CANBERRA PR9

PILOT'S NOTES

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Please note that Flight Simulator X, Prepar3D or Prepar3D v2 must be installed correctly on your PC prior to the installation and use of this Canberra PR9 simulation.

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INTRODUCTION

The genesis of the Canberra, the RAF's first jet bomber, dates back to 1944 when the Air Ministry needed a high-altitude high-speed successor to the Mosquito. The English Electric company was chosen to develop the aircraft under the direction of W.E.W. Petter, who had started designing the P.1056 twin-engined fighter-bomber during his time at Westland Aircraft. Petter would go on to design the Lightning, another iconic English Electric aircraft.

A contract was placed in 1946 for four EE A.1 aircraft, A.1 being the aircraft's designation before it was given the name of the Australian capital in 1950 in recognition of Australia becoming the first export customer.

The Canberra's design owed much to the Mosquito – compact and aerodynamic but with the capacity to carry a large bomb load. Rather than being equipped with defensive armament, which would have proved ineffective against the latest fighters, the Canberra was designed for fast high-altitude flight in order to avoid any chance of becoming involved in aerial combat. It was designed for two crew members but delays in the development of the intended automatic radar bombsight meant that a bomb aimer's position was added in the nose of the aircraft.

Work began on the four prototypes in 1946, but the first aircraft didn't fly until May 1949, by which time 132 aircraft were on order from the Air Ministry in bomber, reconnaissance and training variants. Trials of the prototype proved successful and the next B.2 model flew in 1950 after only a few modifications, which included an engine upgrade to the more powerful Rolls-Royce Avon RA.3 turbojets. The Canberra entered production shortly afterwards and entered service with 101 Squadron.

The aircraft was an immediate success. 27 versions served with a total of 35 RAF units and the Canberra was exported to more than 15 countries.

The Mosquito's strategic reconnaissance role as well as its design aesthetic was taken up by the Canberra, with the B.2 design modified to include a bay behind the cockpit designed to house seven cameras and an extra fuel tank in the bomb bay. A trainer version was developed to enable crews to convert to flying the Canberra and was largely similar to the B.2 model apart from its side-by-side seating for pilot and instructor and a solid nose in place of the B.2's glazed version which was required for the bomb aimer. 231 Operational Conversion Unit of the RAF was the first to fly this training variant in early 1954.

Such was the popularity of the Canberra that English Electric was unable to keep up with manufacturing demand and Handley Page, Short and Avro all manufactured the aircraft under licence. More than 1,300 Canberras were built, of which over 900 were manufactured in the UK. In the USA Martin manufactured the Canberra under licence as the B-57 Canberra to replace the Douglas B-26 Invader, and 48 slightly modified aircraft were built in Australia for the Royal Australian Air Force.

In its early years of service the Canberra achieved several world records, including those for the first non-stop transatlantic crossing by a jet without refuelling in 1951 and the first double transatlantic crossing the following year. Various world altitude records also fell to the Canberra in the 1950s.

The Canberra could carry a total conventional bomb load of up to 10,000lb in its two bomb bays and another 2,000lb of additional ordnance on under-wing pylons. Early nuclear bombs were too bulky for the aircraft to carry, and with a range of only 2,000 miles the Canberra often acted as more of a tactical bomber than a strategic one.

The introduction in 1955 of the Vickers Valiant, with its greater range and capacity for carrying heavier weapon loads, began the demise of the Canberra in a high-level conventional bombing role. It was still a very useful aircraft nonetheless, and remained suitable for low-level strike, ground attack and tactical nuclear strike roles.

The last Bomber Command Canberra was retired in 1961 but overseas squadrons continued to use the aircraft in a nuclear strike role until 1972 and the aircraft still had a great deal to offer in its photo-reconnaissance role. After its withdrawal from front line duties the Canberra served the RAF well as a reconnaissance machine when equipped with special LOROP (Long-Range Optical Photography) cameras for high-altitude target surveillance and infrared cameras for low-level night reconnaissance. Canberras were used by the RAF for reconnaissance and photographic duties during the Balkan conflicts of the 1990s, in the 2003 invasion of Iraq and as late as 2006 in Afghanistan.

The RAF's last three flying Canberras were PR9s of 39 Sqn, RAF Marham. One of these, XH131, touched down at Kemble Airfield on 31 July 2006 to bring to a close over half a century of Canberra service with the RAF. A year later the Indian Air Force, one of the Canberra's longest users, retired its last aircraft. Several ex-RAF machines are still used in the US for research and mapping tasks and less than a dozen airworthy examples remain in private hands.

RAF Canberra PR9 operations

by Nick Ireland, former PR9 pilot (13 Squadron Akrotiri, 1961-1964)

Pilots were trained to fly both the Canberra PR7 and the Canberra PR9s that were delivered to the Royal Air Force. They did their flying checks and instrument rating tests in the Canberra T4, a training variant of the aircraft that consisted of a modified B.2 variant with the addition of side-by-side seating for the pilots. Unfortunately the T4 had little similarity to the PR9, however there were no dual-control PR9s so one's first flight in it was the first solo, accompanied by an apprehensive navigator!

The PR9 was built by Short Brothers in Belfast, sub-contracted from English Electric. It had two Rolls-Royce Avon engines, the same as those fitted to the Lightning but without the reheat. It had an increased wing span and an increased wing area, inboard of the engines. The highest altitude that I reached was over 60,000ft. For flights above 45,000 feet we had to wear a pressurised jerkin over the body and a special Taylor pressure helmet, which was very uncomfortable!

We were limited to 90% power for take-off as a consideration in case of an engine failure below safety speed, which was about 180kts at full power. I well remember the first one being delivered to Akrotiri; it arrived light on fuel from Malta and the pilot did a full power overshoot and reached about 10,000ft by the end of a 9,000ft runway, The engines made a very distinctive noise at full power, and the boss sitting in his office knew if anyone was breaking the rules!

It had all-hydraulic controls with no manual back-up. There was an autopilot which could be coupled to the ILS for automatic approaches but it was not cleared for use other than in good weather conditions.

The standard camera fit was a 'fan' of four F126 cameras which gave coverage from about 40 degrees below the horizon on one side to 40 below on the other. There was also a wide-angle vertical camera (a Wild F49). For certain roles one of the fan cameras could be set to 15 degrees below the horizontal to allow for long-range oblique photography, i.e. looking into an area without overflying it!

When Iraq threatened to invade Kuwait in 1961 there was a large military response which included two PR9s detached to Muharraq, from where they flew daily sorties along the Kuwait Iraq border at high level, using the oblique camera mentioned above. The photos were compared with the previous day's ones to check for any changes or movement of military targets. Additionally, one aircraft flew from Muharraq to Akrotiri and back once a week to fly North/South up the Iran Iraq border, looking west into Iraq to monitor military activity in Eastern Iraq.

Long-term routine tasks included photographing all coastal airfields in North Africa, typically every three months, and taking low-level oblique photographs of the Mediterranean coast line. These would be used by the Royal Navy and by any Royal Air Force aircraft that might be used to attack coastal targets.

We were also detached to Aden in support of ground operations against Yemeni insurgents in the Radfan Mountains.

Additionally we were tasked to do a complete survey of Kenya, Uganda and the then Tanganyika. This involved operating out of the Nairobi civil airport, as RAF Eastleigh was too small for Canberra operations. These sorties were, candidly, very boring! The aircraft had to be flown with precision down a 200-mile-long track with the wings level. Obviously heading corrections had to be made and these had to be achieved in the 40 seconds between each camera exposure. The pilot had a warning light to tell him when the camera was within five seconds of firing and he had that time to get the aircraft back to straight and level. If he failed then the camera went off with a wing up and there was a gap in the photo coverage.

At the end of the run the aircraft was turned and went back up another 200-mile track, parallel to the first one and overlapping it by 30%. These tracks took about 30 minutes each so, depending on how far we were operating from Nairobi, on a four-hour sortie we could perhaps fly six tracks. After the sortie each individual photo was plotted by the photo section and they could establish if the coverage was complete. If some unlucky pilot had been caught with a wing up, or the overlap was not close to 30%, there would be a gap in the coverage. Then a special sortie had to be organised just to fill in the gaps!

Finally, the terrain was largely devoid of usable ground features for navigation. The navigator had only a periscope with which to see down below him. It pivoted fore and aft, but if the wings were not level then visibility was compromised.

Aircraft in this simulation

A PR9 Canberra, XH134, has been restored after two years' hard work and returned to flight at Cotswold airport. As part of the newly formed Midair Squadron, XH134 will be taking part in its first full airshow season in 2014 in the capable hands of ex-RAF pilots. The aircraft featured in this product was developed with the kind assistance of Midair Squadron and with access to XH134. It features the modifications which have been implemented by Midair, including the addition of a modern Garmin suite and electrical engine starters.

The Canberra PR9 is a photographic reconnaissance aircraft powered by two Rolls-Royce Avon Mk 206 engines, each delivering 11,250 lb static thrust at sea level.

The PR9 has a crew of two: a pilot in the cockpit and a navigator in the nose section. Both crew members have ejection seats. The pilot enters the cockpit using a ladder secured to the left side of the fuselage. Entrance to the navigator's position is through the hinged nose.

Hydraulic power is provided for the operation of the rudder and ailerons, and a rudder auto-stabiliser is fitted. The elevators are manually operated and an electrically operated, variable-incidence tailplane is fitted.

The Canberra development team and some of the Just Flight crew with XH134 at Kemble – (L-R) Mark Griffiths, Martyn Northall, Tom Williams, Alex Ford, Richard Slater

Liveries

Four authentic RAF colour schemes are supplied with the Canberra PR9, covering 13 Squadron, 39 Squadron and 58 Squadron:

- Hemp
- Silver
- Grey
- Green/grey

Operating Data Manual

An additional Operating Data Manual PDF document is included with this software to supplement the information in this manual. It provides operating charts for various phases of flight and can be found in **Start > All Programs > Just Flight > Canberra PR9** (or from the Start Tile screen if you are a Windows 8 user).

Aircraft specifications

Wingspan	67 feet
Length	66 feet
Height (to top of fin)	15 feet
Height (to top of canopy)	9 feet
Nosewheel	Twin wheel, non-steerable castering
Engines	2 x Avon Mk 206 turbojets
Starting system	Rotax electrical starter
Electrical system	Two generators (28 volts), aircraft battery (24 volts) and emergency battery (24 volts)
Fuel capacity	2,773 gallons / 22,184 pounds

INSTALLATION

Installing the DVD-ROM software

1. Close all open programs and applications prior to installation. Place the DVD-ROM in your DVD drive.
2. If your computer has 'Autorun' enabled, the installation program will start. If not, select 'Start' on the Windows taskbar, click on 'Run…' and type *D:\start.exe* in the 'Open' window (where 'D' is the drive letter of your DVD-ROM drive), then press 'OK'.
3. The first screen to appear will ask you to select between installation into FSX, Prepar3D or Prepar3D v2. Select your chosen Flight Simulator and then follow the on-screen instructions.
4. If the installer is unable to find a valid entry for the selected simulator a warning dialogue will appear telling you to browse manually to the folder where you have installed your host simulation.
5. The default path for Flight Simulator X is C:\Program Files\Microsoft Games\Microsoft Flight Simulator X. The default path for Prepar3D is C:\Program Files\Lockheed Martin\Prepar3D. The default path for Prepar3D v2 is C:\Program Files\Lockheed Martin\Prepar3D v2. These paths will be correct unless you specified another location when you installed your Flight Simulator.

Once the installation is complete you will see a confirmation window. Click the 'Finish' button to exit the install program and return to Windows. The installation is complete.

DVD-ROM installation FAQs

After inserting the disc I get told to insert the correct disc even though I have already inserted it, or an error appears warning that CD/DVD emulation software has been detected.

This problem occurs because the SafeDisc protection software on the disc is failing to validate. The most common reasons for this are:

If you have anti-virus software or a firewall active on your PC this might be interfering with the installation. Please disable all programs running in the background of Windows and try installing again.

Important: *If you have an nVidia nForce 2 motherboard please ensure that you visit nvidia.com and install the latest driver as older versions are known to have compatibility problems with SafeDisc.*

The disc may have been damaged and become unreadable. Please check for any damage to the disc and give the readable surface a clean.

The drive that you are using to load the software may be incompatible with SafeDisc. Please visit the manufacturer's website to download any updated drivers/firmware that may be available or alternatively try installing using an alternative drive (if you've got one).

If you have any Virtual Drive or Emulation software on your PC then this can prevent the SafeDisc protection software from validating. In order to install the software you must disable the emulator from trying to circumvent SafeDisc. Typical emulation software includes Daemon Tools, CloneCD and Alcohol 120%.

If Alcohol 120% is on the machine:

Start Alcohol 120% and go to the Emulation options.

Select 'Emulation' from the options tree. Uncheck the 'Ignore Media Types' box to turn off the media type emulation.

Select 'Extra Emulation' from the options tree. Uncheck the 'BAD Sectors Emulation' to turn off this type of emulation, exit Alcohol 120% and restart the installation.

If CloneCD is on the machine:

Look on the taskbar at the bottom right of your screen (next to the clock). Locate the CloneCD tray icon, which can be a picture of two CD-ROMs or of a sheep's head.

Right-click on the icon and make sure 'Hide CD-R media' is unticked.

Restart the installation.

If Daemon Tools is on the machine:

Right-click on the Daemon Tools icon in the taskbar. Select the Emulation tab and deselect SafeDisc.

If you continue to have problems after trying the above solutions please contact the Support team via the Support page at justflight.com.

When trying to install this title I receive an error message that mentions either -6001 or -5001. How do I fix this?

This error is caused by the InstallShield system leaving some files behind during a previous installation of some other software. Please download and run the ISClear tool (obtainable from the Support page at justflight.com). This should solve the problem and you will then be able to install correctly.

Installing the Download software

You've already purchased the Download and have got this far by following the instructions on our website, but here are some FAQs about our download service that might be helpful.

How do I install and unlock the software once I have paid for it?

Full instructions will appear on screen once you have bought a download add-on. These will also be sent to you in an email for future reference.

How will I know the product has unlocked correctly?

A message will appear on screen telling you that the unlocking process has been completed (and how to contact us in the unlikely event that you experience any problems). Please read all instructions and emails carefully.

What happens if I change my PC or need to reinstall the software?

If you change your computer system or your licence files are 'broken' (perhaps due to a re-installation of Windows or a hard drive malfunction) you will need to unlock the software again.

Once you have unlocked the product you can install it as often as you like on the same computer system.

How do I re-download my product?

1. Click on the 'Account' tab on the Just Flight website (justflight.com)
2. Log into your account
3. Click the 'Your Orders' button
4. A list of your purchases will appear and you can download the software you require

Accessing the aircraft

To access the Canberra in FSX:

1. Click on 'Free Flight'
2. Select 'Just Flight' from the 'Publisher' drop-down menu
3. Select 'English Electric' from the Manufacturer drop-down and choose one of the Canberra variants

Tick the 'Show all variations' box to see all the available liveries.

To access the Canberra in Prepar3D:

1. Select Aircraft > Select Aircraft from the menu bar
2. Select the 'Publisher' filter mode and then select 'Just Flight' from the list of publishers
3. Choose one of the Canberra variants and click on 'OK'

To access the Canberra in Prepar3D v2:

1. Click on 'Vehicles' in the menu bar
2. Type 'Canberra' into the search bar, or select 'Group by Publisher' and scroll down the list to locate 'Just Flight'
3. Choose one of the Canberra variants and click on 'OK'

Website Updates

Please check the News and Support pages on our website at justflight.com for news and updates for this and all our other products.

Technical Support

To obtain technical support (in English) please visit the Support pages at justflight.com. As a Just Flight customer you can obtain free technical support for any Just Flight or Just Trains product.

If you don't have Internet access, please write to us at Just Flight Technical Support, 2 Stonehill, Stukeley Meadows, Huntingdon, PE29 6ED, UK.

Regular News

To get the latest news about Just Flight products, sign up for our monthly newsletter and regular emails at justflight.com/newsletter.

You can also keep up to date with Just Flight via Facebook (facebook.com/justflight) and Twitter (twitter.com/justflight).

Uninstalling

To uninstall this software from your system:

1. Go to the Windows Start menu and select 'Control Panel` (if you are in Windows Classic view, Control Panel will be found under 'Settings').
2. Double-click on the item 'Add or Remove Programs' (Windows XP) or 'Programs and Features' (Windows Vista or 7). In Windows 8 move your mouse to the bottom left corner, right-click with your mouse, then left-click on the 'Programs and Features' menu that appears.
3. Select the program you want to uninstall from the list provided and click the 'Uninstall' option.
4. Follow the on-screen instructions to uninstall the program.

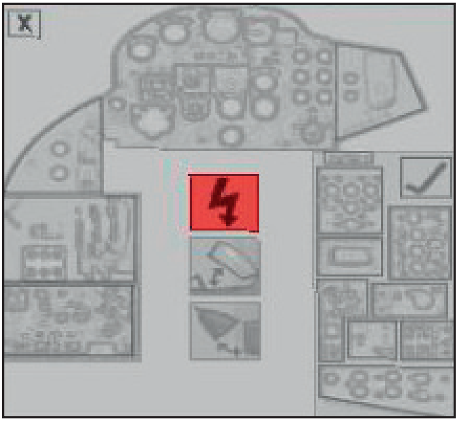
Uninstalling or deleting this software in any other way may cause problems when using this program in the future or with your Windows set-up.

PANEL GUIDE

Panel Selector

The Panel Selector arrow should appear in the top left corner of the screen every time you load the Canberra:

Left-click on this arrow to open the Panel Selector:



You can use this to open any of the twelve main 2D panels. Simply place your mouse cursor over the panel that you would like to open (the panel will turn a darker shade of grey to make it easier to see which one you are about to select) and then left-click on it. It will turn red to indicate that it's open and the relevant 2D panel should pop up.

The name of the panel on which you place your mouse cursor will appear in the space in the bottom left of the Panel Selector.

Clicking the main panel will close all 2D panels with a single click. Alternatively, you can close the 2D panels individually by clicking on them again on the Panel Selector.

The cross in the top left corner closes the Panel Selector and reverts back to the arrow.

The three icons in the centre of the Panel Selector are not actually linked to 2D panels:

- Lightning bolt – clicking this sets the aircraft to a 'cold and dark' or 'ready for take-off' state. The aircraft will load with this icon active (red), indicating that the aircraft is in a 'ready for take-off' state.
- Canopy – clicking this opens/closes the cockpit canopy.
- Nav hatch – clicking this opens/closes the navigator's hatch.

Menu Bar options

When the Canberra PR9 is loaded in Flight Simulator, a new entry will appear in the **Add-ons** menu called **Just Flight Canberra**.

This menu allows you to save/load panel states, and to control the ground equipment.

Saving and loading panel state

The panel state of the Canberra (position of switches, levers etc.) can be saved and subsequently reloaded using the options found under **Panel State**:

Save Panel State – click this menu entry to save the current Canberra panel state

Load Panel State – click this menu entry to reload the last panel state that was saved using the 'Save Panel State' option

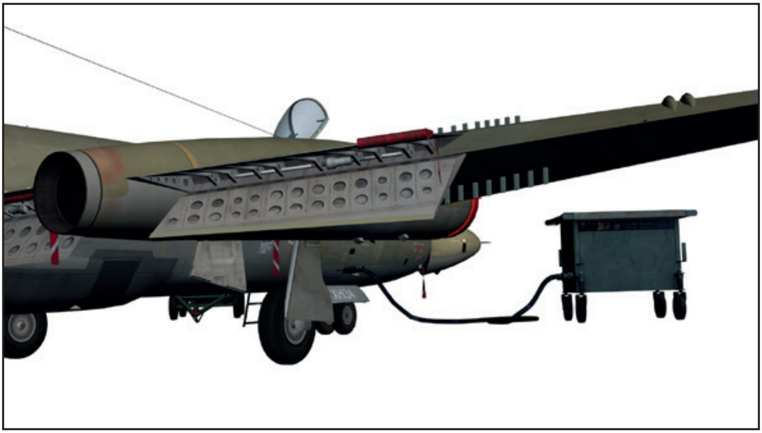
Only a single panel state can be saved at any one time. Selecting 'Save Panel State' will cause any previously saved panel state to be overwritten with the current panel state.

Ground equipment

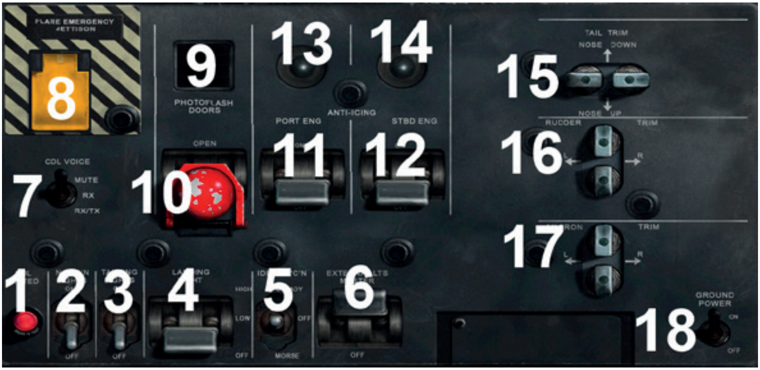
The ground equipment can be toggled on or off using the options found under Ground Equipment:

- Toggle Sign, Tabs, Flap Guards
- Toggle Ladder
- Toggle Engine Covers
- Toggle Ground Power Units
- Toggle All External Objects On/Off

The ground equipment can only be toggled ON if the aircraft is on the ground.



