

HUNTER T Mk 7A

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1 General

The Hunter T Mk 7A is basically a T Mk 7 aircraft fitted with an Integrated Flight Instrument System (IFIS), Tacan, and ILS. The differences between the Hunter T Mk 7A and the T Mk 7 are fully covered in this Annexe. Reference should be made to the main part of the Manual for all other systems, and to Part 6 Fig 3 for illustration of the cockpit.

Electrical System

2 Standby DC supplies

(a) A pair of series-connected 12-volt batteries in the radio bay provide emergency supplies for the standby artificial horizon and direction indicator and the cockpit emergency lighting.

(b) A 24-volt battery, also in the radio bay, provides an emergency supply for the standby UHF set.

3 AC supplies

(a) The AC supplies are provided by two type 103 inverters (No 1 and No 2) and one type 100A inverter (No 3). The No 3 inverter is normally off but can act as a limited standby for either No 1 or No 2 inverter.

(b) The No 1 inverter supplies the master reference gyro (MRG), the air data system, the IFIS lighting, the instructor's artificial horizon, the standby artificial horizon and direction indicator, the engine oil pressure gauge and top temperature control and the cockpit pressurisation. The No 2 inverter supplies Tacan and also acts as a standby for the No 1 inverter.

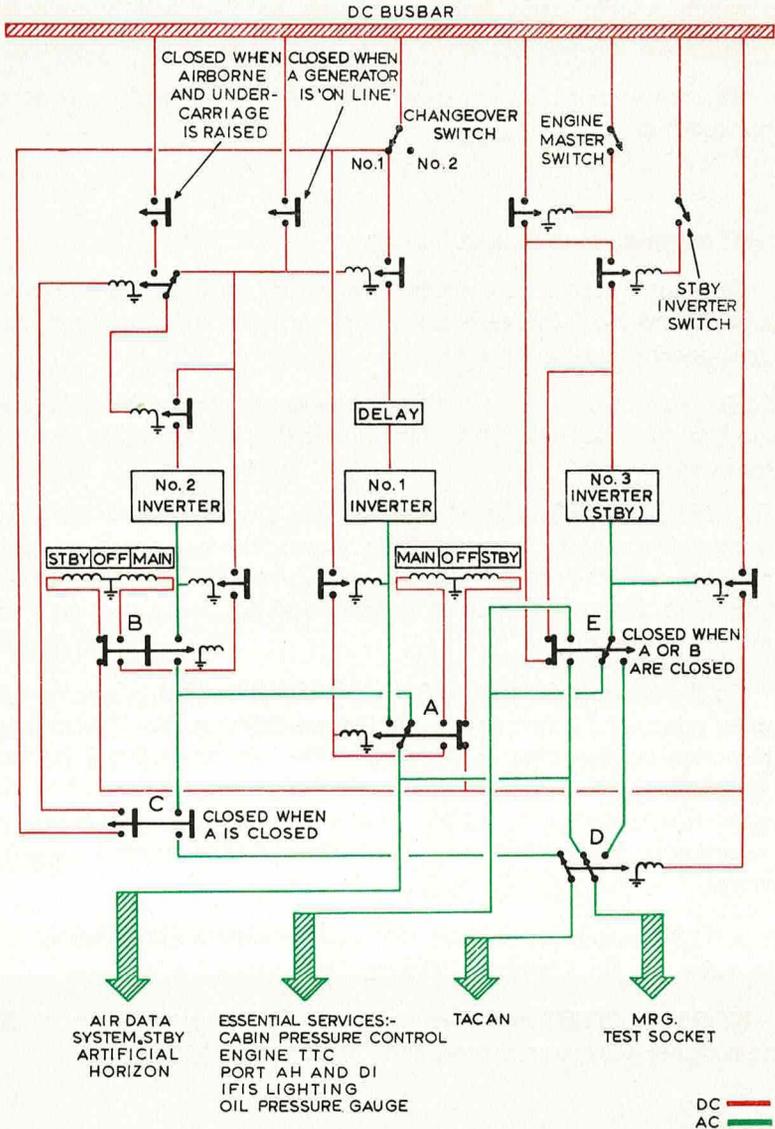
(c) When the engine master switch is set ON, the No 3 inverter starts up and supplies the engine services, the standby artificial horizon and direction indicator and IFIS lighting. After starting the engine the No 2 inverter starts up and the No 3 inverter runs down. Then, after five seconds, the No 1 inverter starts up and cuts off the No 2 inverter. The No 2 inverter does not start up again until the weight of the aircraft is taken from the landing gear on take-off.

