# 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. It is intended as a training aircraft for Lightning F. Mk. 3 pilots. 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 Notes for all other systems, and to Part 6 Fig. 3 for cockpit illustration.

## 2 Standby DC supplies

Two standby batteries are in the radio bay. One, which is a pair of series-connected 12v. 4 amp.hr. batteries, provides a standby supply for the standby direction indicator and Mk. 6C artificial horizon, the turn and slip indicator and the cockpit emergency lighting. The other, a 24-volt battery, is provided for the emergency operation of the standby UHF set.

## 3 AC supplies

(*a*) The AC supplies are provided from two type 103 inverters and one Type 100A inverter, arranged in such a manner that the 100A inverter is normally idle, but can act as standby for either 103 inverter.

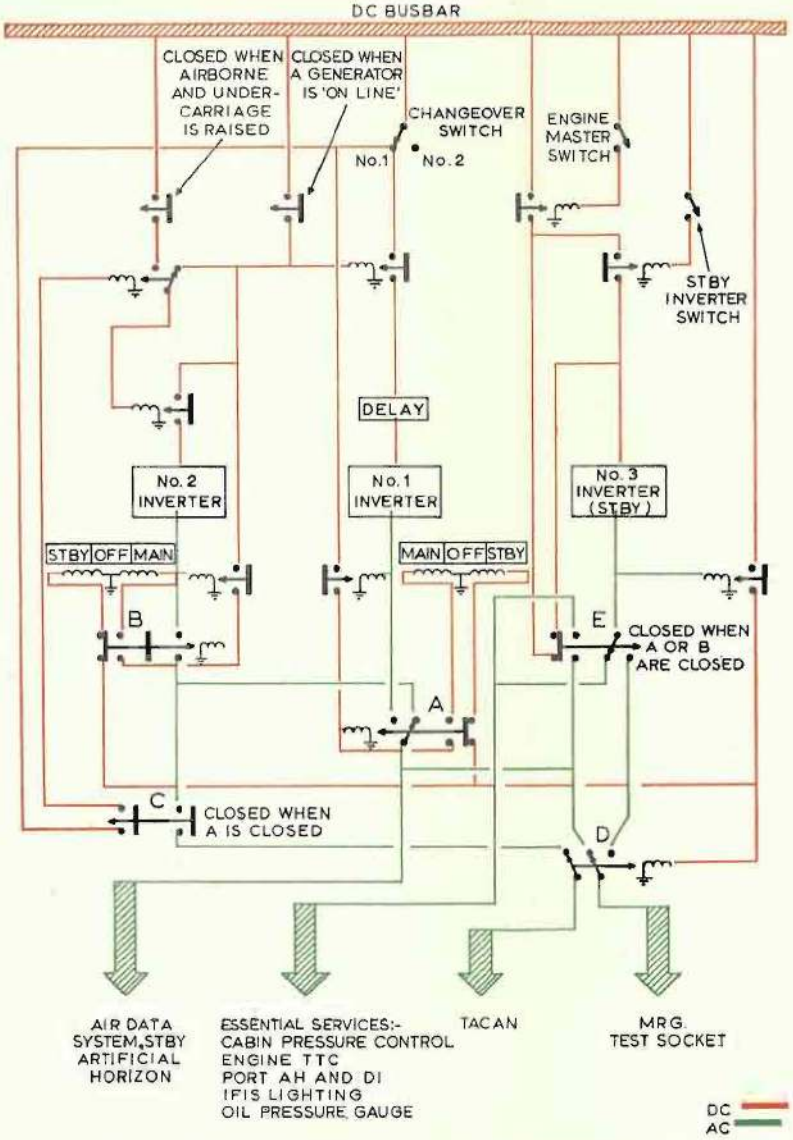
(*b*) One Type 103 inverter supplies Tacan and the other supplies the master reference gyro (MRG), engine essential services, the instructor's artificial horizon, the air data system, the IFIS lighting and cabin pressurisation.

(*c*) When the engine master switch is set ON, the 100A 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 Type 103 inverter starts up and the 100A inverter runs down. Then, after five seconds, the No. 1 Type 103 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.

## 4 Standby battery controls

(*a*) Failure of generator supplies to the standby artificial horizon and direction indicator results in the main batteries taking over the load. When main battery voltage falls below that of the emergency battery, the latter takes over automatically.