Trim Panel



1. **CDL MUTED light**

   This light will illuminate if the CDL VOICE switch is placed in the MUTE position, alerting the pilot to the Comms Data Link (CDL) being muted.

   The light will also illuminate if the CDL MUTED light is pushed in (left-click), allowing you to test it prior to use.

2. **NAV'G'N LIGHTS switch**

   This two-position switch can be operated using left-click to move it between OFF and ON.

   The switch controls power to the external navigation lights. In order for the navigation lights to function, the EXTERNAL LTS MASTER switch must be set to ON and the aircraft must have electrical power.

3. **TAXYING LIGHTS switch**

   This two-position switch can be operated using left-click to move it between OFF and ON.

   The switch controls power to the taxi lights. In order for the taxi lights to function, the EXTERNAL LTS MASTER switch must be set to ON and the aircraft must have electrical power.

4. **LANDING LIGHT switch**

   This three-position switch can be operated using left-click to move it between OFF, LOW and HIGH.

   The switch controls power to the landing lights. In order for the landing lights to function, the EXTERNAL LTS MASTER switch must be set to ON and the aircraft must have electrical power.

5. IDENTIF'C'N switch

This three-position switch can be operated using left-click to move it between MORSE, OFF and STEADY.

The switch controls power to the external identification lights. In order for the identification lights to function, the EXTERNAL LTS MASTER switch must be set to ON and the aircraft must have electrical power.

6. EXTERNAL LTS MASTER switch

This two-position switch can be operated using left-click to move it between OFF and ON.

The switch controls power to the external lights (navigation, taxi, landing and identification). In order for the external lights to function, the aircraft must have electrical power.

7. CDL VOICE switch

This three-position switch can be operated using left-click to move it between MUTE, RX and RX/TX.

The Comms Data Link (CDL) is used when the aircraft is beyond the range of traditional radio communication.

MUTE – mutes the CDL. With MUTE selected, the CDL MUTED light will illuminate.

RX – only the CMOS receiver will function.

RX/TX – both the CMOS receiver and transmitter will function.

In order for the CDL to function, the aircraft must have electrical power.

8. Flare emergency jettison – guarded switch

Open/close cover – right-click (left-click in virtual cockpit).

Operate switch – left-click.

This switch serves no function on this aircraft.

9. PHOTOFLASH DOORS magnetic indicator

The magnetic indicator will show black with the flare doors fully closed, black/white stripes with the doors in transit, and white with the doors fully open.

10. PHOTOFLASH DOORS lever

Left-click to operate the lever.

This lever operates the flare doors located on the underside of the fuselage. Refer to the magnetic indicator located above the lever to see the current position of the flare doors.

11. PORT ENG anti-icing switch

This two-position switch can be operated using left-click to move it between OFF and ON.

The switch controls power to the port engine anti-ice system. In order for the port engine anti-ice system to function, the port engine must be on.

12. STBD ENG anti-icing switch

This two-position switch can be operated using left-click to move it between OFF and ON.

The switch controls power to the starboard engine anti-ice system. In order for the starboard engine anti-ice system to function, the starboard engine must be on.

13. PORT ENG anti-icing magnetic indicator

This magnetic indicator displays the status of the port engine anti-ice system. The indicator shows black when the system is OFF and white when the system is switched ON.

14. STBD ENG anti-icing magnetic indicator

This magnetic indicator displays the status of the starboard engine anti-ice system. The indicator shows black when the system is OFF and white when the system is switched ON.

15. TAIL TRIM switches

Both of these switches are linked together for ease of use. Left-click on the area above the switches to move them upwards (nose down), and left-click on the area below the switches to move them downwards (nose up). Continue to hold down the left mouse button to make large changes to trim.

A tooltip is displayed when the mouse cursor is placed over these switches and displays the current tail trim setting in degrees of deflection.

16. RUDDER TRIM switches

Both of these switches are linked together for ease of use. Left-click on the area to the left of the switches to move them left (rudder left), and left-click on the area to the right of the switches to move them right (rudder right). Continue to hold down the left mouse button to make large changes to trim.

A tooltip is displayed when the mouse cursor is placed over these switches and displays the current rudder trim setting in degrees of deflection.

17. AILERON TRIM switches

Both of these switches are linked together for ease of use. Left-click on the area to the left of the switches to move them left (ailerons left), and left-click on the area to the right of the switches to move them right (ailerons right). Continue to hold down the left mouse button to make large changes to trim.

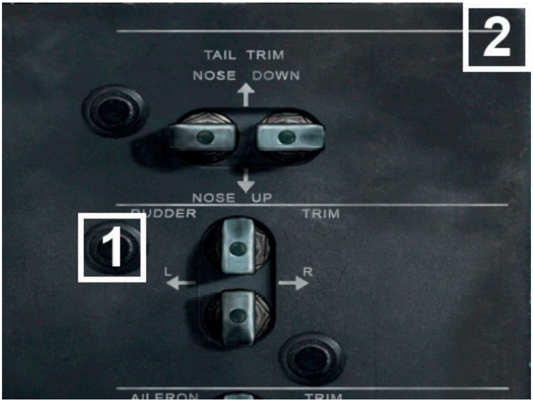
A tooltip is displayed when the mouse cursor is placed over these switches and displays the current aileron trim setting in degrees of deflection.

18. **GROUND POWER switch**

This two-position switch can be operated using left-click to move it between OFF and ON.

Switch the ground power on to connect external power to the busbar. Ground equipment will appear outside of the aircraft.

Note: *The aircraft battery switch should be set to OFF before moving this switch to ON.*



1. **Reset trims clickspot**

   Left-click in this area to reset the tail, rudder and aileron trims to their neutral positions.

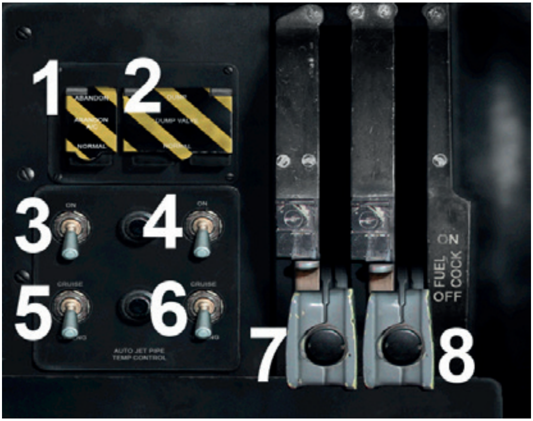
2. **Nose-wheel clickspot**

   'Direct nose-wheel steering' option selected – left-click in this area to isolate the nose-wheel. With the nose-wheel isolated, you can use the FSX rudder axis assignment to steer the nose-wheel without the rudder being deflected.

   'Castoring nose-wheel steering' option selected – left-click in this area to activate rudder-controlled steering. With this mode active, applying left and right rudder using the joystick axis will apply differential braking.

   The clickspot tooltip indicates if either mode is active.

Throttle Panel



1. **ABANDON A/C guarded switch**

   Open/close cover – right-click (left-click in virtual cockpit)

   Operate switch – left-click

   This switch controls a red warning light at the navigator's station. When the switch is placed in the ABANDON (up) position, the red warning light will illuminate to indicate to the navigator to abandon the aircraft.

2. **DUMP VALVE guarded switches**

   Open/close cover – right-click

   Operate switch – left-click

   These two interlocked switches control a cabin pressure dump valve, used to dissipate pressure rapidly in the event that the aircraft needs to be abandoned. With the switches in the DUMP (up) position, loss of cabin pressure can be monitored on the CABIN ALTITUDE gauge situated on the take-off panel.

3. **Port engine JET PIPE TEMP master switch**

   This two-position switch can be operated using left-click to move it between OFF and ON.

   The switch controls power to the port engine JPT system. In order for the port JPT system to function, inverter No. 4 must be available.

4. Starboard engine JPT master switch

This two-position switch can be operated using left-click to move it between OFF and ON.

The switch controls power to the starboard engine JPT system. In order for the starboard JPT system to function, inverter No. 4 must be available.

5. Port engine JPT mode switch

This two-position switch can be operated using left-click to move it between MAX and CRUISE.

The switch controls the port engine JPT system mode. Selecting CRUISE imposes a 705°C JPT limit and selecting MAX imposes a 750°C JPT limit.

6. Starboard engine JPT mode switch

This two-position switch can be operated using left-click to move it between MAX and CRUISE.

The switch controls the starboard engine JPT system mode. Selecting CRUISE imposes a 705°C JPT limit and selecting MAX imposes a 750°C JPT limit.

7. Port engine throttle lever/HP cock

8. Starboard engine throttle lever/HP cock

The throttle levers can be moved independently by left-clicking and dragging them upwards or downwards. The HP cock for each engine is integrated into its respective throttle lever. The HP cock can be closed by moving the throttle lever to the FUEL COCK OFF position, achieved by moving the throttle lever to the idle position and right-clicking on it. Right-click on the throttle lever again to move it to the FUEL COCK ON position, which will open the HP cock. Only when the HP cock is open can the throttle lever position be moved to control engine RPM.

Flap/Gear Panel

1. **HOLD UNTIL CANOPY LIFTS guarded switch**

   Open/close cover – right-click (left-click in virtual cockpit)

   Operate switch – left-click

   Operating this switch whilst on the ground with the canopy closed will result in the canopy lifting. The switch will automatically return to the off/up position after it has been clicked.

2. **Gear position indicator**

   This gauge displays the status of the landing gear:

   - Three green lights – all landing gear units are locked down
   - Any red light – landing gear unit is unlocked
   - No lights – all landing gear units are locked up

   The nose landing gear red light comes on if either throttle is less than one third open with the landing gear in any position other than all three units locked down.

   If failure of a green lamp is suspected, reserve green lamps may be brought into operation by turning the change-over switch at the centre of the dial (left-click). For night flying, the intensity of the lamps may be reduced by turning the larger winged knob at the centre of the dial (left-click).

3. **Flap position indicator**

   This gauge displays the position of the trailing edge flaps. In normal operation the needle should move smoothly between the UP and DOWN positions, but in the event of a hydraulics failure while the flaps are in transit, the needle can be used to identify their exact position.

4. FUEL TANK JETTISON guarded switch

Open/close cover – right-click (left-click in virtual cockpit)

Operate button – left-click

When pushed, this button would trigger the jettison of the wing tip fuel tanks. Wing tip tanks are not fitted to this Canberra so the button can be operated but serves no function.

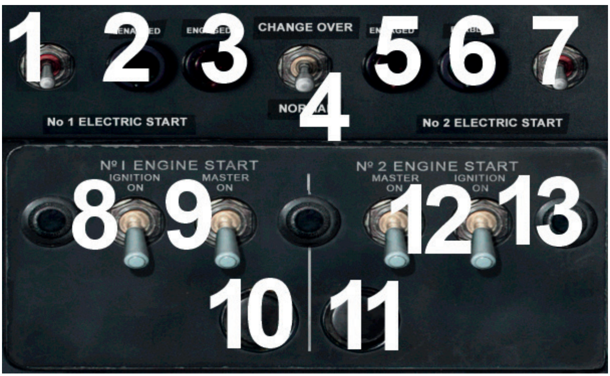
5. Gear buttons

These buttons are used to control the landing gear. Both buttons are spring-loaded and pushing one will release the other. Left-click on the DOWN button to extend the landing gear and left-click on the UP button to retract the landing gear.

6. FLAPS lever

This lever is used to control the position of the trailing edge flaps. The aircraft has only two flap positions – up and down – and the lever can be moved between the two positions using left-click.

Engine Start Panel



1. No. 1 ELECTRIC START switch

This two-position switch can be operated using left-click to move it between ON and OFF.

The switch controls the port electrical start system. This switch must be set to ON before the port starter system can be used.

2. **No. 1 ENABLED light**

This light will illuminate green when the No. 1 ELECTRIC START switch has been placed in the ON/engaged position, indicating that the electrical starter motor for the port engine can be used.

The light can be tested by pushing it in (left-click).

3. **No. 1 ENGAGED light**

This light will illuminate red when the port electrical starter motor is engaged. This should occur from the moment the start button is pushed until the engine RPM gauge has reached approximately 33% RPM.

The light can be tested by pushing it in (left-click).

4. **CHANGE OVER / NORMAL switch**

This two-position switch can be operated using left-click to move it between NORMAL and CHANGE OVER.

This switch controls which of the two electrical starter motors is used when the start button is pushed. With NORMAL selected, the starter motor on the same side as the engine being started will be used (e.g. port engine – port starter). With CHANGE OVER selected, the starter motor on the opposite side to the engine being started will be used (e.g. port engine – starboard starter). This can be used in the event of a suspected electrical start motor failure.

5. **No. 2 ENGAGED light**

This light will illuminate red when the starboard electrical starter motor is engaged. This should occur from the moment the start button is pushed until the engine RPM gauge has reached approximately 33% RPM.

The light can be tested by pushing it in (left-click).

6. **No. 2 ENABLED light**

This light will illuminate green when the No. 2 ELECTRIC START switch has been placed in the ON/engaged position, indicating that the electrical starter motor for the starboard engine can be used.

The light can be tested by pushing it in (left-click).

7. **No. 2 ELECTRIC START switch**

This two-position switch can be operated using left-click to move it between ON and OFF.

The switch controls the starboard electrical start system. This switch must be set to ON before the starboard starter system can be used.

8. No. 1 IGNITION switch

This two-position switch can be operated using left-click to move it between ON and OFF.

This switch controls the port engine ignition system. This switch must be set to ON before the port engine can be started.

9. No. 1 MASTER switch

This two-position switch can be operated using left-click to move it between ON and OFF.

This switch controls power to the port engine start system. This switch must be set to ON before the port engine can be started.

10. No. 1 push start button

This spring-loaded push-button is used to trigger the port engine start sequence. Left-click once on the button to push it in.

11. No. 2 push start button

This spring-loaded push-button is used to trigger the starboard engine start sequence. Left-click once on the button to push it in.

12. No. 2 MASTER switch

This two-position switch can be operated using left-click to move it between ON and OFF.

This switch controls power to the starboard engine start system. This switch must be set to ON before the starboard engine can be started.

13. No. 2 IGNITION switch

This two-position switch can be operated using left-click to move it between ON and OFF.

This switch controls the starboard engine ignition system. This switch must be set to ON before the starboard engine can be started.

Fuel Panel

Note: *Please refer to the FUEL SYSTEM section on page 98 for a more detailed description of this system.*

1. PORT WING PUMP switch

This two-position switch can be operated using left-click to move it between ON and OFF.

This switch controls the electrically operated LP fuel pump that feeds fuel from the port wing/integral tank to either the port engine or rear tank (depending on the position of the NORMAL/TRANSFER TO REAR TANK switch situated on the take-off panel).

This switch must be set to the ON position in order for fuel in the port wing/integral tank to be used.

2. BELLY TANK pump switches

These two-position switches can be operated using left-click to move them between ON and OFF.

These switches control the electrically operated LP fuel pumps that feed fuel from the belly tank to the port and starboard engines.

This switch must be set to the ON position in order for fuel in the belly tank to be used.

3. **STBD WING PUMP switch**

This two-position switch can be operated using left-click to move it between ON and OFF.

This switch controls the electrically operated LP fuel pump that feeds fuel from the starboard wing/integral tank to either the starboard engine or rear tank (depending on the position of the NORMAL/TRANSFER TO REAR TANK switch situated on the take-off panel).

This switch must be set to the ON position in order for fuel in the starboard wing/integral tank to be used.

4. **Port wing quantity gauge**

This gauge displays the quantity of fuel (pounds x100) in the port wing/integral tank.

5. **Belly tank quantity gauge**

This gauge displays the quantity of fuel (pounds x100) in the belly tank.

6. **Starboard wing quantity gauge**

This gauge displays the quantity of fuel (pounds x100) in the starboard wing/integral tank.

7. **FUEL COCKS switches**

These two-position switches can be operated using left-click to move them between ON and OFF.

8. **Top tanks quantity gauge**

This gauge displays the combined quantity of fuel (pounds x100) in the four top tanks.

9. **TOP TO BELLY TRANSFER COCK switch**

Open/close cover – right-click (left-click in virtual cockpit)

Operate switch – left-click

This switch controls the position of the top to belly transfer cock. If the switch is set to ON, fuel is able to flow from the four top tanks to the belly tank, from where it is then fed to the engines. If the switch is set to OFF, the fuel in the four top tanks is not used.

10. **Rear tank PORT PUMP switch**

This two-position switch can be operated using left-click to move it between ON and OFF.

This switch controls the electrically operated LP fuel pump that feeds fuel from the rear tank to the port engine.

This switch must be set to the ON position in order for fuel in the rear tank to be used by the port engine.

11. Rear tank quantity gauge

This gauge displays the quantity of fuel (pounds x100) in the rear tank.

12. Rear tank STBD PUMP switch

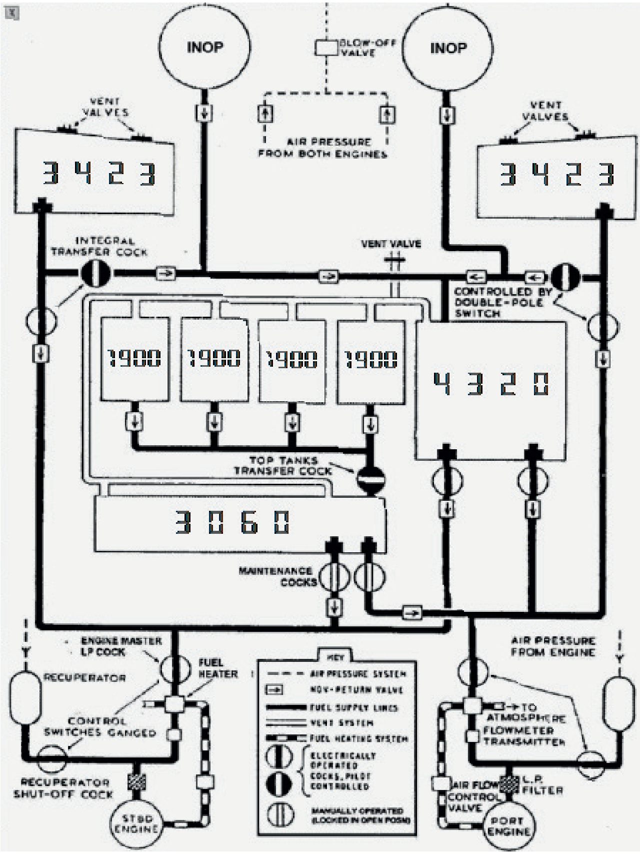
This two-position switch can be operated using left-click to move it between ON and OFF.

This switch controls the electrically operated LP fuel pump that feeds fuel from the rear tank to the starboard engine.

This switch must be set to the ON position in order for fuel in the rear tank to be used by the starboard engine.

1. Fuel system overview clickspot

Left-click on this clickspot to open the fuel overview panel.



This panel displays the fuel quantity in each tank and the position of all fuel cocks.

The panel can be closed by clicking on the cross in the top left corner.

2. Automatic fuel management clickspot

Left-click on this clickspot to activate the automatic fuel management system. This system will automatically perform the fuel management drill actions.

The clickspot tooltip indicates if the automatic fuel management system is active.

Take-off Panel

1. **CANOPY demist switch**

   This two-position switch can be operated using left-click to move it between ON and OFF.

   This switch controls power to an electrically driven blower motor which is used to demist the canopy.

2. **PITOT switch**

   This two-position switch can be operated using left-click to move it between ON and OFF.

   This switch controls power to the electrical heaters fitted to the two pressure heads on the aircraft.

3. **VENT VALVES switch**

   This two-position switch can be operated using left-click to move it between ON and OFF.

   This switch controls power to the electrically heated vent valves fitted to the wing/integral fuel tanks.

4. **No. 1 NORMAL/TRANSFER TO REAR TANK switch**

This two-position switch can be operated using left-click to move it between NORMAL and TRANSFER TO REAR TANK.

This switch controls the position of the port integral transfer cock, which directs fuel from the port wing/integral tank to either the port engine or the rear tank. If the switch is set to NORMAL, fuel will flow from the port wing/integral tank to the port engine. If the switch is set to TRANSFER TO REAR TANK, fuel will flow from the port wing/integral tank to the rear tank.