(d) After landing when weight is on the landing gear, the No 2 inverter shuts down unless No 1 inverter has previously failed.

(e) A static inverter in the Control Unit type B provides AC power for the standby artificial horizon and direction indicator in the event of a triple inverter failure.

4 Standby battery controls

(a) The standby batteries are automatically switched to the static inverter in the event of the main battery voltage falling below that of



Hunter T7A Electrical Supply System (simplified)

the emergency battery. A 75 knot pitot-operated speed switch prevents draining of the batteries when the aircraft is on the ground. Should the switch remain open in flight it may be by-passed by selecting EMERGENCY on the DI AH NORMAL/EMERGENCY switch.

(b) The UHF standby battery is switched into service by the UHF power selector switch.

5 AC supplies, controls and indicators

(a) Selection of the engine master switch ON starts the No 3 inverter. The No 1 and No 2 inverters are started and controlled automatically when a generator is brought on line.

(b) (i) Two indicators on the centre pedestal, one for No 1 inverter and the other for No 2 inverter, give indication of which inverters are in use.

(ii) When an indicator shows MAIN, the associated type 103 inverter is running. When OFF is shown, the associated type 103 inverter is shut down. If an indicator shows STBY, the standby type 100A inverter (No 3) is running and the associated type 103 inverter is shut down.

(c) On the centre pedestal is a CHANGEOVER switch which may be used to select No 2 inverter if it is suspected that No 1 inverter is malfunctioning. Selection of changeover in flight when No 2 inverter is not running does not cause No 1 inverter to run down. The switch may be used to reset a failed No 1 inverter, if the failure is transient, by selecting to No 2 inverter momentarily and then re-selecting No 1 inverter.

(d) A STBY switch at the right of the CHANGEOVER switch is used to energise the No 3 inverter. The switch is spring-loaded to off.

(e) NORMAL/TEST switches, for servicing purposes, are at the bottom of the generator control panel in the radio bay.

6 Pre-flight procedures

(a) Before starting the engine, switch the battery master switch ON and check the functioning of all DC operated instruments and indicators.

(b) Switch ON the engine master switch, and check that the No 3 inverter is operating by observing that both inverter indicators change from OFF to STBY.

(c) Start the engine. Check that the generator warning lights go out and, simultaneously, that the No 2 inverter starts up, its indicator shows MAIN and that No 1 inverter indicator shows OFF (indicating that the No 3 inverter has shut down). After 5 seconds, check that the No 1 inverter starts up, that its indicator shows MAIN and that the No 2 inverter indicator changes to OFF.

(d) Check the functioning of the changeover facility by setting the CHANGEOVER switch to No 2 inverter. Check that the No 1 inverter indicator changes to OFF and the No 2 inverter indicator to MAIN. Reselect the CHANGEOVER switch to No 1 inverter and check that after a delay of 5 seconds, the No 1 inverter indicator shows MAIN and the No 2 inverter indicator shows OFF.

(e) Note that, after the engine has been started, Tacan can only be tested by starting the No 3 inverter, since only one type 103 inverter is running at this stage. However, the No 3 inverter should only be started when the IRIS display failure flags have disappeared.

7 Malfunctioning of the system

(a) Single inverter failure

(i) If No 1 inverter fails, No 2 inverter automatically off-loads Tacan and takes over the No 1 inverter load.

(ii) If No 2 inverter fails, Tacan is off-loaded.

(iii) Tacan can be regained by selecting the No 3 inverter switch to STBY. When the No 3 inverter is running it takes over the MRG load and re-connects the Tacan load to the No 2 inverter. If the un-serviceable type 103 inverter is restarted, ie by use of the changeover switch or if the malfunction automatically clears, the No 3 inverter shuts down and the system reverts to normal since it is not possible for all three inverters to be running simultaneously.

