudes and large accelerations should be avoided ; an overshoot should not be carried out unless the fuselage tanks contain a total of at least 5,000 lb. of fuel or the bomb-bay tanks contain a total of at least 4,000 lb.

(*b*) *Failure to transfer*

If, during a flight when transfer to a receiver is planned, a failure to transfer all or part of the fuel occurs, continue the fuel handling from the appropriate point in para. 17 reducing the contents of the bomb-bay tanks, the fuselage tanks and finally the wing tanks before transferring the pod fuel and then the wing fuel to the bomb-bay tanks.

17 Transit flights

(*a*) Start and taxy as normal.

(*b*) Take-off with all wing and fuselage booster pumps ON and all proportioners NORMAL.

(*c*) After take-off select the wing proportioners to BYPASS and the wing booster pumps OFF.

(*d*) At 20,000 feet:

(i) If the bomb-bay tanks total contents are 4,000 lb. or less, continue to fly on the fuselage tanks.

(ii) If the bomb-bay tanks total contents exceed 4,000 lb., feed the bomb-bay fuel to the engines.

(*e*) When the bomb-bay tank contents fall to 2,000 lb. each select the fuselage booster pumps ON, fuselage proportioner NORMAL and cease feeding the bomb-bay tank fuel to the engines.

(*f*) When the fuselage tank contents fall to 14,000 lb., select the wing booster pumps ON, wing proportioners NORMAL, fuselage proportioner BYPASS and the fuselage booster pumps OFF.

(*g*) When the wing group contents fall to 5,000 lb. each, select the fuselage tank booster pumps ON and transfer the pod fuel and then the wing tank fuel to the bomb-bay tanks.

(*h*) Continue as in para. 16(*a*) (ix) and (x).

18 Tanker refuelling

(*a*) When the tanker is to be refuelled in flight, adjust the fuel tank contents so that the fuselage and bomb-bay tanks can receive the greater part of the fuel to be transferred. This ensures that the wing relief limitations cannot be exceeded and that a high rate of fuel flow is achieved. During transfer, fly on the fuselage group.

(*b*) After contact, to reduce the possibility of pressure build up in the fuel lines and to open the bomb-bay/fuselage NRV, pass fuel to the wing, fuselage and bomb-bay tanks ; as soon as fuel is flowing, stop refuelling the wing tanks.

(*c*) When filling a fuel tank group completely, stop refuelling that particular group when :

(i) *Bomb-bay tanks*
The gauges show full.

(ii) *Fuselage group*
Two magnetic indicators show striped.

(iii) *Wing groups*
One magnetic indicator shows striped.

Malfunctioning of the Pods and HDU

NOTE : In this section only those procedures necessitating action or consideration by the pilot are given. Other malfunctions which rely entirely on Tanker Operator actions have been omitted.

19 Failure of pod isolation cocks to open

If this occurs the only fuel available for transfer will be that already in the pod. Diagnosis of this condition can only be made by reference to the pod isolation cocks indicator or fuel contents gauges. Additionally the REFUELLING indication is not given.

20 Pod hydraulic failures

(*a*) *Hose stowed*

The hose must not be trailed if the pod HYDRAULIC POWER FAILURE warning light is on.

(*b*) *Hose trailed*

(i) If failure occurs during contact, fuel stops flowing.

(ii) Attempt to wind in the hose normally.

(iii) If the hose cannot be wound in, it should be jettisoned when safe to do so.

21 Failure of a pod high level float switch

If the high level float switch in a pod fails, fuel streams from a vent about fifteen feet inboard of the pod at a rate of approximately 40 gallons/minute. The pattern of flow passes above the receiver and should cause no hazard if the receiver does not fly above his normal station.

22 Failure of fuel to flow following a normal contact

If, following an apparently normal contact and appearance of the green light, no fuel is transferred to the receiver, proceed as follows :

(*a*) Receiving aircraft checks all relevant switches.

(*b*) Tanker checks all relevant switches.

(*c*) The fault may have been a " soft " contact, therefore receiver withdraws and makes a further contact.

(*d*) If fuel still fails to transfer, a fault in the pod or HDU is probable and no remedial action is possible.

23 Drogue failures

(*a*) During transfer in turbulent conditions if a hose becomes unstable the receiver aircraft should withdraw. Both tanker and receiver should then adjust height to another level where turbulence is not experienced and establish a fresh contact.

(*b*) (i) In severe turbulence there is a risk of loss of or damage to the drogue.

(ii) If the drogue is lost the hose quickly winds in.

(iii) Partial breakdown of the drogue may cause hose instability. Reduce speed prior to rewind in an attempt to stabilise ; when stabilisation occurs rewind the hose. If it remains unstable the hose must be jettisoned.

24 Receiver probe lodged in coupling

(*a*) If the pod is in use close the isolation cocks and select fuel counters to " Zero " to minimise loss of fuel from the pod. If the HDU is in use switch OFF the master switch and the bomb-bay tank pumps.

(*b*) Check with receiver aircraft whether:

(i) Nozzle, or

(ii) Nozzle and fuel tube is lodged in coupling, causing hose gyrations.

(*c*) In case (i) wind in hose normally. In case (ii) the hose must be jettisoned.

25 Hose fails to wind in

If the hose fails to wind in, increase airspeed to maximum then progressively reduce airspeed with WIND selected. Rewind should commence at 240 knots. The application of sideslip may be of assistance.

26 Hose jettison

(*a*) If, because of electrical or hydraulic failure, a hose cannot be wound in it must be jettisoned, if possible, before landing.

(*b*) Before jettisoning the hose, speed should be reduced to 200 to 230 knots depending on AUW. The operator then selects EMERGENCY TRAIL, with repeated selections until panel indications show the hose to be at full trail. In the case of a Mk. 17 HDU hose, during trailing the EMERGENCY HYDRAULIC WARNING light on panel AZ indicates the aircraft hydraulic system is operating in the emergency condition.

(*c*) With the hose at full trail, speed should be adjusted to 230 knots and then the operator instructed to select HOSE JETTISON.

27 Landing with a hose trailed

(i) If the aircraft has to be landed with a hose trailed, to ensure that the hose does not contact the undershoot area, a normal approach should be made to the instrument touchdown point, approximately 300 yards in from the runway threshold.

(ii) When landing with the centre hose trailed, to prevent the HDU striking the ground, the threshold speed should be increased by 5 knots. The hold-off must be kept to a minimum as a nose-up attitude is to be avoided and the touchdown should be as gentle as possible. On a short runway make an early touchdown, accepting the possibility of the hose contacting the undershoot area.

(iii) The aircraft should be positioned so that the trailing hose is as near the centre of the runway as possible at touchdown.