5. **No. 1 LP cock switch**

Open/close cover – right-click (left-click in virtual cockpit)

Operate switch – left-click

This switch controls an electrically actuated engine master LP cock, located in the main fuel line to the port engine, and a recuperator shut-off cock which is located in the fuel line between the port engine recuperator and port engine. If the switch is set to ON, both cocks will be opened. If the switch is set to OFF, both cocks will be closed.

6. **No. 2 LP cock switch**

Open/close cover – right-click (left-click in virtual cockpit)

Operate switch – left-click

This switch controls an electrically actuated engine master LP cock, located in the main fuel line to the starboard engine, and a recuperator shut-off cock which is located in the fuel line between the starboard engine recuperator and starboard engine. If the switch is set to ON, both cocks will be opened. If the switch is set to OFF, both cocks will be closed.

7. **No. 2 NORMAL/TRANSFER TO REAR TANK switch**

This two-position switch can be operated using left-click to move it between NORMAL and TRANSFER TO REAR TANK.

This switch controls the position of the starboard integral transfer cock, which directs fuel from the starboard wing/integral tank to either the starboard engine or the rear tank. If the switch is set to NORMAL, fuel will flow from the starboard wing/integral tank to the starboard engine. If the switch is set to TRANSFER TO REAR TANK, fuel will flow from the starboard wing/integral tank to the rear tank.

8. **AIRCRAFT BATTERY switch**

Open/close cover – right-click (left-click in virtual cockpit)

Operate switch – left-click

This switch controls the 24 volt lead acid battery located in the left equipment bay. If the switch is set to ON the battery is connected to the electrical busbar. If the switch is set to OFF the battery is isolated from all electrical circuits except for the locking pins control circuit and cabin pressure dump system.

9. CABIN ALTITUDE gauge

This gauge displays the current cabin altitude in feet (x1000).

10. HYDRAULIC PRESSURE gauge

This gauge displays the current main hydraulic system pressure in PSI (x100).

11. BRAKE PRESSURE gauge

This gauge displays the current brake hydraulic system pressure in PSI (x100).

12. CABIN AIR gauge

This gauge displays the currently selected cabin air temperature, which can be adjusted using the CABIN AIR switch located below it.

13. COMPASS/D GYRO switch

This two-position switch can be operated using left-click to move it between COMPASS and D GYRO.

This switch controls whether the Mk 4B compass located on the main instrument panel is acting as a compass or directional gyro.

14. ENGINE AIR TO CABIN – No. 1 ENG and No. 2 ENG switches

These two-position switches can be operated using left-click to move them between ON and OFF.

These switches control electronically operated gate valves which in turn control the supply of hot air from engine compressors for use as cabin air conditioning.

15. CABIN AIR switch

This switch is spring-loaded to the central position. Left-click on the clickspots found to the left and right of the switch in order move the switch in either direction. Hold down your left mouse button to make large changes.

This switch controls a mixing valve which governs the temperature of the air entering the cabin. Changes to the selected cabin air temperature can be seen on the CABIN AIR gauge located above this switch.

Oxygen Regulator Panel

1. **OXYGEN FLOW INDICATOR magnetic indicator**

   This magnetic indicator will display white when oxygen is flowing through the regulator and black when no oxygen is flowing through the regulator.

2. **NORMAL/100% OXYGEN (air inlet control)**

   This two-position switch can be operated using left-click to move it between NORMAL and 100%.

   This switch controls the ratio of oxygen to air that is delivered through the regulator. If NORMAL is selected the regulator will automatically vary the ratio to supply the proper mixture to the pilot dependent on altitude. If 100% is selected the regulator will supply pure oxygen.

3. **ON/OFF valve**

   This two-position switch can be operated using left-click to move it between ON and OFF.

   This switch controls the flow of oxygen to the regulator.

4. **Regulator pressure gauge**

   This gauge displays the current oxygen supply pressure.

5. **Four-position manual selector control**

   Left-click on the clickspot located above the control to rotate it clockwise. Left-click on the clickspot located below the control to rotate it anti-clockwise.

   This control is used to test the supply of oxygen to the mask and jerkin.

   A magnetic indicator located on top of this control will operate if the selector is set to any position other than NORMAL.

Autopilot Switch Panel

***Note:** Please refer to the autopilot section on page 115 for a more detailed description of the autopilot system.*

1. **SLIP BALL LGT DIMMER**

   Left-click on this dimmer to rotate it between the OFF and FULL positions.

   This dimmer controls the slip ball lighting.

2. **RDU LGT DIMMER**

   Left-click on this dimmer to rotate it between the OFF and FULL positions.

   This dimmer controls the Repeater Display Unit lighting.

3. **TRACK switch**

   This two-position pull-push switch can be operated using left-click to move it between OFF (down) and ON (up).

   With the autopilot engaged and the TRACK switch pulled up, the aircraft will track the heading according to the heading error signal from the heading selector and the ILS localiser beam.

4. **GLIDE switch**

   This two-position pull-push switch can be operated using left-click to move it between OFF (down) and ON (up).

   With the autopilot engaged and the GLIDE switch pulled up, the aircraft will alter the pitch in accordance with the glide path beam.

5. **POWER switch**

This two-position pull-push switch can be operated using left-click to move it between OFF (down) and ON (up).

When the POWER switch is pulled ON, DC/AC power is supplied to the autopilot system from inverter No. 2. This is indicated by the READY magnetic indicator changing from black to black and white stripes.

6. **BOMB switch**

This two-position pull-push switch can be operated using left-click to move it between OFF (down) and ON (up).

This autopilot mode is non-functional in the Canberra PR9 due to its photoreconnaissance role. In this simulation, pulling the BOMB switch ON will instantly disengage the autopilot.

7. **ALT switch**

This two-position pull-push switch can be operated using left-click to move it between OFF (down) and ON (up).

When the ALTitude lock switch is pulled ON, the autopilot will level off and maintain the current altitude. The autopilot POWER and ENGAGE switches must be pulled ON before the altitude lock mode will function.

8. **ENGAGE switch**

This two-position pull-push switch can be operated using left-click to move it between OFF (down) and ON (up).

When the ENGAGE switch is pulled ON, the autopilot will couple to the control surfaces. This is indicated by the IN magnetic indicator changing from black to white.

9. **Rudder, aileron and elevator channel switches**

These two-position switches can be operated using left-click to move them between OUT (down) and IN (up).

These switches control whether a particular control surface is coupled to the autopilot. Moving all three switches to the OUT (down) position will disengage the autopilot.

10. **READY magnetic indicator**

This magnetic indicator displays black if power is not available to the autopilot system and displays black and white stripes if power from inverter No. 4 is connected to the autopilot system. The indicator will subsequently display black if the ENGAGE switch is pulled ON. It will display black and white stripes again if any of the three channel switches are set to OUT.

11. **IN magnetic indicator**

This magnetic indicator displays black if the autopilot is not coupled to the flight control surfaces and displays white if the autopilot is coupled to at least one flight control surface (rudder, aileron or elevator).

1. **Autothrottle clickspot**

   Left-click in this area to engage or disengage the autothrottle. The real aircraft does not have an autothrottle but this invisible clickspot has been included to provide this functionality if required.

   A tooltip indicates if the autothrottle is active.

Avionics Panel

1. **AVIONICS MASTER switch**

   This two-position switch can be operated using left-click to move it between OFF and ON.

   This switch controls power to the aircraft avionics. The aircraft battery or ground power must be switched ON before the avionics can be used.

2. **IPOD socket**

   This audio jack allows the pilot to listen to their personal music device through their headset.

3. **INST LIGHTS circuit breaker**

   This circuit breaker can be operated using left-click to move it between IN and OUT.

4. **DVM circuit breaker**

   This circuit breaker can be operated using left-click to move it between IN and OUT.

   With the circuit breaker pulled (OUT), the digital volt meter display will no longer function.

5. **EMERGENCY AVIONICS switch**

   Open/close cover – right-click (left-click in virtual cockpit)

   Operate switch – left-click

   With the switch in the ON (up) position, a limited selection of avionics are powered by the emergency battery.

6. **DVM (digital volt meter)**

   When the PUSH UP TO READ switch is set to the UP position, the digital volt meter displays the current voltage supplied by the electrical starter system batteries. This should read 124 volts prior to the engines being started and should drop 1 volt per single engine start. Do not attempt an engine start if the DVM is displaying less than 114 volts.

7. **PUSH UP TO READ switch**

   This two-position switch can be operated using left-click to move it between DOWN (off) and UP (on).

   This switch controls power to the DVM. If the switch is set to the UP position, the electrical starter system battery voltage will be displayed on the DVM.

1. **Restore volts clickspot**

   Left-click on this clickspot to instantly recharge the electrical starter system batteries. Once recharged, the DVM will display 124 volts.

Lights Panel

1. **INVERTER No. 2 GROUND TEST SWITCH**

   Open/close cover – right-click (left-click in virtual cockpit)

   Operate switch – left-click

When this switch is set to the TO TEST position inverter No. 2 will be started regardless of whether the engines are on. This allows for the ground testing of equipment dependent on inverter No. 2 for power.

2. E2B COMPASS LIGHT

Left-click on this knob to set it to ON (fully clockwise position) or OFF (fully anti-clockwise position).

This knob controls the cockpit floodlighting.

3. STARBOARD CONSOLE

Left-click on this knob to set it to ON (fully clockwise position) or OFF (fully anti-clockwise position).

This knob controls the cockpit floodlighting.

4. COAMING PANEL

Left-click on this knob to set it to ON (fully clockwise position) or OFF (fully anti-clockwise position).

This knob controls the cockpit floodlighting.

5. VHF SELECTOR

Left-click on this knob to set it to ON (fully clockwise position) or OFF (fully anti-clockwise position).

This knob controls the cockpit floodlighting.

6. ACCELEROMETER

Left-click on this knob to set it to ON (fully clockwise position) or OFF (fully anti-clockwise position).

This knob controls the cockpit floodlighting.

7. DIMMER PANEL

Left-click on this knob to set it to ON (fully clockwise position) or OFF (fully anti-clockwise position).

This knob controls the gauge illumination.

8. PORT CONSOLE

Left-click on this knob to set it to ON (fully clockwise position) or OFF (fully anti-clockwise position).

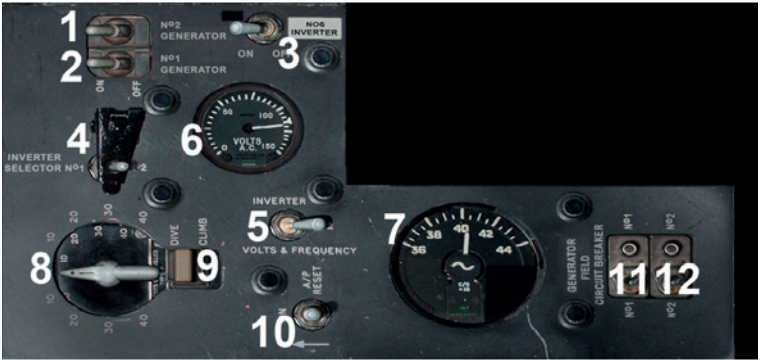
This knob controls the cockpit floodlighting.

9. REMOTE PILOTS INDICATOR

Left-click on this knob to set it to ON (fully clockwise position) or OFF (fully anti-clockwise position).

This knob controls the cockpit floodlighting.

Electrical Panel



1. **No. 2 GENERATOR switch**

   This two-position switch can be operated using left-click to move it between OFF and ON.

   This switch controls the engine-driven generator located in the starboard wing, which provides power for the electrical, instrument and radio equipment. If the starboard engine is running and this switch is moved to the ON position, No. 2 generator will come online.

2. **No. 1 GENERATOR switch**

   This two-position switch can be operated using left-click to move it between OFF and ON.

   This switch controls the engine-driven generator located in the port wing, which provides power for the electrical, instrument and radio equipment. If the port engine is running and this switch is moved to the ON position, generator No. 1 will come online.

3. **No. 6 INVERTER switch**

   This two-position switch can be operated using left-click to move it between OFF and ON.

   This switch controls inverter No. 6 which supplies power to the radio altimeter. Inverter No. 6 will provide power when this switch is set to ON.

4. **INVERTER SELECTOR No. 1/No. 2 switch**

   Open/close cover – right-click (left-click in virtual cockpit)

   Operate switch – left-click

   For normal operations this switch is left in the guarded position with inverter No. 2 selected. If reversion to inverter No. 1 is necessary, moving this switch to No. 1 will bring inverter No. 1 back online.

Refer to the section titled 'No. 1 and No. 2 inverter controls' on page 96 for a more detailed description.

5. **INVERTER VOLTS & FREQUENCY selector**

   This two-position switch can be operated using left-click to move it between OFF and ON.

   This switch controls the inverter from which readings are taken before being displayed on the voltage and frequency gauges located on this panel.

6. **Inverter AC voltage gauge**

   This gauge displays the AC voltage being supplied from the inverter that is selected by the INVERTER VOLTS & FREQUENCY selector.

7. **Inverter frequency gauge**

   This gauge displays the frequency being supplied from the inverter that is selected by the INVERTER VOLTS & FREQUENCY selector.

8. **Bank selector**

   Left-click on the clickspot located above the selector to rotate it clockwise. Left-click on the clickspot located below the selector to rotate it anti-clockwise.

   When the autopilot is engaged and neither GLIDE nor TRACK is selected, this selector can be used to select a bank angle for the autopilot to hold.

   Refer to the section titled 'Bank control' on page 116 for a more detailed description.

9. **DIVE/CLIMB selector switch**

   This switch is spring-loaded to the central position. Left-click on the clickspots found to the left and right of the switch in order to move the switch in either direction. Hold down your left mouse button to make large changes.

   When the autopilot is engaged and neither GLIDE nor ALT is selected, this selector can be used to select a pitch angle for the autopilot to hold.

   Refer to the section titled 'Pitch control' on page 116 for a more detailed description.

10. **A/P RESET switch**

    This two-position switch can be operated using left-click to move it between OFF and ON.

    When moved to the ON position, the autopilot and any associated functions will be disengaged.

11. **Generator 1 circuit breaker**

    This circuit breaker can be operated using left-click to move it between IN and OUT.

    Pulling this circuit breaker will disconnect power from generator 1.

12. **Generator 2 circuit breaker**

    This circuit breaker can be operated using left-click to move it between IN and OUT.

    Pulling this circuit breaker will disconnect power from generator 2.

Radio/GPS Panel

1. **Circuit breakers**
2. **GMA 340**
3. **GTN 650**
4. **SL30**

GMA 340

1. **Left knob**

   Large – in the real aircraft this knob is used to control the squelch level. As this functionality is not possible within Flight Simulator, this knob serves no function.

   Small – this knob is used to switch on/off power to the GMA 340 unit.

2. **AOM lights**

   These marker beacon lights will illuminate when the aircraft passes over Airway/Inner, Outer or Middle marker beacons.

3. **MKR MUTE**

This button is used to toggle the mute function for the marker beacon audio. If a valid marker beacon signal is being received by the unit but you wish to mute the audio, press this button and confirm that the green LED illuminates. Press the button once more to un-mute the sound.

4. **SENS**

This button is used to select either high or low marker beacon sensitivity. The HI and LO LEDs located above the SENS button indicate which sensitivity has been selected.

Low sensitivity is used on ILS approaches, and high sensitivity used when operating over airway markers.

5. **COM 1**

This button is used to toggle the COM 1 transceiver audio, allowing you to select COM 1 as the audio source to monitor. COM 1 audio is selected if the LED is illuminated.

COM 1 transceiver audio can be selected regardless of which MIC transmitter is selected.

6. **COM 1 MIC**

This button is used to toggle COM 1 MIC, allowing you to select to transmit on the COM 1 frequency. You are transmitting on COM 1 if the LED is illuminated.

COM 1 transceiver audio will be automatically selected when COM 1 MIC is selected.

7. **COM 2**

This button is used to toggle the COM 2 transceiver audio, allowing you to select COM 2 as the audio source to monitor. COM 2 audio is selected if the LED is illuminated.

COM 2 transceiver audio can be selected regardless of which MIC transmitter is selected.

8. **COM 2 MIC**

This button is used to toggle COM 2 MIC, allowing you to select to transmit on the COM 2 frequency. You are transmitting on COM 2 if the LED is illuminated.

COM 2 transceiver audio will be automatically selected when COM 2 MIC is selected.

9. **COM 3**

This button is used to toggle the COM 3 transceiver audio, allowing you to select COM 3 as the audio source to monitor. COM 3 audio is selected if the LED is illuminated.

COM 3 transceiver audio can be selected regardless of which MIC transmitter is selected.

Note: *The Flight Simulator ATC system does not provide for the facility of a COM 3 radio, so although the COM 3 controls are functional, they will not have any impact on ATC operations.*

10. COM 3 MIC

This button is used to toggle COM 3 MIC, allowing you to select to transmit on the COM 3 frequency. You are transmitting on COM 3 if the LED is illuminated.

COM 3 transceiver audio will be automatically selected when COM 3 MIC is selected.

Note: *The Flight Simulator ATC system does not provide for the facility of a COM 3 radio, so although the COM 3 controls are functional, they will not have any impact on ATC operations.*

11. NAV 1

This button is used to toggle the NAV 1 audio source. NAV 1 audio is selected if the LED is illuminated.

12. NAV 2

This button is used to toggle the NAV 2 audio source. NAV 2 audio is selected if the LED is illuminated.

13. DME

This button is used to toggle the DME audio source. DME audio is selected if the LED is illuminated.

14. ADF

This button is used to toggle the ADF audio source. ADF audio is selected if the LED is illuminated.

15. COM 1/2

This button is used to toggle the Split Com function which, when enabled, will automatically select the COM 1 MIC and COM 2 MIC. Pressing the button a second time will disable the function.

Split Com is enabled if the LED is illuminated.

16. SPKR / PA / PILOT / CREW

These buttons are used to toggle cabin audio functions. They do not serve a purpose in this aircraft. LED lights will illuminate on each switch when they are selected.

17. TEST

Pressing this button with the unit switched on will activate the test mode.
All LEDs and the AOM lights on the unit should illuminate for several seconds before extinguishing.

18. Right knob

This knob would be used to control the volume and squelch levels for the co-pilot. As this is operated by a single crew member, this knob serves no purpose in this aircraft.

GTN 650

1. **Left knob**

   This knob is used to control power to the GTN 650 unit. Left-click on the knob to toggle the power on/off.

2. **Touchscreen**

   Most functions on the GTN 650 are controlled by clicking on this touchscreen. Please refer to the explanations of each menu/page below for more details.

3. **HOME**

   Pressing this button will always return you to the Home page.

4. **DIRECT-TO**

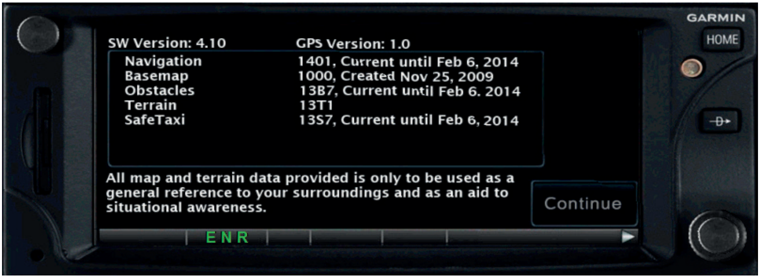
   With the Map page selected, pressing this button will bring up a dialogue box from which you select an airport or waypoint to fly to directly.

5. **Right knob**

   This knob consists of a large outer and a small inner knob. They provide multiple functions depending on which page is selected. If the knob does not serve a special purpose on the selected page, it can be used to alter the standby COM 1 or NAV 1 standby frequency. The outer knob increases/decreases the whole numbers and the inner knob increases/decreases the fractions.

   Please refer to the explanations of each menu/page below for more details.

Start page



This is the first page that will be visible when the GTN 650 is switched on. It displays information regarding the databases used by the unit, as well as a disclaimer regarding its usage.

Click on the **Continue** button to proceed to the Home page.

Note: *This unit makes use of the default FSX GPS unit database and therefore it cannot be updated using services such as Navigraph.*

Home page

The Home page serves as the main menu, from where you choose to open one of eight pages:

1. Map
2. COM
3. NAV
4. XPDR
5. Default NAV
6. Flight Plan
7. PROC
8. FUEL

You can return to this page at any time by pressing the physical HOME button on the top right of the GTN 650 unit.

Sidebar

The right sidebar remains visible on the majority of the pages. It displays:

- Active and standby COM 1 or NAV 1 frequencies
- Active transponder frequency and mode
- Control buttons which are dependent on the selected page (Enter, up/down arrows, or Map page shortcut)

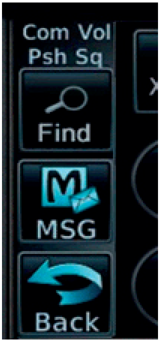
The active and standby COM 1 or NAV 1 frequencies can be swapped by clicking on the double-ended arrow located between the active and standby frequency windows.

Right-click on the right inner knob to switch between COM 1 and NAV 1 modes.

Left-click on the right inner and outer knobs to alter the standby frequency.