(b) Double inverter failure

If both No 1 and No 2 inverters fail, No 3 inverter runs up automatically to supply the essential services (standby artificial horizon and

direction indicator, engine oil pressure gauge and top temperature control, cockpit pressurisation control and IFS lighting). All other AC operated services are lost.

(c) Triple inverter failure

If all three inverters fail all AC operated services are lost except for the standby artificial horizon and direction indicator whose single phase AC power requirements are automatically supplied by the static inverter in the Control Unit type B.

(d) Single generator failure

Failure of one generator causes the No 2 inverter to shut down unless No 1 inverter has previously failed.

(e) Double generator failure

If both generators fail, No 1 and No 2 inverters shut down and No 3 inverter runs up automatically to supply the essential services. The DI AH NORMAL/EMERGENCY switch should be set to EMERGENCY to ensure that an emergency battery supply is available to the static inverter.

Flight Instruments

8 Integrated flight instrument system — general

(a) The Integrated Flight Instrument System (IFIS) derives its information from the following sources:

- (i)* A dynamic reference system
- (ii)* An air data system
- (iii)* Tacan and ILS coupling units

(b) The information is presented at the pupil's station on an attitude indicator, a navigation display, a speed display and a height and rate of climb display.

(c) To cover failure of the dynamic reference system, a standby artificial horizon and direction indicator are fitted. A standby ASI and standby altimeter are fitted to meet the case of failure of the air data system.

(d) The 115 volt, 3 phase, 400 Hz AC power required for the system is derived from No 1 inverter with No 2 and No 3 inverters as standby.

9 Dynamic reference system

(a) The dynamic reference system uses a master reference gyro (MRG) to supply continuous attitude and heading information to the attitude indicator and the navigation display.

(b) *Master reference gyro (MRG) Mk 1 type E*

(i) The MRG comprises a gyroscopically stabilised, servo-operated platform assembly. Two platforms, an inner and an outer, are stabilised to the vertical by an earth gyro, which in turn is monitored for drift, any tendency to precess being corrected by gyro torque motors, and servo-motors re-align the platforms. The platforms are therefore slaved to the gyro gimbal rings and any relative movement between the aircraft and the two platforms induces bank and pitch signals which are fed to the attitude indicator.

(ii) An azimuth gyro is mounted on the inner platform to feed heading information to the compass. This gyro is normally monitored by a compass detector unit, but compass monitoring is cut off whenever DG is selected on the compass or when flight accelerations and attitudes would cause errors during compass detection.

(iii) The MRG is brought into use by the No 1 inverter which, when started, causes the platforms to servo to their datum position (ie approximately level) during the first 3 seconds and then rapidly erects the gyros during the next 17 seconds. An off flag on the attitude indicator disappears when the system is functioning normally. If the flag still remains 35 seconds after switch-on, shut down and have the fault investigated.

(iv) An MRG FAST ERECTION spring-loaded push button is below the attitude indicator. A second fast erection button is on the starboard shelf. When the push button is operated erection of the vertical gyro takes place at a rate of $17^{\circ}/\text{min}$; the normal erection rate is $3^{\circ}/\text{min}$. FAST ERECTION should be selected if it is necessary to remove false errors in attitude indications which may have occurred through sustained accelerations below the limits catered for by the monitoring cut-out devices. The selection should be made in straight and level unaccelerated flight.

(c) *Attitude indicator type F4C*

(i) The attitude indicator which is operated by signals from the MRG gives a continuous indication of pitch by a roller blind presentation

and of roll by a pointer at the bottom of the blind frame. The blind is half pale-grey and half-black and the dividing line represents the natural horizon. When the horizon is not visible on the display at high climbing or diving angles a zenith or nadir star is shown, the long tails of which point in the direction of the nearer horizon. Looping manoeuvres which pass the zenith or nadir result in a rapid rotation of the blind through 180°. Two concentric circles on the face of the instrument represent 20° and 40° of pitch and, in the vertical plane only, are additional marks representing 10°, 30° and 50°. Roll markings are 10°, 20°, 30°, 60° and 90° port and starboard.

(ii) A translucent orange disc, bearing two arrows, indicates power failure. It is normally covered by a black disc which lifts up to show the orange disc if power is lacking. One arrow points to the attitude indicator and the other to the navigation display, for which no separate warning device is fitted.

(iii) A slip indicator is fitted above the face of the instrument.