**Hunter T7A — Electrical Supply System (simplified)**

(*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 starts the 100A inverter. The type 103 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 is running and the associated Type 103 inverter is shutdown.

(*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 reselecting No. 1 inverter.

(*d*) A STBY switch at the right of the CHANGEOVER switch is used to energise the type 100A 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 Type 100A 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 Type 103 inverter starts up, its indicator shows MAIN and that No. 1 inverter indicator shows OFF (indicating that the 100A 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 Type 100A inverter, since only one Type 103 inverter is running at this stage. However, the Type 100A inverter should only be started when the IFIS display failure flags have disappeared.

## 7 Inverter failure

(*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 may be regained by starting the standby inverter; when running, it supplies the MRG load allowing Tacan to be brought on to the load of the serviceable Type 103 inverter. If the unserviceable Type 103 inverter is restarted, i.e. by use of the changeover switch or if the malfunction automatically clears, the standby 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, the standby inverter

runs up automatically to supply the engine essential services, IFIS lighting and cockpit pressurisation. All other systems are lost.

(*c*) *Generator failure*

Failure of one generator causes the No. 2 inverter to shut-down unless No. 1 inverter has previously failed. If both generators fail, both No. 1 and No. 2 inverters are shut down and the standby inverter runs up automatically.

## 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 the No. 1 inverter with the No. 2 and the standby inverter 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. 1E*

(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 Type 103 inverter which, when started, causes the platforms to servo to their datum position (i.e. 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°/min.; the normal erection rate is 3°/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 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 push-button 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; illumination of the blue light is difficult to detect in daylight consequently an orange domed type light will be fitted by modification action.

(*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 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 system

(*a*) The standby artificial horizon and direction indicator are fitted to meet the case of failure of the MRG. The system is started by a supply from the Type 100A inverter. When a generator comes on line after engine starting, the Type 100A inverter supply is cut off and the system then operates from 28 volt DC generator supply via a Control Unit Type B. The instruments are positioned on a panel to the right of the IFIS display.

(*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 Type 100A inverter during starting before supplies are provided by the generators. This is to ensure that the gyro rotors are up to full speed and in a condition such that the DC transistorised inverter of the Control Unit can maintain them. 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/EMERGY 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/EMERGY switch to EMERGY. In complete DC electrical failure conditions, it is advisable to select EMERGY 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 Notes for information on controls.

(*b*) The T. Mk. 7A embodies an RT/MIX/BEAC switch 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 Notes 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 on the table below.

| *Engine RPM* | *Approximate Equivalent Percentage RPM* |
|---|---|
| 3,000 | 36% |
| 3,500 | 42% |
| 4,000 | 48% |
| 4,500 | 54% |
| 5,000 | 60% |
| 5,500 | 66% |
| 6,000 | 72% |
| 6,500 | 78% |
| 7,000 | 84% |
| 7,500 | 90% |
| 8,000 | 96% |
| 8,100 | 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 indicator and RPM gauges 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*) *Cockpit lighting*

An IFIS lighting dimmer switch is below the IFIS display. The switch also controls the leg panel lighting.

## EMERGENCY PROCEDURES

### 18 Single inverter failure

(*a*) *Indications*

Associated indicator shows OFF.

(*b*) *Actions*

If No. 1 failure, attempt to reset by selecting CHANGE-OVER switch momentarily to No. 2. If unsuccessful, no further actions possible.

(*c*) *Considerations*

Irrespective of which main inverter has failed, Tacan is not available unless standby inverter is selected.

## 19 Double inverter failure

(*a*) *Indications*

Both indicators show STBY.

(*b*) *Actions*

Attempt to reset No. 1 inverter by use of CHANGEOVER switch.

(*c*) *Subsequent actions*

If No. 1 inverter cannot be reset, use the standby flight instruments which continue to run from DC power.

(*d*) *Considerations*

All AC services are lost except essential engine services and cockpit pressurisation.

## 20 Complete electrical failure

In complete electrical failure conditions, i.e. following engine seizure, engine flame-out or double generator failure, carry out the following additional drills.

(*a*) Set DI AH — NORMAL / EMERGY switch to EMERGY.

(*b*) Use the standby flight instruments.