Option buttons

Various buttons will be displayed in the left sidebar, varying depending on which page is currently selected. Please refer to the explanations of each menu/page below for more details.



Annunciations

ENR/APR – this will appear when a GPS flight plan is active, indicating whether the GPS is operating in en-route or approach mode.

SUSP – this will appear if a GPS flight plan is active and the OBS button on the default Navigation page has been clicked, indicating that automatic sequencing of waypoints is disabled.

OFF – this will appear if the MSG mode has been disabled.

Com Freq / Psh Nav and Nav Freq / Psh Com – this will appear to indicate what function right-clicking the right inner knob will have.

Map page

This page displays the GPS map along with information regarding the loaded flight plan:

- Bearing to next GPS waypoint
- Course to steer to next GPS waypoint
- Estimated time of arrival at next GPS waypoint
- Name/identifier of next GPS waypoint

IN/OUT buttons are located at the bottom of the right sidebar for zooming the GPS map in or out.

The **Menu** button will open up the GPS menu window.

The **MSG** button will open up the GPS message window. Pressing it a second time will turn off the messages.

The **Back** button will clear any data inputted into the GPS windows.

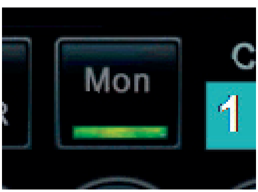
COM page

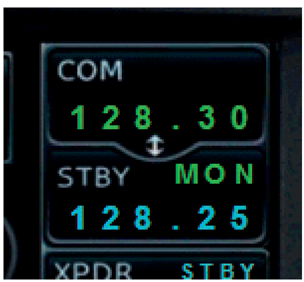
This page is used to input a new COM 1 standby frequency.

Click on a number button to begin the entry inputting process. Square brackets will appear to indicate which digit of the frequency is currently being inputted. Pressing the **BKSP** (backspace) button will move one digit backwards. Once you have finished entering a new frequency, press the Enter button to input the frequency into the COM 1 standby slot.

The **XFER** button transfers the COM 1 standby frequency into the COM 1 active frequency slot.

In the real aircraft the **MON** button can be used to select COM monitoring mode, with which you can monitor both the active and standby COM frequencies at the same time. This is not possible within Flight Simulator, so although this mode can be selected, it will not perform any function.





NAV page

This page is used to input a new NAV 1 standby frequency.

Click on a number button to begin the entry inputting process. Square brackets will appear to indicate which digit of the frequency is currently being inputted. Pressing the **BKSP** (backspace) button will move one digit backwards. Once you have finished entering a new frequency, press the Enter button to input the frequency into the NAV 1 standby slot.

The **XFER** button transfers the NAV 1 standby frequency into the NAV 1 active frequency slot.

XPDR page

This page is used to input a new transponder code.

Click on a number button to begin the entry inputting process. Square brackets will appear to indicate which digit of the code is currently being inputted. Pressing the **BKSP** (backspace) button will move one digit backwards. Once you have finished entering a new code, press the **Enter** button to input the code.

Pressing the **VFR** button will automatically set the transponder code to 7000.

Pressing the **Mode** button will cycle through the transponder modes:

- STBY (standby)
- GND (ground)
- ON
- ALT (altitude reporting)

The selected mode is indicated on the Mode button and in the right sidebar.

Default NAV page

This page is used to view information on the active GPS flight plan:

- Distance to the next GPS waypoint (in nautical miles)
- Direct track to the next GPS waypoint (in degrees)
- Bearing to the next GPS waypoint (in degrees)
- Current groundspeed (in knots)
- Current track (in degrees)
- Estimated time en-route – time left until the next GPS waypoint is reached (in hours, minutes)
- Name/identifier for the previous and next GPS waypoint
- Course deviation – left/right from the GPS routing

Pressing the **CDI** button will toggle the magenta course deviation indicator.

Pressing the **OBS** button will toggle the automatic sequencing of GPS waypoints. When automatic sequencing is disabled, the SUSP annunciation will appear.

Pressing the **Map** button will bring up the GPS map page.

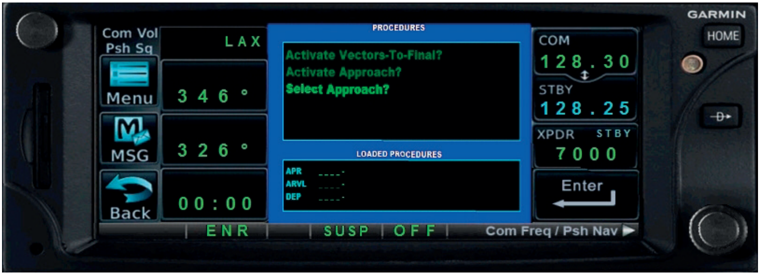
Flight Plan page

This page is used to make changes to the active GPS flight plan.

Selections can be made using the right inner and outer knobs. Changes can be confirmed using the **Enter** button.

The **Back** button will clear any inputs and/or return you to the previous page.

PROC page



This page is used to make changes to the GPS flight plan procedures, for example selecting an approach.

Selections can be made using the right inner and outer knobs. Changes can be confirmed using the **Enter** button.

The **Back** button will clear any inputs and/or return you to the previous page.

FUEL page

This page is used to input a new aircraft fuel quantity in pounds.

Click on a number button to begin the entry inputting process. Square brackets will appear to indicate which digit of the fuel quantity is currently being inputted. Pressing the **BKSP** (backspace) button will move one digit backwards. Once you have finished entering a new fuel quantity, press the **Enter** button to input the quantity. The fuel level will be instantly updated and balanced across the appropriate fuel tanks.

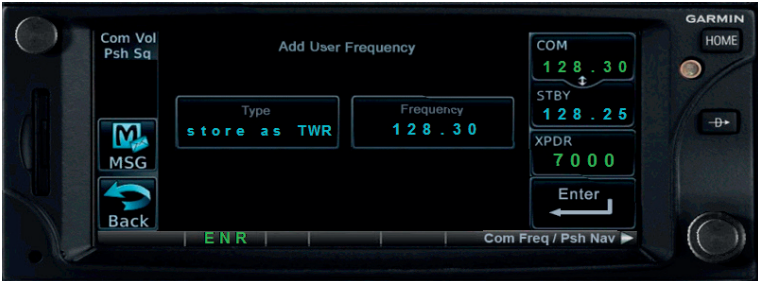
Pressing the **Full** button will automatically input the maximum quantity of fuel that the aircraft can hold.

Find Frequencies page

You can access this page by clicking the **Find** button in the left sidebar.

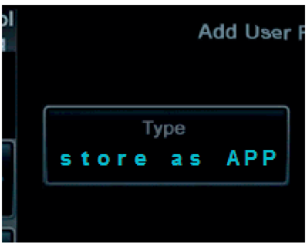
This page is used to select either the **User frequencies** (User) or **Add User Frequency** (Store) page.

Add User Frequency page



This page is used to store COM 1 or NAV 1 frequencies (from the standby slot) into the GTN 650 database. Up to nine COM 1 frequencies and nine NAV 1 frequencies can be stored in the database. These frequencies can then be recalled into the COM 1 or NAV 1 standby slot at any time in the future using the **User frequencies** page.

A frequency type can be selected for each frequency that is added to the database.



Left-click on the right inner knob to cycle through the available frequency types:

COM

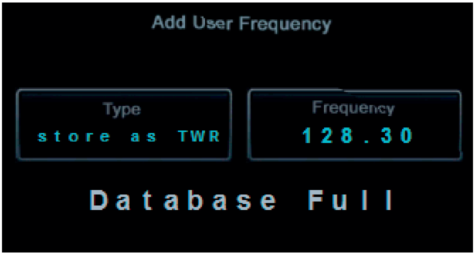
- TWR
- GND
- ATS
- ATF
- APP
- ARR
- AWS
- CLR
- CTF
- DEP
- FSS
- RFS
- UNI

NAV

- LOC
- ILS

Right-click on the right inner knob to switch between storing a COM or NAV frequency.

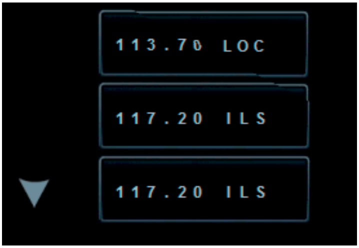
When you are ready to store the frequency, press the **Enter** button. A ‘Frequency Stored’ message will appear on the screen if the frequency has been successfully stored in the database. ‘Database Full’ will appear on the screen if you are attempting to add a new frequency with all nine COM 1 or NAV 1 slots already filled.



You can remove unwanted frequencies using the Flight Analysis tool (see page 147) outside of Flight Simulator.

User frequencies page

This page is used to recall the frequencies that you have stored in the GTN 650 database. Stored COM 1 frequencies will be displayed if COM mode is active, and stored NAV 1 frequencies will be displayed if NAV mode is active.



The nine frequency slots are displayed sequentially, in descending order from slot 1 to slot 9. White arrows will appear to the left of the frequencies list to indicate if there are additional frequencies preceding or following those that are currently shown. Click on the **Up** and **Down** buttons to cycle through the list.

'Memory empty' is displayed in any frequency slot that is not currently holding a frequency.

To recall a stored frequency into the standby frequency slot, simply click on the required frequency in the list. The frequency will be transferred to either the COM 1 or NAV 1 STBY slot.

SL30

1. **Left knob**

   This knob is used to control power to the SL30 unit. Left-click on the knob to toggle the power on/off.

2. **Flip-flop**

   This button is used to transfer the COM 2 standby frequency into the COM 2 active frequency slot, or the NAV 2 standby frequency into the NAV 2 active frequency slot, depending on which mode is selected.

3. **COM**

   This button is used to select COM mode. With COM mode active, as indicated by a green LED above the COM button illuminating, the active/standby COM 2 frequency can be altered using the right knob.

   The active COM 2 frequency is shown on the left and the standby COM 2 frequency is shown on the right, preceded by the letter ‘s’.

4. **NAV**

   This button is used to select the NAV mode. With the NAV mode active, as indicated by a green LED above the NAV button illuminating, the active/standby NAV 2 frequency can be altered using the right knob.

   The active NAV 2 frequency is shown on the left and the standby NAV 2 frequency is shown on the right, preceded by the letter ‘s’.

5. **SYS**

This button is used to select the system mode. With the system mode active, as indicated by a green LED above the SYS button illuminating, you can cycle through the SL30 system menus using the right knob. With SYS mode active, no other mode (COM, NAV or OBS) can be selected.

There are four menu categories with various options within each:

System Info

- Software Versions
- Low Display Intensity
- High Display Intensity

Nav Options

- Nav Audio Level
- Nav/Com Mix Level
- Additional CDI Info
- Display Ident over OBS

Comm Options

- RF Signal Level
- Com Noise Level
- Mic1 Squelch
- Mic2 Squelch
- Transmit Using…
- Intercom Level
- Sidetone Level
- Headphone Level

VOR Equipment Test

- Date of Last Test
- Type of VOR Test
- Location
- Bearing Error
- First Name
- Last Name

When SYS mode is first selected, the first menu category will be displayed – System Info. The right outer knob can then be used to cycle through the four menu categories. Pressing the **ENT** button will select the menu category and the right outer knob can then be used to cycle through the options within the category.

To exit SYS mode, press the SYS button a second time.

6. OBS

This button is used to select the OBS mode. With the system mode active, as indicated by a green LED above the OBS button illuminating, a VOR CDI will be displayed on the right side of the unit and the current OBS course setting will be displayed in the centre of the unit.

With OBS mode active, the right knob controls the OBS course setting and cannot be used to alter the COM 2 or NAV 2 frequencies. The right outer knob adjusts the course setting in tens (00-35) and the right inner knob adjusts in single degrees.

'---flagged---' text will appear in place of the VOR CDI if no valid VOR signal is being received by the NAV 2 radio.

The VOR CDI is shown as an aeroplane icon in the centre of the display. When you are operating on a radial that is more than 85 degrees off the OBS course setting, the aeroplane icon is replaced by a **+** (cross) icon. The CDI is shown as a bar graph of up to five pairs of short and tall bars, to the right or left of the aeroplane icon. Each of these pairs indicates two degrees of deflection. In order to remain on course, turn in the direction of the bars.

7. T/F

This button is used to enable to/from indications on the VOR CDI display. With the indications enabled, 'to' or 'from' will appear in the areas to the left or right of the VOR CDI.

8. ID

This button is used to toggle the NAV 2 audio output. With the NAV 2 audio output selected ON, as indicated by a green LED above the ID button illuminating, the Morse ident for the active NAV 2 frequency will be audible.

9. SEL

With the SYS and OBS modes inactive, the SEL button is used to select the frequency recall mode. Like the frequency database functionality on the GTN650, the SL30 can store both COM and NAV frequencies. The frequency mode that is currently selected (COM or NAV) when the SEL button is pressed will dictate which frequency list is displayed.

The frequency stored in slot 1 in the database will be displayed first, along with its type. The slot number currently being displayed is shown on the right side of the display, within square brackets. The right inner knob is used to cycle through the ten available slots, with the text 'Slot empty' appearing for any slot that does not currently hold a frequency.

Press the **Enter** button to recall the selected stored frequency into the standby frequency slot.

You can then press the flip-flop button to transfer the recalled frequency into the active slot.

To exit the frequency recall mode, press the **SEL** button again.

10. ENT

With the SYS and OBS modes inactive, the ENT button is used to select the frequency save mode. Ten COM 2 or NAV 2 frequencies can be stored in the SL30 database.

To store a frequency, make it the active frequency before pressing the **ENT** button to select the frequency save mode. Use the inner right knob to select the frequency type before pressing the **ENT** button a second time.

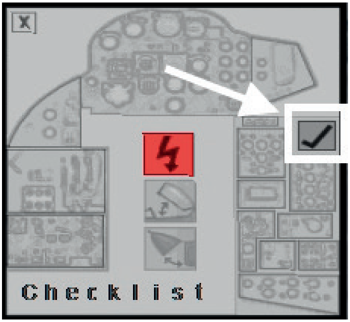
To exit the frequency save mode, press the **SEL** button.

11. Right knob

If the knob does not serve a special purpose on the selected mode, it can be used to alter the standby COM 2 or NAV 2 standby frequency. The outer knob increases/decreases the whole numbers, and the inner knob increases/decreases the fractions.

INTERACTIVE CHECKLIST

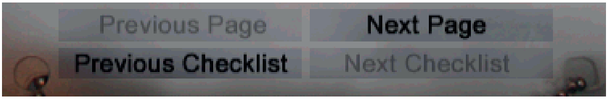
In addition to the checklists and reference data contained in this manual and the Operating Data Manual PDF, an interactive checklist is included in the aircraft as a 2D pop-up panel which can be accessed by clicking on the appropriate symbol on the panel selector.



In the top left corner of the panel is the name of the currently selected checklist, for example 'External' or 'Before Take-off'. The checklist page number is displayed in the top right corner.

The checklist items are displayed in the centre of the panel. When the panel is first opened, or when a new checklist is selected, the items will appear in red text. Click on the checklist item when you have completed the relevant action/check, and the item text will turn green to indicate that the item is complete.

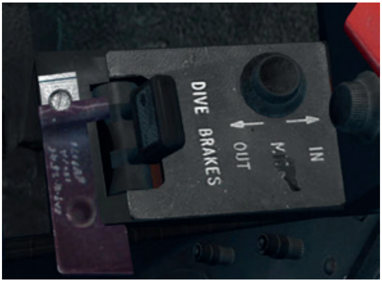
Located at the bottom of the panel are four buttons. These allow you to cycle through the available checklists and select the previous/next page of the selected checklist.
The button will be greyed out if it is not active.



VIRTUAL COCKPIT

Coaming

DIVE BRAKES switch



Left-click and hold before moving your cursor to drag this switch between the OUT, MID and IN positions.

The OUT position is guarded to prevent inadvertent selection. Left-click on the guard to slide it sideways before moving the switch to the OUT position.

IN – dive brakes retracted

MID – dive brakes extended halfway

OUT – dive brakes extended fully

FLARE DISPENSE

Left-click on the cover to open/close it and left-click on the spring-loaded button to push it in, dispensing flares from the aircraft.

EMERGENCY LIGHTS

Left-click on this switch to move it between the ON and OFF positions.

With the switch set to the ON position, the emergency battery will supply power to the cockpit lighting.

LOW ALT/HIGH ALT switch

Left-click on this switch to move it between the LOW ALT and HIGH ALT positions.

This switch controls the sensitivity of the aileron controls. Sensitivity is greater with LOW ALT selected and reduced with HIGH ALT selected.

AILERON CONTROL magnetic indicator

This magnetic indicator will display black when LOW ALT is selected and WHITE when HIGH ALT is selected.

PULL TO DEMIST lever

Left-click on this switch to move it between the IN and OUT positions.

This lever controls power to the windshield demisting.

RUDDER POWER FAIL lights (50% and 100%)

These lights indicate failures of the hydraulic supply to the rudder controls.

The amber 50% light comes on to indicate failure of either the primary or secondary power supplies.

The red 100% light comes on to indicate failure of both the primary and secondary power supplies.

Both lights can be tested by pushing them in (left-click).

CABIN PRESS FAIL light

This light will illuminate if the cabin altitude exceeds 34,000ft.

The light can be tested by pushing it in (left-click).

AILERON POWER FAIL light (50% and 100%)

These lights indicate failures of the hydraulic supply to the aileron controls.

The amber 50% light comes on to indicate failure of either the primary or secondary power supplies.

The red 100% light comes on to indicate failure of both the primary and secondary power supplies.

Both lights can be tested by pushing them in (left-click).

PRESS TO TEST buttons

These buttons can be pressed to test the fire warning lights. The left button tests the TANK FIRE light and the right button tests the PORT ENGINE and STBD ENGINE lights.

TANK FIRE light/button

The light on this button will illuminate red if a fire is detected in the fuselage/flare bay or the PRESS TO TEST button is pressed. If a fire is detected, the button can be pushed to fire the extinguisher bottles.

PORT ENGINE light/button

The light on this button will illuminate red if a fire is detected in the port engine or the PRESS TO TEST button is pressed. If a fire is detected, the button can be pushed to fire the extinguisher bottles.

STBD ENGINE light/button

The light on this button will illuminate red if a fire is detected in the starboard engine or the PRESS TO TEST button is pressed. If a fire is detected, the button can be pushed to fire the extinguisher bottles.

Main Panel (primary instruments)

Mach meter

This gauge displays Mach between a minimum of 0.5 and maximum of 1.0.

Airspeed indicator

This gauge displays indicated airspeed (in knots) between a minimum of 40kts and a maximum of 600kts.

The gauge has two scales and two needles. The smaller needle corresponds to the inner scale (0 to 600), indicating hundreds of knots. The larger needle corresponds to the outer scale (0 to 9), indicating tens of knots.

Horizon Gyro Unit (HGU) and slip ball

The HGU displays aircraft bank and pitch. The white horizon line moves up and down the gauge face to indicate current pitch and the gauge face rolls left and right to indicate current bank.

A blue and green bar is connected to the white horizon line, symbolising the sky and ground. Bank angle can be read using the white arrow at the bottom of the gauge face, which corresponds to the white markings on the bezel.

The HGU is powered from inverter No. 2 with inverter No. 1 as a standby. Failure of the power supply to the instrument is indicated by an OFF flag on the face of the instrument. A fast erection button for use with the instrument is adjacent.

A conventional slip ball is located below the HGU.

Altimeter

This gauge displays barometric altitude. A needle rotates around the gauge corresponding to an outer scale which indicates altitude in hundreds of feet (and values in between). An inner set of counters rotates to indicate tens of thousands, thousands and hundreds of feet.

Red and white hatched lines appear over the tens of thousands counter if the altitude is less than zero. Black and white hatched lines appear over the tens of thousands counter if the altitude is less than 10,000ft.

A barometric pressure window displays the currently selected pressure setting in millibars. The pressure setting can be changed using the knob on the bottom left of the gauge.

The knob on the bottom right of the instrument allows manual selection of the standby ‘S’ or servo ‘R’ mode of operation. Refer to page 120 for a more detailed description of this function.

A red STBY flag will appear if the standby mode of operation is selected or power to the gauge has failed (supplied by inverter No. 6).

Standby attitude indicator

This gauge is a conventional attitude indicator, showing bank and pitch.

To cage the indicator, press (left-click) the knob at the bottom right comer of the gauge.

A red flag appears between the 30° and 60° positions while the knob is pressed. Power supply to the indicator is 28-volt DC and is controlled by the STANDBY/NORMAL switch above the indicator. If the normal supply fails, a red and black failure indicator appears in the display; setting the switch to STANDBY connects the indicator to the emergency battery.

VOR 1

This GI-106A is driven by the active NAV 1 frequency, which can be tuned into the GTN 650, or driven by the GPS.

The gauge consists of a compass card, deviation needles (localiser and glideslope) and red fail flags to indicate either a power failure or a lack of valid VOR/glideslope signal. The gauge is powered by inverter No. 2.