10 Navigation display

On one display, the instrument combines the functions of a gyro magnetic compass indicator, an ILS display, a Tacan range and bearing display and an off-set Tacan display. Any one of the four modes can be selected by a COMP/ILS/TAC/DL mode selector.

(a) *Compass mode (COMP)*

(i) With COMP selected at the mode switch, the display shows only the compass card. A COMP-DG pushbutton to the left of the display selects either magnetic compass monitoring or directional gyro. If DG is selected, the window beneath the button shows DG; with COMP selected, it remains blank.

(ii) A compass monitoring annunciator window is on the face of the instrument. With compass selected and synchronised, a dot/cross annunciator slowly oscillates in the window. If DG is selected the annunciator is rigid in the de-energised central position. Fast synchronisation is achieved by the use of a SYN knob at the bottom right of the instrument. The knob must be depressed and turned. The correct direction of turn is indicated by the ease with which the knob can be turned. If resistance is felt, it indicates turning in the wrong direction.

(iii) At the bottom left of the instrument, is a HDG knob which, when depressed and turned, moves a heading selection pointer on the instrument.

(b) *ILS mode (ILS)*

When ILS is in operation and the mode selector set at ILS, the BEAM and GLIDE amber lights disappear from the windows at the top right of the instrument when signal strength is sufficient for reliability. At the same time, the ILS presentation appears, framed by the compass card, as a pair of parallel lines representing the runway or localiser beam. The parallel lines move over the display in sympathy with heading changes or displacement from the beam. A localiser datum marker is visible through an aperture in the display and represents the centre of the beam. The datum marker can be set to the runway heading by pulling *out* and turning the HDG knob. The glide path indicator is represented by a horizontal bar across the display, moving up or down relative to the centre of the display. A blue flashing ILS MARKER light is at the bottom of the display.

(c) *Tacan (TAC/DL)*

(i) With DL selected on the mode selector and Tacan in operation, the display presents heading and range information from the Tacan beacon. The roller blind display gives a series of concentric arcs, each representing 20 nm distance from the beacon. Distance to the beacon is read off at the centre of the display and is also repeated in a RANGE NM window at the top left of the display. A line bisecting the range arcs indicates the bearing of the beacon when read against the compass card.

(ii) With TAC selected, the display indicates the range and bearing of a selected homing point (not equipped with a Tacan beacon) from the aircraft. The selected homing point is set in by an offset computer located on the IFIS display. The computer has two controls and two veeder counters by which the range and bearing of the homing point from a conveniently situated Tacan beacon is selected.

11 Air data system

(a) *General*

(i) The air data system measures pitot/static and static pressure signals, converts them into electrical signals by transducers and passes them to an air data computer. The computer transforms the signals into suitable output for the speed display and the height and rate of climb display.

(ii) The system is powered by 115 volts, 3 phase 400 Hz AC from the No 1 inverter.

(b) Speed display

The speed display consists of a white strip moving horizontally across a fixed IAS scale above the strip and a moving Mach number scale below the strip. The Mach number scale overreads at high speed; pressure error correction is approximately $-0.06M$ for an indicated $1.01M$ reading.

(c) Height and rate of climb display

The height and rate of climb instruments present normal indications to the pilot. When power supplies to the display are lacking an orange disc appears to replace the 0 scale mark on the height dial.

12 Standby artificial horizon and direction indicator

(a) The standby artificial horizon and direction indicator are fitted to meet the case of failure of the MRG. The two instruments are started by a supply from No 3 inverter prior to engine start; the supply to the instruments is controlled by a Control Unit type B which incorporates a static inverter. After engine start the AC is supplied by No 1 inverter. Should AC supplies to the control unit fail, the static inverter is automatically switched on to provide a continuing supply of AC to the standby instruments. The static inverter is powered from the main DC busbar; if both generators fail, DC is provided by the main batteries until the voltage falls below that of the emergency battery when an automatic changeover takes place.

(b) The Mk 6C artificial horizon incorporates a fast erection button and an orange and black striped off flag. The off flag disappears about 10 seconds after the engine master switch is set to on, and the instrument is ready for use about 80 seconds later. To restore the gyro axis, depress the FAST ERECTION button keeping it depressed until fast erection is complete. FAST ERECTION should only be used in straight and level unaccelerated flight.

(c) A direction indicator is fitted below the artificial horizon. The turn button of this instrument is also a fast erection push switch. When used for fast erection, a blue light in the indicator comes on. On releasing the button, if the blue light goes out, the instrument is ready for use. If the blue light remains, auto fast erection takes place and the blue light goes out when the instrument is ready for use.

(d) The system requires a minimum of $1\frac{1}{2}$ minutes operation under the power supply from the No 3 inverter during starting before supplies are provided by the generators. This is to ensure that the gyro rotors are run up to full speed. During engine starting, therefore, a period of $1\frac{1}{2}$ minutes minimum must elapse between setting the engine master switch to on and bringing a generator on line; if this period is reduced, the gyros run down during the subsequent flight.

(e) A DI AH — NORMAL / EMERGENCY switch, wire locked to NORMAL, is adjacent to the instruments. At the NORMAL position, supply from the standby batteries is cut off by a pitot switch when speed is below 75 knots. This can be overridden by setting the NORMAL/EMERGENCY switch to EMERGENCY. In complete dc electrical failure conditions, it is advisable to select EMERGENCY to ensure a supply to the instruments in case the pitot switch has failed to close.

13 Standby airspeed indicator and altimeter

To meet the case of failure of the Air Data System, a standby ASI is fitted at the standby instruments panel and a standby altimeter is on the centre panel.

Radio and Radar Controls

14 UHF

(a) UHF equipment is fitted and reference should be made to the main part of the Manual for information on controls.

(b) An RT/MIX/BEAC switch is on the cockpit port wall. With the switch set to RT, UHF reception only is heard. At the MIX position, both UHF and Tacan beacon reception is heard and at the BEAC position only Tacan signals are heard.

15 ILS

(a) Standard ILS equipment is fitted, the presentation being shown on the navigation display of the IFIS. The ILS control unit is on the port shelf and the ILS master switch is on the centre panel. An ILS

MARKERS lamp is below the navigation display and marker signals will be heard provided the UHF is switched on. A volume control is on the cockpit port wall.

(b) The ILS presentation on the navigation display is covered in para 10 of this Annexe.

16 Tacan

(a) Tacan navigational equipment is fitted and reference should be made to the main part of the Manual for information on controls.

(b) The range and bearing information is presented on the navigation display of the IFIS and an additional facility, offset Tacan, enables the aircraft to be homed to a position of which the range and bearing from a beacon are known.

(c) The offset Tacan indicator is on the IFIS display and has BEARING and RANGE NM windows in which a veeder counter is situated. Below each window is a setting control and these are used to set up the bearing and distance from the selected beacon. If no offset is required the counters are set to zero.

(d) In the Tacan role the navigation display must be set to DL and in the offset Tacan role it must be switched to TAC.

(e) Reception of Tacan beacon signals is heard only when the RT/MIX/BEAC switch is at MIX or BEAC.

(f) Tacan presentation on the navigation display is covered in para 10 of this Annexe.

MISCELLANEOUS

17 Miscellaneous changes

The following miscellaneous changes to the T Mk 7 are embodied to bring the aircraft to T Mk 7A standard.

(a) Engine RPM indicator

A percentage type RPM indicator is fitted. The corresponding percentage RPM indications are shown in the table below.

<i>Engine RPM</i>	<i>Approximate Equivalent Percentage RPM</i>
3000	36
3500	42
4000	48
4500	54
5000	60
5500	66
6000	72
6500	78
7000	84
7500	90
8000	96
8100	96.4