OBS/course can be altered using the knob to the bottom left of the gauge.

The VLOC light will illuminate if the gauge is being driven by NAV 1 and the NAV light will illuminate if the gauge is being driven by the GPS.

VOR 2

This GI-106A is driven by the active NAV 2 frequency, which can be tuned into the SL30.

The gauge consists of a compass card, deviation needles (localiser and glideslope) and red fail flags to indicate either a power failure or a lack of valid VOR/glideslope signal. The gauge is powered by inverter No. 2.

OBS/course can be altered using the knob to the bottom left of the gauge.

Horizontal situation indicator (HSI)

This HSI is driven by the active NAV 1 frequency, which can be tuned into the GTN 650, or driven by the GPS.

The gauge consists of a compass card, deviation needles (localiser and glideslope) and red fail flags to indicate either a power failure or a lack of valid VOR/glideslope signal. The gauge is powered by inverter No. 2.

A counter in the top left indicates the distance (in nautical miles) to the VOR tuned into NAV 1 or the next GPS waypoint. A counter in the top right indicates the currently selected course value.

A green arrow points to the VOR tuned into NAV 1 or the next GPS waypoint.

OBS/course can be altered using the knob to the bottom right of the gauge. Heading can be altered using the knob to the bottom left of the gauge.

Refer to the RADIO EQUIPMENT section on page 122 for a more detailed description of this gauge.

Vertical speed indicator (VSI)

This gauge is a conventional VSI, indicating vertical speed in feet per minute between a minimum value of -4,000ft/min and a maximum value of +4,000ft/min.

Mk 4B Compass

The Mk 4B compass consists of a rotating compass card, heading selector knob (bottom left) and bug/arrow and compass annunciator knob (bottom right).

The compass card will rotate to indicate the current magnetic heading at the top of the gauge, under the white lubber line.

The SET HEADING knob is used to control the position of the heading bug/arrow.

The compass annunciator knob is spring-loaded to the centre position and can be rotated clockwise or anti-clockwise using left and right clicks. This knob serves no function in this aircraft.

Radio altimeter

This gauge indicates the height of the aircraft above ground level.

The gauge has two range scales, 0 to 500ft and 0 to 5,000ft. The range scale can be selected using a switch on the radio altimeter control unit (described later).

An OFF flag will be visible at the top of the gauge when either the ON/OFF switch located on the radio altimeter control unit is set to OFF or inverter No. 6 is off.

Trim position indicator

This gauge indicates the position of the tail, rudder and aileron trim as well as the position of the airbrakes (dive brakes).

Autopilot heading selector

The heading selector is comprised of a compass repeater, course setting knob (bottom right) and pre-select turn engagement button (top left). Courses can be pre-selected on the heading selector and the aircraft will turn on to the selected heading when the pre-select turn button is pressed.

The compass card will rotate to indicate the current magnetic heading at the top of the gauge, under the white lubber line.

Parking brake

The parking brake can be engaged by left-clicking on this lever. It can be released with a second left-click.

Main Panel (control column)

You can toggle the visibility of the control column by clicking on the green base of the column, where it meets the cockpit floor. Click once to hide the control column, and click a second time to show it again.

Camera switch and guard

Left-click on the guard before left-clicking on the switch to move it between the ON (left) and OFF (right) positions.

This switch was used to operate the F95 aerial reconnaissance camera. It serves no function in this aircraft.

Push-to-transmit button

Left-click on this button to push it in. When pushed, the FSX ATC window will appear.

Tail trim rocker switch

Left-click on this rocker switch to trim nose-up and right-click to trim nose-down.

Main Panel (engine instruments)

Fuel flow gauges

These gauges indicate the current fuel flow into either engine in pounds per minute (x10), from a minimum value of 0 to a maximum value of 150 lb/min.

This gauge is powered by inverter No. 2.

RPM gauges

These gauges indicate the current engine RPM in percent, from 0 to 100%.

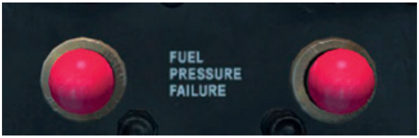
Small inset gauges indicate in the range 0 to 10% RPM.

Jet pipe temperature (JPT) gauges

These gauges indicate the jet pipe temperature for each engine in degrees Celsius (x100) between a minimum value of 0°C and a maximum value of 800°C.

These gauges are powered by inverter No. 2, with No. 1 as a standby.

FUEL PRESSURE FAILURE lights



These lights will illuminate red if, for any reason, the fuel delivery pressure from the LP pumps to either engine falls appreciably below normal.

OIL PRESSURE FAILURE magnetic indicators

These show black when the oil pressure is 20 PSI or above and white when it is below 20 PSI.

GENERATOR FAIL lights

These lights illuminate red to indicate that the engine-driven generators are offline.

BUSBAR VOLTS gauge

The volt meter indicates the output of whichever supply is connected to the electrical system busbar:

- Generators online – 28 volts
- Aircraft battery – 24 volts
- External supply – 28 volts

Main Panel (other)

DUMP VALVE light

This light illuminates amber when the cabin pressure dump valve is open.

RADIO ALT LIMIT lights

These lights indicate deviation from the height selected using the LIMIT SELR knob on the radio altimeter control unit.

The amber light will illuminate if you are above the selected height, the green light will illuminate if you are at the selected height and the red light will illuminate if you are below the selected height.

ELEVATOR SERVO LOAD indicator

This indicator is used to gauge the amount of load being placed on the elevator servo by the autopilot. If the aircraft is correctly trimmed, the white square will be located within the white CORRECT A/C TRIM band. If forward elevator trim is required the white square will be located to the right of the CORRECT A/C TRIM band, and if rearward elevator trim is required the white square will be located to the left of the CORRECT A/C TRIM band.

READY/ENGAGED magnetic indicators

READY magnetic indicator

This is a repeater of the READY magnetic indicator found on the autopilot switch unit.

ENGAGED magnetic indicator

This is a repeater of the IN magnetic indicator found on the autopilot switch unit.

OXYGEN magnetic indicators

NAVIGATORS OXYGEN magnetic indicator

This displays the flow of oxygen through the navigator's oxygen regulator.

PILOTS OXYGEN magnetic indicator

This is a repeater of the oxygen flow magnetic indicator found on the oxygen regulator panel.

MARKER lights

These lights illuminate when the aircraft passes over the marker beacons or the LAMP TEST switch is set to ON (up).

The blue light indicates the outer marker, the amber the middle marker and the white indicates an airways marker.

LAMP TEST switch

Left-click on this switch to move it between the down (off) and up (on) positions.

Moving the switch to the up (on) position will cause the three marker lights to illuminate.

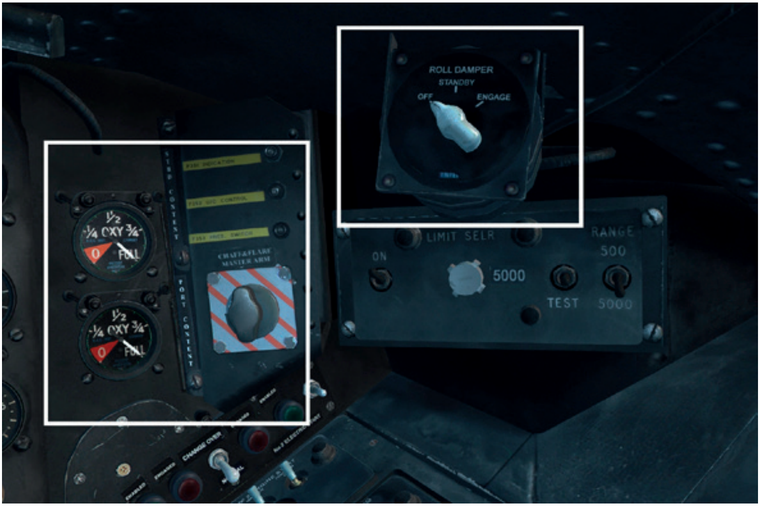
STANDBY INVERTER magnetic indicator

This magnetic indicator will display white if inverter No. 2 is offline, indicating that inverter No. 1 is running.

RESET No. 2 INVERTER button

If No. 2 inverter fails, and the failure is due to a temporary overload or faulty shutdown, it may be possible to restart it by a RESET No. 2 INVERTER push-switch on the flight instrument panel.

Right Panel



Oxygen quantity gauges

These gauges display the quantity of oxygen contained within the cylinders located in the starboard and port wings.

CHAFF & FLARE MASTER ARM knob

Left-click to rotate this knob clockwise or anti-clockwise.

This knob is used to arm the chaff and flare dispensing system.

ROLL DAMPER knob

Left-click – rotate knob clockwise

Right-click – rotate knob anti-clockwise

This knob controls the power to the roll damper system. The yaw damper system will be engaged when the knob is placed in the ENGAGE position.

The yaw damper is powered by inverter No. 2, with No. 4 as a standby.

Radio Altimeter Control Unit

ON/OFF switch

Left-click on this switch to move it between the OFF and ON positions.

This switch controls power to the radio altimeter. Inverter No. 6 must be online before the radio altimeter can be switched on.

LIMIT SELR knob

Left-click – rotate knob clockwise

Right-click – rotate knob anti-clockwise

This knob is used to set a height limit for use with the radio altimeter limit lights, from a minimum value of 50ft to a maximum value of 5,000ft.

TEST switch

Left-click on this switch to move it between the OFF and ON positions.

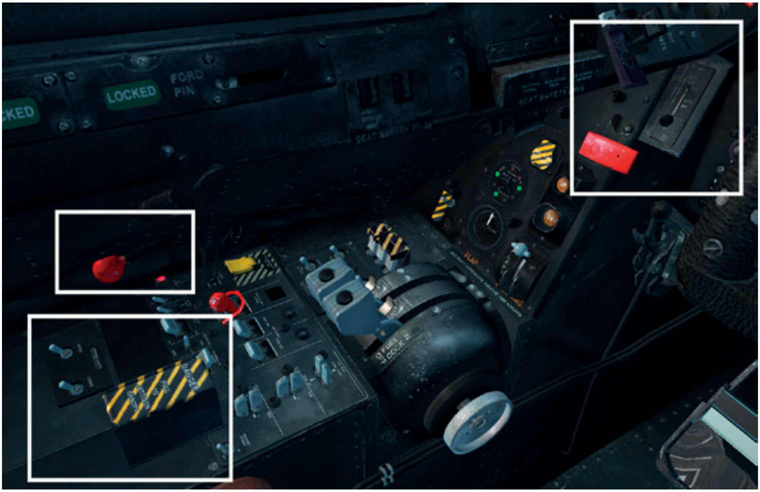
Move this switch to the ON position to test the radio altimeter gauge. The needle will move around the entire range of the gauge.

RANGE switch

Left-click on this switch to move it between the 500 and 5000 positions.

This switch controls which of the two height range scales (0 to 500ft and 0 to 5,000ft) is used on the radio altimeter. When 5000 (ft) is selected, the windows beside the 100, 200, 300, 400 and 500 markings on the radio altimeter will display a ‘0’ to indicate the new range.

Left Panel



AUTOSTABILISER lever

Left-click – move lever downwards

Right-click – move lever upwards

This lever controls power to the rudder autostabiliser system. The lever should be moved from the OFF to the STDBY position, left in this position for at least five seconds, and then moved to the ON position.

The autostabiliser is powered by inverter No. 2, with No. 1 as a standby.

Emergency gear release lever

Left-click on this switch to move it between the OUT and IN positions.

Pulling the handle fully out operates the selector valve mechanically to the ‘down’ position and also opens the emergency down selector valve. After pulling the handle, the landing gear lowers immediately if the fault is due to electrical failure of the selector valve, but if the failure is hydraulic the hand-pump must also be operated to pump fluid through the emergency selector valve to lower the landing gear.

FLARE bay DOORS EMERGENCY CONTROL lever

If the hydraulic system fails, the flare doors may be operated by the hand pump with normal selections on the flare doors control switch. However, avoid this procedure unless it is vital, as subsequent landing gear lowering and wheel braking may be prejudiced due to lack of hydraulic fluid.

If the flare doors selector fails to operate electrically, it can be moved mechanically to the ‘open’ position by pulling down on a gated lever on the cockpit left wall. However, if the flare doors are opened in this way, they cannot be closed again until after maintenance.

STROBE LIGHTS switches

Left-click on these switches to move them between the RED, OFF and WHITE positions.

One switch operates the strobe light located on the top surface of the centre fuselage and the other operates the strobe light on the underside of the centre fuselage.

Canopy jettison control

Left-click on the jettison canopy guard to open/close it.

Left-click on the jettison canopy lever to pull it out/push it in.

With the lever in the pulled position the canopy will be jettisoned.

Canopy handles

If the canopy is raised/open, left-click on either canopy handle to lower it back to the closed position. Please note that the handles cannot be used to raise/open the canopy; for this the canopy lift switch must be used.

Hydraulic system hand pump

Left-click on the spring-loaded hand pump to push it forwards. Each push of the hand pump will draw fluid from the hydraulic reservoir in order to supply pressure to operate the flare bay doors, wheelbrakes and landing gear in case of normal hydraulic pressure failure.

Please refer to the information in the **Hydraulic systems failures** section on page 160.

Rudder FEEL SIMULATOR hydraulic pressure gauges PRIMARY (forward), SECONDARY (aft)

These gauges indicate the operating pressure of the hydraulic feel simulators. This system applies an artificial feel, proportional to altitude and airspeed, to the rudder control.

Correct operating pressure with the engines running is between 160lb and 200lb.

ELECTRICAL SYSTEM

DC supply

Generators – Power for the electrical, instrument and radio equipment is initially supplied by two 12kW engine-driven generators, which are also used for charging the aircraft battery. These generators are located in the inboard leading edge of each wing.
Output of each generator is maintained at 28 volts. Each generator has an ON/OFF switch and circuit breaker located on the right cockpit console. A warning light for each generator is located on the main cockpit panel, below the engine instruments.
These lights will illuminate when the generators are offline. The generators cut in at engine speeds of 23% RPM and cut out at slightly below this figure. Full output is available at 35% RPM and above.

Aircraft battery – The aircraft is fitted with a 24 volt lead acid battery located in the left equipment bay. The battery is controlled by a guarded AIRCRAFT BATTERY switch on the take-off panel. When this switch is set to ON, the battery is connected to the busbar. When the switch is set to OFF, the battery is isolated from all electrical circuits except for the canopy locking pins control circuit and the cabin pressure dump system.

External supply – An external supply plug is located in the right equipment bay. The plug is connected directly to the busbar and all electrical services connected to the busbar can be operated from the external supply. The aircraft battery switch must be set to OFF before the external supply is connected.

Voltmeter – A DC voltmeter is located on the main instrument panel, below the engine instruments. The voltmeter indicates the output of whichever supply is connected to the electrical system busbar:

- Generators online – 28 volts
- Aircraft battery – 24 volts
- External supply – 28 volts

Emergency battery – A 24 volt battery is situated next to the aircraft battery in the left equipment bay. It is completely independent of the main electrical system and can supply the following systems:

- Emergency lighting – connected by a switch on the right side of the coaming
- Standby attitude indicator – connected by selecting STANDBY on the switch located above the standby attitude indicator
- Communications system

AC supply

DC supply is converted to AC by five rotary inverters and four static inverters.

No. 2 inverter – The output of No. 2 inverter is 3-phase AC at 115 volts, 400Hz. No. 2 inverter supplies the following instruments:

- Jet Pipe Temperature (JPT) indicators*
- Rudder autostabiliser*
- Horizon gyro unit*
- Heading selector*
- Mk 4B compass*
- Radio compass
- Horizontal Situation Indicator (HSI)
- Aileron roll damper
- Fuel flow meters
- VOR gauges

No. 1 inverter – The output of No. 1 inverter is 3-phase AC at 115 volts, 400Hz. It acts as a standby for No. 2 inverter but only supplies AC to items of a transferable load, which are marked with an asterisk above.

No. 4 inverter – No. 4 inverter supplies 3-phase AC at 115 volts, 400Hz to the JPT controllers. No. 4 inverter is controlled by the No. 2 engine start master switch, i.e. switch ON, inverter running. If No. 2 inverter fails, No. 4 inverter automatically takes over to supply the aileron roll damper.

No. 6 inverter – No. 6 inverter is controlled by an ON/OFF switch on the pilot's right-hand switch panel and supplies single-phase AC at 115 volts, 400Hz to the radio altimeter.

No. 1 and No. 2 inverter controls

Normal controls and failure indicator – No. 1 inverter is started when the No. 1 master starting switch is selected ON. No. 2 inverter starts up when either generator is connected to the busbar. Provided that the INVERTER SELECTOR switch is set to No. 2, No. 1 inverter closes down but is automatically available for the transferable load should No. 2 inverter fail. When No. 2 inverter is running normally, a STANDBY INVERTER magnetic indicator (MI) on the flight instrument panel shows black; the MI shows white if No. 2 inverter closes.

Inverter selector switch – With No. 2 inverter running, No. 1 inverter may be restarted to supply the transferable load by selecting No. 1 on the No. 1/ No. 2 INVERTER SELECTOR switch on the right console, if it is suspected that the voltage and frequency of No. 2 inverter have drifted outside the limits required for the proper functioning of the instruments and systems it supplies. AC voltage and frequency meters are fitted to check this drift accurately. Starting No. 1 inverter in this way still allows No. 2 inverter to supply the non-transferable load, whilst the aileron roll damper supply is transferred to No. 4 inverter.

No. 2 inverter reset switch – If No. 2 inverter fails, and the failure is due to a temporary overload or faulty shutdown, it may be possible to restart it with the RESET No. 2 INVERTER push-switch on the flight instrument panel.

No. 2 inverter ground test switch – For ground testing, No. 2 inverter may be started by the GROUND TEST SWITCH on the pilot's lighting panel, when set at TO TEST.

AC voltage and frequency meters – An AC voltmeter and a frequency meter for No. 1 and No. 2 inverters are on the right console; a guarded No. 1/ No. 2 INVERTER VOLT AND FREQUENCY switch is adjacent. The voltage and frequency of whichever inverter is selected on the switch are shown on the meters. The AC voltage/frequency limits are 115 volts, 400 Hz.

Normal operation

Before starting the engines

An external power supply is normally used for starting. The aircraft battery switch must be OFF before connecting the external power supply. Set the generator switches ON and close their circuit breakers. Select No. 2 inverter on the INVERTER SELECTOR switch and select No. 6 inverter to the OFF position as appropriate.

Starting the engines

When the No. 1 engine start master switch is switched ON, No. 1 inverter cuts in; this can be checked aurally and by the STANDBY INVERTER MI, which should show white. When the No. 2 engine start master switch is selected ON, No. 4 inverter cuts in. During start-up the generators should cut in at 23% RPM and the generator failure warning lights should go out. As soon as either generator comes online, No. 2 inverter starts up, No. 1 inverter stops and the transferable load items are switched from No. 1 and No. 4 inverters to No. 2 inverter.

Before flight

After starting the engines, disconnect the external power supply and switch the aircraft battery ON. Generator output should be shown as 28 volts on the DC voltmeter. It may be necessary to open the throttles to 35% RPM to achieve this. No. 2 inverter should have taken over from No. 1 and the STANDBY INVERTER MI should be black. Check the voltage (115v) and frequency (400Hz) of No. 2 inverter by selecting No. 2 on the meter selector switch.

FUEL SYSTEM

Fuel tanks

Fuselage tanks – Six fuel tanks are in the centre fuselage: five in the upper fuel bay (the four forward of the main spar are referred to as Nos. 1 to 4 or 'top' tanks, and the one aft of the spar is referred to as No. 5 or 'rear' tank) and the sixth below the top tanks (referred to as No. 6 or 'belly' tank).

A collector box at the rear of the belly tank serves the top tanks and the belly tank. Flush-fitting filler caps, one for each of the top tanks and the rear tank, are on the right upper surface of the fuselage. The filler cap for the belly tank is on the right side of the fuselage beneath the wing. All tanks are vented through a common pipe terminating at a short stub pipe on the fuselage under the right tailplane.

Wing integral tanks – An integral tank, divided into interconnected outboard and inboard compartments, forms part of the structure of each wing, outboard of the engine. Each compartment has an electrically heated vent valve and a flush-fitting filler cap on its upper surface. A switch controlling the vent valve heaters is on the take-off panel.