(b) Armament

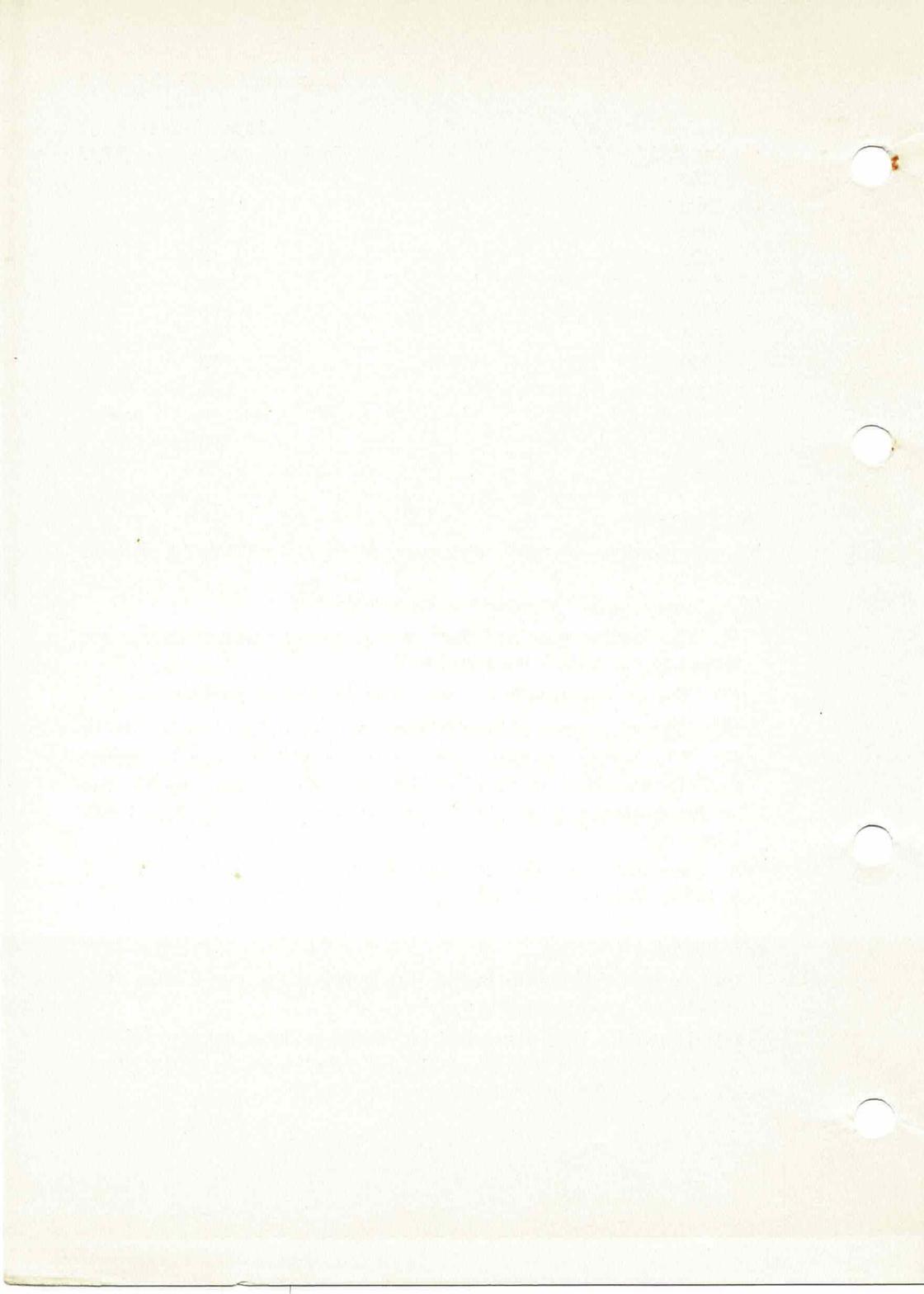
No gun, gunsights or radar ranging are fitted in the T Mk 7A aircraft.

(c) Re-positioned instruments and controls

- (i) The landing gear and flaps emergency air pressure gauges are moved to the cockpit starboard wall.
- (ii) The cockpit altimeter is moved to the cockpit starboard wall.
- (iii) The JPT gauge and RPM indicator are moved to the centre panel.
- (iv) The bombs and RP controls are removed but stores jettisoning facilities are still available. Note that the bomb/RP release pushbutton on the control column remains operative and, if pressed, jettisons inboard stores.
- (v) The brake parachute test switch and circuit breaker are moved to the cockpit port wall adjacent to the UHF controls.

(d) Lighting

- (i) An IFIS lighting dimmer switch is below the IFIS display. The switch also controls the leg panel lighting.
- (ii) Post Mod 1380 upper and lower anti-collision lights are fitted. The ANTI-COLL LIGHTS—ON/OFF switch is on the centre panel. The electrical loading is 8 amps.





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