Fuel capacity

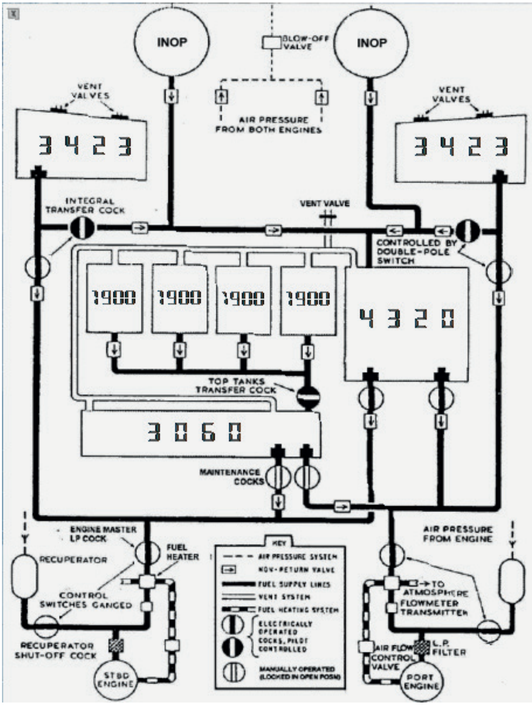
Five capacitor-type gauges, calibrated in pounds, are on the fuel gauge panel. The three gauges at the forward end of the panel indicate, from left to right, the contents of the left integral tank, the belly tank and the right integral tank. The centre gauge indicates the total contents of the top tanks, and the rear gauge the contents of the rear tank.

Tank name	Gallons (imperial)	Pounds (SG 0.8)
Top tanks	960	7,680
Rear tank	540	4,320
Belly tank	417	3,336
Wing tanks	856	6,848
Total	***2,773***	***22,184***

Flow meters

There are two flow meters on the engine instrument. The flow meters on the engine instrument panel indicate the instantaneous rate of fuel flow in pounds per minute. The flow meters are operated by DC and AC; the AC is supplied by No. 2 inverter.

Fuel cocks



Top tanks cock – An electrically actuated cock, controlling the gravity flow of fuel from the top tanks to the belly tank collector box, is controlled by a guarded ON/OFF switch beside the top tanks contents gauge on the fuel gauge panel.

Rear tank cocks – An electrically actuated isolation cock is in the fuel delivery line from the rear tank to each engine. The actuators are controlled by two switches on the fuel gauge panel. The cocks should normally be open when fuel is available in the rear tank. When the tank is empty they should be shut to prevent air being drawn into the fuel system.

Engine master LP (low pressure) cocks and recuperator cocks – An electrically actuated engine master LP cock is in the main fuel line to each engine. An electrically actuated recuperator shut-off cock is in the fuel line between each recuperator and its associated engine. The engine master cock and recuperator shut-off cock are opened or shut together by operating ganged switches (left or right) on the take-off panel labelled ENGINE – ON/OFF.

Wing (integral) tanks LP and transfer cocks – Two electrically actuated cocks are in the fuel lines from each integral tank, one controlling the delivery of fuel to the engine and the other controlling the transfer of fuel to the rear tank. On each side, the two cocks are interconnected and controlled by a WING – NORMAL/ TRANSFER TO REAR TANK switch on the take-off panel. When the switch is at NORMAL, the LP cock is open and the transfer cock is closed; when the switch is at TRANSFER, the LP cock is closed and the transfer cock is open. When transferring integral tank fuel to the rear tank, the appropriate integral tank LP pump must be ON.

Recuperators

Two fuel recuperators, one for each engine, compensate for negative G conditions affecting the supply of fuel to the engines.

Each recuperator is comprised of a flexible bag within a casing, the bag being connected to the engine fuel supply line. Air is fed from the engine compressor to the casing so that it acts on the outside of the bag at a constant pressure. The pressure from an LP fuel pump is greater than this air pressure so when an LP pump on the same side is running, the bag is charged with fuel. If the LP pump ceases to deliver fuel due to negative G conditions, or for any other reason, the air pressure collapses the bag and discharges its contents through the shut-off cock to the engine. The recuperator is recharged as soon as an LP pump delivers fuel again.

The supply of fuel from each recuperator feeds an engine for about 10 to 12 seconds at full power at sea level.

Fuel feed to the engines

Fuel is delivered to the engines from the rear tank, the belly tank collector box and the wing (integral) tanks by six electrically operated LP fuel pumps – two in the rear tank, two in the belly tank collector box and one in each integral tank. The pumps on the left side feed No. 1 engine through the left master LP cock and, similarly, the right pumps feed No. 2 engine. The fuel in the integral tanks may also be transferred to the rear tank. Fuel from the top tanks is fed under gravity to the belly tank collector box. Each LP fuel pump is controlled by a suitably labelled switch on the fuel gauge panel.

Fuel pressure warning lights

Two fuel pressure warning lights (FPWL), one for each engine, are on the engine instrument panel. They come on if, for any reason, the fuel delivery pressure from the LP pumps falls appreciably below normal.

Fuel heaters

On each side of the fuel system, after passing through the engine master LP cock, fuel flows through a heater before passing through an LP filter on the engine. Hot air for the heaters is obtained from the engine compressors, the flow to each heater being automatically controlled by an electrically actuated differential pressure switch which is sensitive to a pressure drop across the associated filter. Thus, if ice crystals in the filter cause a pressure drop, hot air is automatically supplied to the fuel.

Fuel management

Bear the following in mind when deciding in which order to use the tanks:

a. The centre of gravity (CG) of the aircraft without fuel is usually beyond the aft limit, and this is adjusted by the addition of fuel. If the CG is close to the aft limit, indiscriminate use of fuel may easily result in the CG moving beyond the aft limit. This is avoided if the recommended fuel drill is followed. In the last two stages of the fuel drill, however, the CG moves towards the aft limit.

b. It is therefore important to use a large percentage of the fuel from the rear tank early in the flight. It may be emptied completely, provided that when it is empty the rear tank cocks are selected OFF; this avoids the possibility of air being sucked into an engine fuel system and causing a flame-out following a belly tank LP pump failure.

c. The integral tanks' fuel must be retained, for structural considerations, until the appropriate stage of the fuel drill is reached. However, use approximately 300lb fuel from the integral tanks during take-off and initial climb in order to overcome fuel venting. When the integral tank fuel falls to a low level (about 500lb per side) its delivery to the engine may become uncertain and it is therefore safer to transfer this amount to the rear tank while this tank still contains fuel and is being used. This reduces the chance of the CG moving aft, as it does if the fuel is simply transferred into the rear tank when this tank is not in use.

d. Set the top tanks cock ON before take-off and leave on throughout the flight. If it is switched OFF there is a possibility that it might not open in flight when required, due to electrical failure or icing up of the cock, and the top tank's fuel would not be available.

e. When any LP pump change-over is to be made during flight, switch ON the required pump before switching OFF the pump which is no longer required. When a tank is empty, switch its pumps OFF, although no harm will result if they are left running for a short time.

Checks before starting

Before starting the engines, switch the master LP cocks ON and leave the rear tank cocks OFF. Set the integral tanks combined LP and transfer cock switches to NORMAL. Switch ON the rear tank LP pumps and check that the FPWL remain on. Switch the rear tank cocks ON and check the FPWL go out. Switch the rear tank LP pumps OFF, then check each of the other LP pumps aurally and against the FPWL; leave the pumps OFF.

Checks after starting

After starting, with only the belly tank pumps switched ON, check that the FPWL are out and the flow meters are reading. Switch OFF the pumps and check that the FPWL are on and that the flow meters read zero. Then switch ON the rear tank and integral tank pumps, and check the FPWL and flow meters as before. Leave the belly and integral tank pumps ON for taxiing.

Recommended fuel drill

Please refer to the fuel management drill in the Checklists section of the manual.

1. Use the belly tank fuel for start-up and taxiing; this confirms that fuel is feeding from this tank and minimises fuel seepage through the belly tank filler cap which can cause misting of the centre and rear camera windows. Also switch ON the integral tank pumps for taxiing.
2. Use all tanks for take-off and initial climb, and switch OFF integral tank pumps when these tanks show a drop.

   Note: *When climbing from low altitude at high RPM, it is advisable to have two LP pumps ON per engine to ensure adequate fuel delivery. If this becomes necessary during stage 5 of the fuel drill, it is recommended that one belly tank pump and one rear tank pump per engine are selected ON in addition to the integral tank pumps. If the rear tank gauge reading drops to 500lb, switch ON the second belly tank pump and then switch OFF the rear tank pump.*
3. When the top tank gauge reads 6,000lb, switch OFF the belly tank pumps.
4. When the rear tank gauge reads I,000lb, switch ON the belly tank pumps and switch OFF the rear tank pumps.
5. When the top and belly tank gauges read a combined total of 3,000lb, switch ON the integral tank pumps and switch OFF the belly tank pumps.
6. When the integral tank gauges read 500lb each, switch ON one rear tank pump to feed one engine and one belly tank pump to feed the other engine. Transfer fuel from the remaining integral tanks to the rear tank. When the integral tanks are empty, switch OFF their pumps but leave their cocks at TRANSFER to prevent fuel aeration if a belly tank pump subsequently fails.

   WARNING: *When fuel is low in any tank in use, switch on additional pumps.*
7. Procedures for landing – In order to allow for an overshoot followed by an instrument approach and landing, land with at least 1,750lb fuel in the belly and top tanks combined. If fuel remains in the rear tank, then both belly and rear tank pumps are to be ON for landing.

Reduced fuel loads

If the aircraft is to be flown with less fuel than the maximum, the quantity must be distributed in the tanks in accordance with the loads shown in the right-hand columns of the fuel management drill. After take-off, select the tanks as per stage 4 of the fuel drill and follow the drill from then on. Note that the fuel in the rear tank may fall below 1,000lb due to use during take-off and initial climb; this is acceptable. As a general guide to fuel distribution when less than maximum fuel is to be carried, observe the following priorities:

a. Full integral tanks, 1,000lb in the rear tank, and full belly tank are essential.

b. Further fuel may be carried in the top tanks up to a maximum of 6,000lb.

c. Fuel additional to **a** and **b** above should be added to the 1,000lb in the rear tank, e.g. If only 16,000lb of fuel is required, it should be loaded as follows:

    - 6,848lb in the integral tanks
    - 3,336lb in the rear tank
    - 3,336lb in the belly tank
    - 4,816lb in the top tanks

ENGINE SYSTEMS

Avon Mk 206 engine

The Avon Mk 206 is a turbojet aero-engine which features a 15-stage axial flow compressor directly coupled to a two-stage turbine. It develops a nominal 11,250lb static thrust at sea level.

Engine fuel system

Fuel from the main fuel system is delivered to the HP fuel pump through a filter and the pump output is fed to the burners through a fuel-cooled oil cooler and a fuel flow control unit.

The HP fuel pump consists of two variable-stroke pumps contained within a common housing. Either pump of the dual unit is capable of delivering sufficient fuel for approximately 100% RPM to be obtained. The output of the pump is controlled by a servo system in response to signals from an engine speed governor and the flow control unit.

Inlet guide vanes

The first row of stator blades in the engine consists of variable-incidence inlet guide vanes (IGV) which assist in imparting swirl to the incoming air. At low RPM the first stages of the compressor deliver more air than is acceptable to the later stages.
To prevent surge, surplus air is bled off from the seventh stage of the compressor through an air bleed valve and the IGV are at the closed (+25°) position to give an angle of flow acceptable to the first-stage blades at low RPM. The IGV operating ram and the air bleed valve are both controlled by HP pump delivery fuel pressure, but the air bleed valve control cannot operate until the IGV ram has started to move from the closed position. As the normal flight range of RPM is reached, the air bleed valve is closed and the IGV move progressively to the open (minus 10°) position and produce a minimum of swirl.

The IGV are set to leave the closed position at 82.5% RPM on acceleration and leave the open position at 93.5% RPM on deceleration. The air bleed valve should close on acceleration and open on deceleration at 83.5% RPM.

Throttle/HP cock controls

The throttle valve and HP cock of each engine are combined in one unit which is operated by its associated throttle lever in the engine controls quadrant. With the lever fully back in the gated position (labelled FUEL COCK ON/ OFF) the fuel supply to the burners is cut off; when the lever is moved just forward of the gate, sufficient fuel is fed through the throttle valve to maintain idling RPM. A spring-loaded latch on the throttle lever, when lifted by right-clicking on the lever when in the idle position, allows the lever to be moved out of, or returned to, the gated position. Each lever incorporates an engine relight button.

Engine starting and relighting system

General

Starting is effected by an electrically driven starter which accelerates the engine to a self-sustaining speed and two high-energy igniter plugs which initiate combustion. The high-energy spark is provided by an ignition unit which boosts the normal supply and discharges it to the igniter plugs. The engine starter panel is wired so that the starter and ignition unit can be energised separately for motoring the engine on the ground and for relighting in flight.

Starting controls

The main starting controls are on the engine starter panel and, for each engine, consist of a START MASTER switch, an IGNITION switch and a STARTER button. The start master switch must be ON before either the starter button or the ignition switch is operative. Additionally, there is an electric start control panel forward of the engine starter panel. The electrical start master for the respective engine must be switched ON before the electric starters can be used.

Ground starting

With the electrical start control panel set for starting with the respective engine Enable switch set to ON, press the starter button on the engine start panel for the selected engine. This initiates the following sequence:

a. The starter motor will start to rotate the engine, with the Start Enabled light lit and the Motor Engaged light lit.

b. The starter motor accelerates the engine rotating assembly and at the same time the high-energy igniter plugs are operated.

c. At 13% RPM open the HP cock. The engine will accelerate towards idling RPM. 25 seconds into the sequence, the Motor Engaged light will extinguish. The Start Enabled light will remain illuminated.

d. When idling RPM of 33% is achieved, the electric start control panel master should be turned off.

Relighting in flight

With the engine start master and ignition switches ON, pressing the relight button bypasses the normal starting sequence and energises the ignition unit which, in turn, operates the high-energy igniter plugs to ignite the fuel spray.

Jet Pipe Temperature (JPT) control

A 2-datum JPT control monitors fuel flow in each engine to limit the maximum permissible JPT to 750°C and the maximum continuous cruise temperature to 705°C. Each engine system is controlled by an ON/OFF master switch and a two-position MAX/CRUISE switch by which the required condition is selected. All four switches are grouped together outboard of the engine controls quadrant. The systems are operated by AC which is supplied by No. 4 inverter.

Oil system

Each engine has its own independent integral oil system of 12 pints total capacity (7 pints usable). One pressure pump and four scavenge pumps maintain a continuous circulation through a fuel-cooled oil cooler and filter to the engine bearings and gears. The filling point is underneath the engine.

Two magnetic indicators (MI), one for each engine, are on the engine instrument panel. These show black when the oil pressure is 20 PSI or above and white when it is below 20 PSI.

Engine instruments

For each engine the instruments comprise a percentage-calibrated RPM indicator, jet pipe temperature gauge, fuel flow meter, fuel pressure warning light and an oil pressure MI, all on the engine instrument panel. All but the JPT gauge, fuel flow meter and RPM indicators are DC-operated. The JPT gauge is operated primarily by AC from No. 2 inverter with No. 1 inverter as a standby, and the flow meter by AC from No. 2 inverter. The RPM indicators are self-energising and independent of the electrical power supply.

Engine and fuselage bay fire extinguishers and warning lights

Five fire extinguisher bottles are fitted, one in the fuselage and two at each engine. The fuselage bottle serves the fuel tank and flare bays. The inboard bottle at each engine has a twin head so that it can be discharged into either the engine or the fuselage bays depending on which discharge button is used. A fault-free fire detection (FFFD) system is employed. This comprises three loops of firewire sensing elements, with each loop connected to a control box and a warning light. One loop is routed throughout each engine bay and one throughout the fuselage bays.

The power supplies for discharging the fire extinguisher bottles are DC and these are taken directly from the aircraft battery. The power supplies for the operation and testing of the fire detection circuits are DC and these are taken from the main busbar.

Two combined warning light/fire extinguisher buttons, one for each engine, are on the coaming above the engine instrument panel. A warning light comes on when a dangerous temperature rise takes place anywhere along a firewire in the associated engine bay. Pressing the appropriate button fully discharges the two associated fire extinguisher bottles into the affected engine bay. When the fire is extinguished, the light goes out and the detection circuit resets itself.

A combined warning light/fire extinguisher button for the fuselage bays is on the coaming above those for the engines. The button is inoperative; the operation of the fuselage and engine inboard extinguishers is automatic if a dangerous temperature rise takes place anywhere along the firewire loop in the fuselage bays. This occurrence is shown by the warning light coming on. When the fire is extinguished, the warning light goes out and the detection circuit resets itself.

The fire detection circuits of both engines can be tested by means of a single PRESS TO TEST button above the engine warning light/fire extinguisher buttons. When the button is pressed, the warning light for each engine comes on to prove the integrity of the detection circuit and its supply fuse and the continuity of the inner core of the firewire loop.

The fuselage fire detection circuits can be tested by means of a PRESS TO TEST button above and to the left of the fuselage warning light/fire extinguisher button. When the button is pressed, the DC supply to initiate the operation of the fire extinguishers is isolated from the warning light circuit and the warning light comes on to prove the integrity of the detection circuit and its supply fuse and the continuity of the inner core of the firewire loop.

Anti-icing system

Hot air for engine anti-icing is ducted from each engine compressor into the annular manifold surrounding the air intake casing and thence, through hollow IGV, to the starter fairing and engine cowl.

Each engine system is controlled by an ANTI-ICING – ON/OFF switch on the left console. MI, one for each system, are forward of the control switches. An indicator shows black when the system is OFF and white when the system is switched ON.

Hydraulic systems

The hydraulic installation is comprised of three separate systems:

- Services system
- Left controls system
- Right controls system

Each controls system provides power for operating the ailerons. The left system also provides a secondary supply for rudder operation. This arrangement ensures that complete failure of one controls system does not affect the operation of the powered controls.

Services system

The services system provides power to operate the following services:

- Airbrakes
- Flaps
- Landing gear
- Flare bay doors
- Wheel brakes
- Rudder power operation (primary supply)
- Rudder feel simulator (primary supply)

Engine-driven pumps

Power for the services system is provided by two pumps, one driven by each engine. Each pump draws fluid from a reservoir in the front camera compartment and delivers it through a non-return valve to a common supply line and thence through a filter to accumulators and service selectors. At a pressure just below the maximum operating pressure the pumps are off-loaded progressively as line pressure increases, by the operation of mechanisms incorporated in the pumps. When line pressure reaches 2,650-2,750 PSI, pump delivery ceases except for that which is necessary to make up losses caused by seepage. While the pumps are running off-load, bypassed fluid is returned to the reservoir at low pressure. During flight the header tank is subject to cabin pressure.

Accumulators

There are four accumulators in the services system as follows:

1. Services (for the landing gear, flare bay doors, flaps, airbrakes and camera doors)
2. Wheel brakes
3. Rudder jack (primary supply)
4. Rudder feel simulation (primary supply)

The services and wheel brakes accumulators are on the spar frame bulkhead aft of the belly tank. Fluid pressure in these accumulators is shown on two gauges, labelled HYDRAULIC and BRAKE, on the right console.

Hand pump

A hand pump to the right of the pilot's seat can be used to operate the flare bay doors, charge the wheel brakes accumulator and, after operating a mechanical 'down' selector, lower the landing gear. The hand pump draws fluid from the reservoir through a connection in the base of the tank. The positioning of this connection in relation to the engine-driven pumps' line ensures a fluid supply for the hand pump if fluid is lost due to leakage in the system.

Services control

The electrically actuated selector valves for all the services except the wheel brakes, (which are mechanically selected) are controlled by switches at the pilot's and the navigator's stations. In the event of electrical failure, provision is made for the mechanical selection of landing gear lowering and flare bay doors opening. Details of these controls are given in the relevant chapters.

Controls systems

Engine-driven pumps

The left and right controls systems are each powered by a single engine-driven pump, the terms left and right referring to the engine driving the pump. Each pump draws fluid from a reservoir in the main wheel bay on the same side as the pump and delivers fluid to the reservoir to pressurise the fluid content and through a filter to accumulators (one right, three left) and control surface jacks. The operation of the pumps is similar to those in the services system.

Accumulators

There are four accumulators in the controls system, three in the left and one in the right, as follows:

Left: Rudder jack (secondary), rudder feel simulation (secondary) and aileron inboard jacks

Right: Aileron outboard jacks

Normal operation

Please refer to the Hydraulic system failures information in the Checklists section.

Before starting

Check the operation of the hand pump by pumping until at least 1,450 PSI is indicated on the wheel brakes hydraulic pressure gauge.

During start

Start No. 2 engine first and note that the pressure on the services and wheel brakes pressure gauges increases to 2,650-2,750 PSI. Then close the flare bay doors and note on completion of the operation that the pressure on the services pressure gauge returns to 2,650-2,750 PSI.

After start

When both engines have started, check the operation of the flaps and airbrakes and leave these retracted. Note on completion of these checks that the services pressure gauge returns to 2,650-2,750 PSI.

Shutdown

Stop No. 2 engine first and, before stopping No. 1 engine, open the flare bay doors. Note on completion of the operation that the services pressure gauge returns to 2,650-2,750 PSI.

AIRCRAFT CONTROLS

Flying controls

The ailerons and rudder are operated by hydraulic power but the elevators are manually operated with balance tab assistance. The rudder has an autostabiliser and both the rudder and ailerons have artificial feel.

Variable-incidence tailplane and indicator

Variations of tailplane incidence are made by an actuator operated by an electrically driven motor. The motor is controlled by a three-position switch labelled TAIL TRIM NOSE DOWN/off/NOSE UP on the left console. This switch actually consists of two switches; one controls the direction of movement of the tailplane actuator and the other the power supply. The pair of switches are linked and are spring-loaded to the mid (off) position. The normal limits of the tailplane travel are controlled by electrical limit switches.

The amount of available tailplane travel is limited and the elevator trailing edge strips are trimmed so that the aircraft is controllable under any flight conditions within the limitations if the actuator runs away to the fully nose-down trim position. This applies even if the actuator has overrun the normal limit and has reached the mechanical stop.

The tailplane trimmed position is shown on the combined trim indicator on the flight instrument panel.

Power-operated ailerons and failure warning lights

A torsion rod incorporated in the control column provides artificial feel in the aileron controls. To obtain equal sensitivity of control at high and low altitudes, the aileron controls are geared to provide two movement ranges. The gear change is electrically actuated by a HIGH ALT/LOW ALT switch on the left front coaming; HIGH ALT is for use above 40,000 feet and LOW ALT below. A magnetic indicator is adjacent to the control switch and shows black when LOW ALT is selected and white when HIGH ALT is selected.

Two lights, one amber and one red, on the coaming above the flight instrument panel indicate failure of the hydraulic supplies to the aileron controls. The amber light comes on to indicate failure of either of the left or right controls systems, i.e. 50% failure, and the red light comes on to indicate failure of both, i.e. 100% failure.

Aileron trimming

A spring-powered mechanism, operated by an electrical actuator, is incorporated in the controls. Power supplies to the actuator are controlled by a linked pair of three-position AILERON TRIM – L/off/R switches, spring-loaded to the off position, on the left console, with one switch controlling the positive feed and the other the earth return.

The aileron trimmed position is shown on the combined trim indicator on the flight instrument panel.

Rudder failure warning lights

Failure of the hydraulic supplies to the rudder controls is indicated by two lights, one amber and one red, on the coaming above the flight instrument panel. The amber light comes on to indicate failure of either the primary or secondary power supplies, i.e., 50%, and the red light comes on to indicate failure of both, i.e., 100% failure.

Rudder trimming

Power supplies to the rudder trim actuator are controlled by a linked pair of three-position RUDDER TRIM L/off/R switches, spring-loaded to the off position, on the left console, with one switch controlling the positive feed and the other the earth return.

The rudder trimmed position is shown on the combined trim indicator on the flight instrument panel.

Rudder autostabiliser

A rudder autostabiliser is incorporated in the rudder control system. A sensing gyro in the equipment bay transmits corrective impulses to a servo motor connected to the rudder control run. The system uses AC supplied primarily by No. 2 inverter with No. 1 inverter as a standby; a three-position AUTOSTABILISER – OFF/STANDBY/ON switch controlling the system is on the inboard edge of the left front panel. When moving the switch from OFF to ON or vice versa, hold it in the STANDBY position for not less than five seconds so that the servo motor has time to centralise if it is not central at the time of switching.

For normal operation the rudder autostabiliser is switched to STANDBY before take-off. Only switch it ON at a safe height and below 250 knots. On rejoining the circuit, revert to STANDBY and switch OFF during the Shutdown checks.

Roll damper

A roll damper is incorporated in the aileron control system. A combined detector and amplifying unit, on the floor aft of the navigator's seat, detects oscillation of the aircraft in roll and transmits corrective impulses to an actuator connected to the aileron control run. The AC supplies to the system are from No. 2 inverter with No. 4 inverter as a standby. A three-position switch, labelled ROLL DAMPER OFF/STANDBY/ENGAGE, is on the cockpit right wall.

Rudder and aileron control checks

Checks during starting

When No. 2 engine has started, check that both 50% failure indicators are amber and subsequently, when No. 1 engine has started, that these lights go out.

Procedure after shutdown

Due to normal seepage in the control jack system the 50% and 100% failure warning lights may appear as soon as the engine(s) are shut down. It is, however, important to discharge manually the rudder and aileron primary and secondary systems as follows:

After the engines have stopped, switch OFF the BATTERY switch and operate the rudder pedals until they are 'dead' in order to discharge the rudder primary system. Then switch ON the BATTERY switch and again operate the rudder pedals until they are 'dead' to discharge the secondary system. Finally, operate the aileron controls until they are 'dead' to discharge both aileron systems. If the systems are not discharged in this sequence it is possible for fluid from the secondary rudder jack accumulator to return to the services reservoir instead of the left reservoir. Hydraulic fluid is then lost through overflow and the camera doors are contaminated.

Powered flying controls failures

Seizure of an engine causes the appropriate controls hydraulic pump to stop with the subsequent failure of its associated control jacks. Failure of a controls hydraulic pump also causes control jack failure. The effects of controls system failures are as follows:

- **Left control system failure** – failure of secondary rudder supply and the supply to both inboard aileron jacks (50% rudder and aileron amber warning lights on)
- **Right control system failure** – failure of the supply to both outboard aileron jacks (50% aileron amber warning light on)
- **Failure of left and right control systems** – complete aileron failure (l00% aileron red warning light on). The rudder jack continues to function on its primary supply from the services system (50% rudder amber light on)

If the left controls system fails, land as soon as possible. If the right system fails, land as soon as practicable. If both systems fail, abandon the aircraft even though rudder control is still available.

Failure of the hydraulic services system eventually causes failure of the primary supply to the rudder and illumination of the 50% rudder amber warning light. The rudder jack continues to function on its secondary supply from the left controls system. Land as soon as practicable.

Landing gear

The raising and lowering of landing gear is controlled by hydraulic jacks and an electrically operated hydraulic selector valve. Sequence valves in the hydraulic circuits ensure that the landing gear doors operate in their correct sequence. Provision is made for emergency lowering of the landing gear in the event of main hydraulic failure or electrical failure of the selector valves.

Normal controls

The selector switch unit on the left front panel controls the electrically operated up/down hydraulic selector valve. The UP and DOWN buttons on the switch unit are spring-loaded, with pressure on one releasing the other. When the UP button is depressed, the selector valve moves to the up position and the wheels retract. When the wheels have locked in the up position, a sequence valve is actuated to permit the landing gear doors to close. When the DOWN button is depressed, the landing gear doors open fully before lowering of the landing gear begins. At 90% RPM the landing gear should retract in 15 seconds (maximum); at 75% RPM it should lower in six seconds (maximum). These times relate to a speed of 130 knots.

A solenoid-operated mechanical lock in the selector switch unit prevents the UP button from being operated if the airspeed is less than 75 knots.

Landing gear position indicator

A type D indicator on the left front panel is operated by microswitches in the nose and main landing gear bays. The indications given are as follows:

- Three green lights – all landing gear units locked down
- Any red light – landing gear unit unlocked
- No lights – all landing gear units locked up

Note that there is no indication that the main landing gear doors are locked up.
The nose landing gear red light comes on if either throttle is less than one third open with the landing gear in any position other than all three units locked down.

If failure of a green lamp is suspected, reserve green lamps may be brought into operation by turning the change-over switch at the centre of the dial. The intensity of the lamps may be reduced for night flying by turning the larger winged knob at the centre of the dial.

Landing gear emergency lowering

The landing gear emergency lowering control is a red toggle handle above the landing gear selector unit. Pulling the handle fully out, until it is locked in position by a spring clip, operates the selector valve mechanically to the ‘down’ position and also opens the emergency down selector valve.

After pulling the handle, the landing gear lowers immediately if the fault is due to electrical failure of the selector valve, but if the failure is hydraulic the hand-pump must also be operated to pump fluid through the emergency selector valve to lower the landing gear.
If, after using the emergency handle, a loss of hydraulic pressure occurs, check that the handle is fully out and locked.

After the emergency lowering handle has been used, it is not possible to retract or unlock the landing gear until after maintenance.

Flaps

The electrically operated hydraulic selector valve for the flaps is controlled by a two-position, fully UP or fully DOWN, switch lever on the left front panel; the flaps position indicator is outboard of the switch lever. No provision is made for operating the flaps in flight after electrical or hydraulic failure. At 75% RPM the flaps should retract in 20 seconds (maximum) and should lower fully in 15 seconds (maximum). These times relate to a speed of 130 knots.

Airbrakes

The electrically operated hydraulic selector valve for the airbrakes is controlled by a three-position IN/MID/OUT switch on the coaming above the left front panel. A spring-loaded sliding guard aft of the switch must be held aside before OUT can be selected. No provision is made for in-flight operation of the airbrakes in the event of electrical or hydraulic failure.

The airbrakes position indicator is incorporated in the combined trim indicator on the pilot's main instrument panel.

Wheel brakes

The hydraulically operated wheel brakes are controlled by a toe pedal on each rudder pedal. Differential and progressive braking is obtained, irrespective of the position of the rudder bar, by varying the pressure applied to the toe pedals. A separate parking brake lever is on the inboard side of the left front panel. It is moved up to apply the brakes.

The available pressure in the brakes accumulator is shown on a gauge on the take-off panel. Normally 2,750 PSI, this pressure provides sufficient braking for a normal landing if the services hydraulic system fails. The pressure falls to 1,425 PSI as the brakes are used and the anti-skid units operate. At this point the accumulator is discharged of hydraulic fluid and pressure drops rapidly to zero. However, pressure may be restored by means of the hand-pump provided that fluid is available.

AUTOPILOT

The aircraft is fitted with a Mk.10 autopilot. AC and DC supplies are available to the system when No. 2 inverter is running. The autopilot is controlled by a switch unit on the starboard cockpit console and a heading selector on the main instrument panel. A remote trim indicator and remote READY and ENGAGE magnetic indicators are also on the main instrument panel.

Switch unit

The switch unit has the following switches and indicators:

- POWER switch and associated READY magnetic indicator
- ENGAGE switch and associated IN magnetic indicator
- Rudder, aileron and elevator channel switches
- Trim indicator
- BOMB switch (not utilised on this aircraft)
- TRACK switch
- GLIDE switch
- ALTitude lock switch

The rudder, aileron and elevator channel switches are conventional two-position (IN upwards) toggle switches. The remainder of the switches are of the pull (ON) push (OFF) type which are electromagnetically held in the ON position.

POWER switch

When the POWER switch is pulled, the DC and AC supplies are available to the system when No. 2 inverter is running. After approximately one minute the READY magnetic indicator will change from black to black/white stripes, indicating that the autopilot is ready to be coupled to the aircraft controls. The READY indicator on the main instrument panel operates in parallel with the READY indicator on the switch unit.

ENGAGE switch

Provided that the rudder, aileron and elevator switches are IN, pulling the ENGAGE switch will couple the autopilot to all three control surfaces, whereupon the IN magnetic indicator will show white and the READY indicator black. The controls can be disengaged from the autopilot by pushing the ENGAGE switch in. The ENGAGE indicator on the main instrument panel operates in parallel with the IN indicator on the switch unit.

Channel switches

If a control channel switch is selected OFF, its particular control surface will be disengaged from the autopilot; the IN indicator will remain white and the READY indicator will show black/white stripes. Re-engagement can be achieved by selecting the channel switch IN again when the READY indicator will show black. If all three channel switches are off at the same time, the ENGAGE switch will release to off and the control surfaces cannot then be reconnected to the autopilot by selecting them on again. The normal ENGAGE method (pulling out the ENGAGE switch with all or any of the three channel switches selected IN) will have to be used.

Trim indicator

The indicator shows any out-of-trim load being carried by the autopilot elevator servo-motor. The remote trim indicator on the main instrument panel operates in the same sense as the indicator on the switch unit.

ALTitude lock switch

When the ALTitude lock switch is pulled ON with the autopilot engaged, the autopilot will lock on to, and hold, the current barometric height. With the ALTitude lock engaged, the pitch hold controller is isolated. Operation of the GLIDE switch will automatically disengage the height lock.

TRACK and GLIDE path switches

When the TRACK and GLIDE path switches are pulled ON, they link their respective signals to the autopilot, which then controls the aircraft heading according to the heading error signal from the heading selector and the ILS localiser beam, and in pitch in accordance with the glide path beam.

Pilot’s controller

Bank control

The aircraft can be turned at a preset angle of bank by selecting the control knob to the bank required. The knob will remain on the selected angle and the aircraft will maintain the turn at the angle of bank until a different angle is selected or the knob is returned to the central position, when the aircraft will return to straight and level flight. If the autopilot is engaged with the bank control in any position other than central, the control will be inoperative until it has first been returned to the central position. With the TRACK switch on, the bank control is inoperative. At any other time the bank control will override any preselected turn on the heading selector.

Pitch control

The pitch control switch is spring-loaded to the central (off) position. Moving the switch to the DIVE position will decrease the pitch value being held by the autopilot, and moving the switch to the CLIMB position will increase the pitch value being held by the autopilot.

Heading selector

The heading selector is comprised of a compass repeater, course setting knob and pre-select turn engagement button. Courses can be pre-selected on the heading selector and the aircraft will turn onto the selected heading when the pre-select turn button is pressed. The angle of bank when using the heading selector for turns is automatically restricted to 30 degrees.

The heading selector is also used to monitor the aircraft heading when carrying out an automatic ILS approach. This is done by selecting the runway heading (compensating for drift) on the course setting pointer before pulling ON the TRACK switch. With the TRACK switch ON, the pre-select turn facility of the heading selector is isolated.

Pre-flight checks

a) After the engines are started, ensure that the flaps are up and that No. 2 inverter has cut in before starting the checks on the autopilot.

b) Pull on the POWER switch and check that the READY indicator shows black/white stripes after approximately one minute.

c) Switch IN the rudder, aileron and elevator channel switches.

d) Ensure that the trim indicators are within the white sector.

e) With the aircraft controls central, pull out the ENGAGE switch and check that the IN indicator goes white and the READY indicator black. Press lightly on all three controls to check proper engagement of the autopilot.

f) Select each channel switch OUT and then IN, in turn, and in each case in the interval between these two operations, check that the READY indicator shows black/white stripes, the IN indicator remains white and that the respective control becomes disengaged while the other two remain firm. Check also that the READY indicator shows black on resetting the channel switches to IN.

g) With the autopilot fully engaged, select all three channel switches OUT and check that the autopilot disengages.

Operation in flight

Autopilot engagement

a) Check that No. 2 inverter is operating.

b) Pull ON the POWER switch, and when the READY indicator shows black/white stripes after approximately one minute, switch IN all three channel switches.

c) Check that the trim indicator is in the white sector and trim the aircraft to fly hands and feet off in the required flight attitude.

d) Pull ON the ENGAGE switch and note that the IN indicator shows white and the READY indicator black.

Trimming

a) Before engaging the elevator channel any out-of-trim control force must be eliminated.

b) Make periodic checks of rudder and aileron trim by disengaging these channels in turn and adjusting the aircraft trimmer as required before re-engaging the channel.

Climbing and descending

To climb or descend, disengage the ALT switch and move the pitch control to achieve the necessary pitch. When the desired altitude is reached, bring the aircraft back to level flight before re-engaging the ALT switch.

Use of height lock

The height lock must not be engaged if the aircraft is climbing or descending significantly. Level the aircraft at the required altitude and then pull on the ALT switch.

Turning

Turns may be executed either by means of the bank control or the heading selector. Whichever method is used, it will be found, in prolonged turns with the ALT switch disengaged, that some adjustment in pitch may be necessary to maintain altitude, particularly at high altitudes.

Bank control – Select the angle of bank required on the bank control. As the required heading is approached, centralise the control about 5°-10° (depending on the rate of turn) before the heading so that the aircraft rolls out of the turn with a minimum of overshoot or undershoot.

Heading selector – Select the required heading on the course setting pointer and press the pre-select push-button for a minimum of one second. A heading change larger than 90°-120° should not be attempted using this method.

Disengaging

To disengage the autopilot, set the ENGAGE switch to OFF and then push OFF the POWER switch.

FLIGHT INSTRUMENTS

Compasses

A Mk 4B compass is installed. Power is supplied by No. 2 inverter with No. 1 inverter as a standby. The master indicator is at the navigator's station. The amplifier and the control panel are beneath the pilot's right console and the detector unit is in the right wing tip. The pilot's gyro unit, on the flight instrument panel, may also be used as a directional gyro by setting a COMPASS/D GYRO switch, on the right console, to D GYRO; the DG flag then appears in the annunciator window of both indicators. Heading outputs from the GTN 650 are also provided to a GI-106A Navigation remote indicator and a similar output from a SL30 unit to another GI-106A.

An E2B standby compass is at the top centre of the windscreen. The normal and emergency lighting supplies to the E2B compass are controlled by a common dimmer switch. When the battery switch is OFF, the E2B compass light is automatically connected to the emergency battery. Therefore, if the E2B dimmer switch is not fully off, the emergency battery is drained when the battery switch is selected OFF.

Pitot and static pressure system

Two electrically heated pressure heads are fitted, one (primary) on the nose cap and the other (secondary) on the right side of the front fuselage just aft of and below the nose hinge. The power supply to each heater is fed via a separate fuse. A PITOT – ON/OFF switch on the take-off panel controls the heating of both pressure heads. Three static vents are vertically aligned on each side of the hinged nose and a double static vent is on each side of the fuselage just above the lower equipment bay doors.

An airspeed-operated pressure switch is on the left side below the pilot's floor. It operates at 75 knots to prevent inadvertent landing gear up selection below this speed. It also allows induced airflow for ventilated suit cooling below 75 knots and ensures that the maintenance lights are out during flight.

Horizon gyro unit

A horizon gyro unit (HGU) on the flight instrument panel fulfils the requirements of an artificial horizon. It is supplied by No. 2 inverter with No. 1 inverter as a standby. Failure of the power supply to the instrument is indicated by an OFF flag on the face of the instrument. A fast erection button for use with the instrument is adjacent.

Standby attitude indicator

A standby attitude indicator, on the flight instrument panel, is a DC-powered gyroscopic instrument which displays aircraft pitch and roll attitude, on a graduated spheroid, relative to a central aircraft symbol.

The lower half of the spheroid is coloured black and the upper half white. Pitch angle is indicated on a scale marked in 5° increments in climb and dive and annotated at the 30°, 60° and 90° positions.

Roll angle is indicated by the position of a white pointer against a scale graduated at angles of 10°, 20°, 30°, 60° and 90° left and right. The indicator has unrestricted freedom in roll and ±85° in pitch. To cage the indicator, press the knob at the bottom right comer of the indicator bezel until the indicator has settled in the caged position (within 2°). This may take up to 45 seconds. A red flag appears between the 30° and 60° positions while the knob is pressed. Power supply to the indicator is 28-volt DC and is controlled by the STANDBY/NORMAL switch above the indicator. If the normal supply fails, a red and black failure indicator appears in the display; setting the switch to STANDBY connects the indicator to the emergency battery.

Slip ball indicator

A slip ball indicator, directly below the horizon gyro on the flight instrument panel, is comprised of a black floating ball inside a tubular case with a white background and indicates aircraft slip.

Altimeter

A Mk 29B altimeter is on the pilot's flight instrument panel. The altimeter dial is marked from 0 to 1,000 feet in 50-foot intervals and is swept by a single pointer. Inset on the left of centre is a three-digit counter which indicates altitude in 100-foot intervals over the range -1,000 to +60,000 feet. The 10,000-foot wheel is marked with diagonal black/white hatching at altitudes below 10,000 feet and with red/white hatching at negative altitudes. A setting knob, on the bottom left of the instrument, enables altitude to be displayed relative to the selected barometric pressure which is displayed on a millibar counter behind a window in the dial.

A standby/reset knob marked S <-------> R, on the bottom right of the instrument, provides for manual selection of the standby 'S' or servo 'R' mode of operation. The knob is spring-loaded to the central position. When 'S' is selected momentarily, the altimeter reverts to pressure capsule operation, an integral vibrator starts to operate and a flag marked STBY appears in the window above the altitude counter. When 'R' is selected for about three seconds, with system power supplies available, the altimeter resets to servo operation, the flag clears and the vibrator stops working.

When the altimeter is being operated in the servo (reset) mode, there is a risk that an unsignalled (no warning flags) fault in the system could cause the same incorrect altitude to be indicated on both altimeters. To safeguard against the possible flight safety hazards of such errors, particularly at low level, the following procedure is recommended:

Pre-take-off – select the altimeter to 'S' and check that the flag shows STBY.

After take-off – when passing transition altitude in the climb, select the altimeter to 'R' and check that the flag clears.

At top of climb, after changing flight level and periodically (15 minutes) during cruise – select the altimeter to 'S', check the flag shows STBY, reselect 'R' and check that the flag clears.

Descent – at the top of the descent, select the altimeter to 'S' and check that the flag shows STBY.

LIGHTING

External lighting

The external lighting switches are in line, right to left, on the left console with the strobe light switches aft of the other switches. From the right they consist of:

The EXTERNAL LTS MASTER – ON/OFF switch; this must be ON before any external lighting functions.

- Downward IDENTIF'C'N light – STEADY/OFF/MORSE switch
- LANDING LIGHT – HIGH/LOW/OFF switch
- TAXI LIGHTS – ON/OFF switch
- NAV'G'N LIGHTS – ON/OFF switch

Two strobe lights are fitted, one on top and one under the centre fuselage. These can be selected to flash either red or white; two three-position switches labelled STROBE LIGHTS – UPPER – R/0/W and LOWER – R/0/W are on the left console aft of the other light switches. When the camera doors switch is at OPEN, the lower light, if on, is extinguished.

Two taxi lamps are fitted, one in each wing tip. The landing lamp is in the under-surface of the left mainplane. The identification light is in the under-surface of the rear fuselage.

Internal lighting

The left and right consoles are illuminated by 'translite' panels supplemented by red flood lamps while the instrument panels are illuminated by bridge and pillar lamps.

All of these lamps are controlled collectively by either of the E2B Compass, Starboard Console, Coaming Panel, VHF Selector, Port Console or Remote Pilot Indicator rotary switches on the cockpit lighting panel on the right console.

An additional lighting circuit for the aircraft gauges can be activated by the Dimmer Panel rotary switch on the same panel.

The Garmin unit is self-illuminating via internal backlighting.

Lighting requires an active power supply in the aircraft. In emergencies, however, the lighting system can be activated and run off the aircraft battery by activating the EMERGENCY LIGHTS – ON/OFF switch on the coaming panel. The lights will then be powered by the aircraft emergency battery.

RADIO EQUIPMENT

The radio equipment includes the following:

- GMA 340 audio panel
- GTN 650 NAV/COM
- SL30 NAV/COM
- 2x GI 106A NAV indicator
- VOR/ILS
- Radio altimeter

Communication control system

The GMA 340 communication control system provides intercom facilities for crew and ground crew members, combined with a means of selecting and mixing the aircraft radio communication services and audio signals from the navigation aids.

Horizontal situation indicator (HSI)

The HSI controls and indications are as follows:

- **Compass card** – A rotating compass card reading against a fixed lubber at the top of the unit indicates the heading of the aircraft.
- **Selected heading index** – The selected heading index rotates with the compass card. The index may be manually set relative to the card by using the select course knob at the bottom right of the indicator.
- **Course pointer** – The course pointer rotates with the compass card. The pointer may be manually set relative to the card by using the select heading knob at the bottom left of the indicator in the event of a power failure or 'zero' remote selected course input.
- **VOR relative bearing pointer** – The VOR relative bearing pointer indicates the bearing of a selected VOR or GPS waypoint.
- **Course deviation bar and scale** – The course deviation bar is parallel to the course pointer and moves left or right over a scale of five square dots. It indicates deviation from a selected course, defined by an ILS localiser beam or by a selected VOR radial.
- **Glidepath deviation pointer** – Glidepath deviation is indicated by a horizontal bar moving up or down over a scale of five dots.
- **Compass select flag** – A DG flag at the lower right of the compass card indicates that the compass system is switched to direct gyro.
- **Localiser acquisition flag** – A red NAV flag is displayed when localiser input signals are invalid.
- **Glidepath acquisition flag** – A red GS flag is displayed when glidepath information is unsatisfactory.

- **VOR To/From flags** – Either a ‘to’ or ‘from’ flag is displayed on a central background and indicates the sense of the VOR reference signal.
- **Range counter** – A counter (labelled N MILES) displays the range up to a maximum of 999 miles of the VOR tuned into NAV 1 or the next GPS waypoint.
- **Range mode/warning bar** – A bar obscures the range counter when no valid signal is received.
- **Course indicator** – A three-digit indicator labelled COURSE displays the aircraft heading and is a repeat of the course pointer reading.
- **Power failure flag** – A red and black striped flag appears at the lower left of the compass card when power to the HSI fails or is removed.

Marker receiver

The marker receiver operates on a fixed frequency and receives signals from ground marker beacons. Three MARKER lights, coloured blue, amber and white, are above the HSI on the flight instrument panel and flash when the aircraft passes over the marker beacons.

The blue light indicates the outer marker, the amber light the middle marker and the white indicates an airways marker. Audible signals from the marker beacons may be heard by selecting VOR/ILS MKR on the intercom station box. The sensitivity of the marker receiver may be varied by the operation of a SENSITIVITY MKR – HIGH / MEDIUM / LOW switch adjacent to the lights. A LAMP TEST switch enables the lights to be checked.

Radio altimeter

The Mk 78 radio altimeter provides accurate indication of height above surface level in either of two ranges, 0-500 feet or 0-5,000 feet. Any one of 11 different heights can be selected; limit indicator lights show deviation from the selected height.

A single-pointer dial indicator and ‘press to test’ limit lights are on the flight instrument panel. A control unit is above the forward end of the right console and has the following two switches: ON/OFF and LIMIT SELECTOR.

Power supplies are DC and AC. The AC is supplied by No. 6 inverter.

Transponder

A GTX33D mode S transponder is fitted to the aircraft and is controlled via the GTN 650 unit.

AIR CONDITIONING AND PRESSURISATION SYSTEMS

Air conditioning

Hot air from the engine compressors is used for cabin air conditioning. The initial supply from each compressor is through an electrically operated gate valve controlled by one of two ENGINE AIR TO CABIN – ON/OFF switches on the take-off panel.

The temperature of the air entering the cabin is governed by a mixing valve controlled by a spring-loaded CABIN AIR COLD/off/HOT switch to the right of the engine air switches. The setting of the mixing valve is shown on an indicator, labelled CABIN AIR, above the control switch.

With the mixing valve set to fully HOT, the hot air is passed direct to the cabin. By moving the mixing valve to fully COLD, hot air is passed first through a primary cooler in the right inner mainplane leading edge, then through the mixing valve to a secondary cooler and a cold air unit in the left inner mainplane leading edge and thence into the cabin. The proportion of air can be varied between the two extremes by setting the mixing valve to any intermediate position.

At the pilot's station, conditioned air is passed into the cabin through two louvres at each side of the windscreen, a diffuser at the pilot's feet and through perforated tubes on each side of the pilot's seat. The supply to each louvre can be controlled by an adjacent butterfly valve control.

Pressurisation system

At an altitude of about 10,000 feet, a pressure controller and a combined valve unit (which regulates the outlet of air from the cabin according to static pressure) work together to regulate the cabin pressure with increasing altitude until a maximum differential pressure of 4 PSI is reached at about 30,000 feet. Above this altitude the differential pressure remains constant. Cabin altitude is shown on an altimeter on the take-off panel.

Cabin pressure warning light

A 'press to test' cabin pressure warning light is on the cockpit coaming. The light is controlled by an altitude switch below the pilot's floor which causes the light to come on if cabin altitude exceeds 34,000 feet.

Dump valve

A cabin pressure dump valve is on the aft face of the pressure bulkhead to dissipate pressure speedily when it is necessary to abandon the aircraft or jettison the navigator's hatch.

Two guarded and mechanically interlocked DUMP/NORMAL switches controlling the dump valve and the supply from the engine compressors are at the forward end of the left console, together with a guarded ABANDON/NORMAL switch controlling a red warning light at the navigator's station. An amber light, at the left side of the flight instrument panel, comes on when the dump valve is open. The ABANDON switch is mechanically interlocked with the DUMP/NORMAL switches so that it cannot be operated without operating the dump valve.

Demisting system

The interspaces of the pilot's canopy and windscreen quarter-panels and the navigator's windows are provided with dry-air demisting from a separate air drier circuit incorporating an electrically driven blower motor. The electrically driven blower motor is controlled by a CANOPY – ON/OFF switch on the take-off panel.

To demist the canopy, the conditioned air supply to the louvre on each side of the front canopy can be diverted through a diffuser beside each louvre by means of the PULL TO DEMIST toggle handle on the left above the cockpit coaming.

Use of air conditioning and pressurisation systems

Pre-start checks – Before starting the engines, check that the engine air switches are OFF and test the operation of the mixing valve over its full range, leaving it set at fully HOT.

Checks after starting the engines – After starting, switch ON the engine air switches and set the mixing valve as required. The valve is not to be set at fully COLD for longer than five minutes on the ground.

Use of engine air switches in flight – In flight always keep the engine air switches ON so that air conditioning and pressurisation is obtained. If an engine fails or is shut down, switch off its engine air switch.

Checks after landing – After landing, switch OFF the engine air switches. Operate the DUMP valve and ABANDON switches and check their associated warning lights. Ensure that cabin pressure has dissipated before opening the canopy or hinged nose.

During taxiing, cooling from the aircraft system is below optimum and it is advisable to have the canopy in the half-open position. While holding at the runway, maintain 70% RPM if the canopy is open. If the canopy is closed, 80% RPM is necessary and the waiting period should not exceed 10 minutes owing to the danger of heat exhaustion.

OXYGEN SYSTEM

Oxygen supplies and contents gauges

Oxygen is carried in ten 750-litre cylinders, five in each inner wing aft of the main spar. As the aircraft is operated by a single crew member, five bottles are blanked off. From each group of cylinders, the supply is passed through a line valve (normally wire-locked on) on the forward face of the rear pressure bulkhead to a contents gauge on the miscellaneous instrument panel, and then through a non-return valve to a common line. A regulator at each crew station is connected to the common line via a pressure-reducing valve which incorporates a 450-500 PSI safety relief valve. This arrangement allows each group of cylinders to supply the regulators independently and safeguards against total loss of oxygen due to the fracture of one supply line.

Oxygen regulators and supply points

The supply of oxygen is controlled by Mk 21B regulators, one on the right console at each crew station. Each regulator carries the following controls and indicators:

- Regulator pressure gauge
- ON/OFF valve
- Flow magnetic indicator (MI)
- NORMAL/100% OXYGEN air inlet control
- Four-position NORMAL/EMERGENCY/MASK TEST/JERKIN TEST manual selector

Two remote flow magnetic indicators are on the pilot's instrument panel, one to indicate the flow from his own regulator and one to enable him to monitor the navigator's supply.

A regulator is used in conjunction with a P2 or Q2 oxygen mask with toggle harness. To give adequate protection at high altitudes, a sleeveless pressure jerkin and anti-G suit must also be worn. The supply from a regulator is connected to the personal equipment connector on the associated ejection seat. For personal comfort it is recommended that an air-ventilated suit is worn beneath the partial pressure clothing.

The maximum safe aircraft altitude is 41,000ft when not wearing pressure clothing and 50,000ft when wearing a jerkin and anti-G suit.

Note: *The maximum safe aircraft altitudes take into account the reduction of pressure in the cabin below that of the aircraft environment which occurs after loss of the canopy/hatch or serious cabin damage.*

Checks before flight

Before flight ensure that the oxygen contents gauges indicate sufficient for the flight. On the regulator check that the ON/OFF valve is wired ON, the air inlet control is at NORMAL and the pressure gauge indicates 200-400 PSI. With the manual selector control at NORMAL, the flow MI should show white when inhaling.

CANOPY AND FLARE DOORS

Canopy controls and indicators

The canopy is held closed by four locking pins, two on each side of the coaming rail. The pins are operated by an electrical actuator via a transverse torque tube and push-pull rods. When the pins are released, the canopy pivots on hinges at the rear under spring pressure so that the front is lifted up to permit entry and exit through the canopy aperture. The electrical supply to the actuator is taken directly from the aircraft battery and it is therefore unnecessary to have the battery switch ON or an external supply plugged in.

From the cockpit, the canopy is closed by pulling downwards on two handles on the front of the canopy, one on each side. With the canopy held at the closed position, the locking pin actuator is energised by operation of two microswitches below the coaming rails and the pins are engaged. When not in use the canopy closing handles should be folded forward. From outside, the canopy can be locked by holding it firmly in the closed position until the locking pins have engaged.

Indicators for the locking pins are mounted on covers which enclose the locking pin mechanism. There is one indicator for each pin. Each indicator is painted with Day-Glo paint and labelled so that when the locking pin is fully engaged the word LOCKED on a green background shows in a slot. When the pin is in any position other than fully engaged, the red painted area of the strip shows at the slot.

From the cockpit, the canopy locking pins are withdrawn electrically by operation of a guarded switch on the left front panel; the guard is raised and the switch held down until the pins are withdrawn.

The canopy is to be opened only when the aircraft is stationary. Provided that the support strut is attached to the canopy, the aircraft may be taxied with the canopy open at combined headwind/taxiing speeds up to 45 knots. Rough ground is to be avoided.

Flare doors control and indicator

The electrically actuated flare doors selector valve is controlled by an OPEN/CLOSE switch lever on the left console. Indication of the position of the doors is given by a magnetic indicator forward of the control switch. This indicator shows black with the doors fully closed, black/white stripes with the doors in transit, and white with the doors fully open.

Flare doors emergency control

If the flare doors selector fails to operate electrically, it can be moved mechanically to the ‘open’ position by pulling down on a gated lever on the left cockpit wall. However, if the flare doors are opened in this way, they cannot be closed again until after maintenance.

If the hydraulic system fails, the flare doors may be operated by the hand pump with normal selections on the flare doors control switch. However, avoid this procedure unless it is vital, as subsequent landing gear lowering and wheel braking may be prejudiced due to lack of hydraulic fluid.

AIRCRAFT LIMITATIONS

Airframe limitations

The Canberra PR9 is cleared for use in the RAF by day and night in temperate or tropical climates, at home and overseas subject to the limitations given here.

Maximum weights

The maximum permissible weights are:

- Ramp weight – 54,187lb
- Maximum weight for take-off – 53.300lb
- Maximum normal landing weight – 40,000lb

Note: *In an emergency the aircraft may be landed at weights in excess of 40,000lb, but care is to be taken to keep the landing shock to a minimum, and with your use of the brakes.*

Speeds

The tyre limiting speed on the ground is 161 knots groundspeed.

Aircraft condition	Maximum permitted speed	Maximum indicated Mach
Clean or with airbrakes in MID position	450 knots (Note 1)	0.83M
Flare doors open	350 knots (Note 2)	N/A (Note 2)
Airbrakes fully out	400 knots	0.75M between 2,500ft and 25,000ft 0.79M above 25,000ft
Landing gear down	190 knots	N/A
Flaps down	160 knots	N/A

Note 1: *When turbulence is encountered during flight, the maximum IAS is not to exceed 362 knots at all weights below 42,600lb.*

Note 2: *The flare doors are not to be opened in flight except when the flare bay is empty.*

G-force limitations

Spinning and aerobatics are prohibited.

	With negligible aileron		With aileron applied	
Condition	Integral tanks or more full	Integral tanks less than full	Integral tanks or more full	Integral tanks less than full
Up to 48,000lb	3.2G	3.2G	2.0G	1.5G

Note: *The application of negative G is to be avoided.*

In all manoeuvres involving the application of G, the ailerons should be used with care. Negative-G should normally be avoided, but flight in severe turbulence may result in negative-G loads; the acceptable limit for such loads is minus 2.5G indicated on the accelerometer.

Engine limitations

Oil pressure

At all times when using 45% RPM or above, the oil pressure MI is to be black.

RPM and JPT

ENGINE OPERATING LIMITATIONS			
Operating conditions	**Time limit per flight**	**% RPM**	**Max. JPT °C**
Maximum	10 minutes	100.5 (max.)	750
Intermediate	30 minutes	97.5 (max.)	720
Maximum continuous	Unrestricted	95 (max.)	705
Ground idling	Unrestricted	31 to 34	625
During starts			700

Note 1: *For take-off, restrict RPM to limit engine thrust to 8,000lb except under conditions of operational necessity.*

Note 2: *During climbs at maximum conditions, the governed RPM may be permitted to rise to 102.5%.*

Note 3: *Temperatures in excess of 800°C are experienced during certain types of rapid accelerations. During any acceleration the total elapsed time before full control to 750°C is not to exceed 15 seconds.*

Miscellaneous limitations

Aircraft category – The aircraft category for instrument approaches is Category C.

Engine out allowance – The engine out allowance (EOA) is 450 feet.

Visual committal height – The visual committal height (VCH) is 600 feet.

Autopilot limitations

- Maximum airspeed – 450kts/0.80M
- Minimum altitude – 1,500ft AGL (except for auto ILS)
- Maximum bank angle – 30° (15° above 50,000ft)
- The auto heading selector is not to be used above 50,000ft
- Before engaging the elevator channel, any out-of-trim elevator control force must be trimmed out

Pilot's eye to main wheel height

In normal landing configuration at maximum normal landing weight and at normal approach speed on a 3° glidepath, the pilot's eye height is 9.6 feet above the main wheels and the effect of a 1° change in attitude is 0.3 feet.

Electrical generator loading

The type 514 generators are limited to a maximum loading of 360 amperes per generator. The cooling system does not permit a higher loading.

Canopy operation

The canopy is only to be opened when the aircraft is stationary. Provided that the canopy support strut is supporting the canopy, the aircraft may be taxied with the canopy open at combined headwind/taxiing speeds up to 45 knots.

Crosswind

The maximum recommended crosswind component for take-off and landing is 25 knots.

FLIGHT PREPARATION AND HANDLING

Preliminary checks

Carry out the **Initial** and **External** checks. Systematically check the outside of the aircraft for signs of damage and the security of panels, filler caps, doors and hatches. The engine intakes should be free from obstruction, the starter fairings secure and the jet pipes free from distortion. Check the condition of camera optical surfaces.

In winds above 35 knots the external elevator locks are to be left in for taxiing downwind.

Internal checks – Carry out the **Internal** checks

Starting the engines – Carry out the **Starting** checks

Checks before taxiing – Carry out the **After start** and **Taxi** checks

Checks before take-off – Carry out the **Before take-off checks**

Engine performance – effects of changes in air temperature

Under ISA conditions, the engine governed speed is 8000 RPM, i.e. 100%, at which maximum thrust is obtained at sea level. With variations in ambient air temperature, governed RPM may be expected to vary as follows:

+15°C and above – 100% RPM

-10°C – 99% RPM

-25°C – 98% RPM

Note: *At temperatures lower than +15°C, thrust will be more than maintained despite the lower governed RPM.*

Take-off

Fatigue restrictions

Except under conditions of operational necessity, limit take-off thrust from each engine to 90% RPM in order to:

- Reduce aircraft fatigue, particularly tailplane fatigue
- Conserve engine life
- Reduce safety speed
- Reduce aircraft acceleration thereby allowing more time for the landing gear to lock up before the maximum landing gear operating speed is reached.

Initial swing – There may be a slight tendency to swing during the early stages of the take-off run. The swing is easily corrected initially by short applications of brake and thereafter by rudder. At about 80 knots the rudder becomes fully effective.

Unstick – During the take-off run check the tendency for the nose to rise early. At 10 knots below unstick speed, move the control column steadily backwards and fly the aircraft off at the speed given in the Operating Data Manual PDF. If the nose is raised too early, the take-off run is prolonged.

Acceleration – Acceleration after take-off is extremely rapid, particularly at lighter weights. Therefore, as soon as the aircraft is safely airborne, apply the wheel brakes and retract the landing gear. Take care not to exceed 170 knots before the wheels are locked up (all landing gear lights out). If 190 knots is reached before the doors are closed, they may not close at all. There is no visual indication that the main doors are open, but buffeting may be felt. If this happens reduce speed to about 170 knots to allow the doors to close.

Trim change – There is little change of trim with landing gear movement but during the initial climb the aircraft accelerates rapidly with an increasing nose-up change of trim. Carry out the **After take-off** checks.

Climb away – If a sustained climb is intended, allow the speed to increase to the full throttle safety speed (170 knots) then set climbing RPM and increase to climbing speed. For circuit practice it is recommended that the speed be kept below 220 knots. For the climb to circuit height, 80% RPM is ample.

Aborted take-off

Below stop speed – If a take-off is aborted below stop speed, the aircraft can be stopped in the remaining distance available using the following technique:

1. Close both throttles
2. Select flaps DOWN
3. Apply maximum continuous wheel braking
4. Select HP of malfunctioning engine OFF (if applicable)
5. When flaps have travelled, select HP cock of remaining engine(s) OFF

Above Stop speed – If a take-off is aborted above stop speed, the abort technique is influenced by such factors as the speed and weight of the aircraft, weather conditions, runway length and availability of an arresting barrier. Use the following technique:

1. Close both throttles
2. Select flaps DOWN
3. Select HP cock of malfunctioning engine OFF (if applicable)
4. When flaps have travelled, select HP cock of remaining engine(s) OFF

Engine failure after take-off

Safety speed at 90% RPM is 150 knots. With full throttle, safety speed is 170 knots.

If an engine fails during take-off, give priority to controlling the aircraft before dealing with the engine emergency. The aircraft responds to an engine failure by yawing and rolling towards the dead engine. The rates of yaw and roll increase rapidly if recovery action is delayed.

Factors affecting recovery are:

- Aircraft speed – Aircraft response to engine failure is more marked at low speeds, particularly below safety speed. The rudder is less effective at low speeds and recovery technique becomes more critical.
- All-up-weight and centre of gravity position – All-up-weight (AUW) affects the speed from which recovery is possible by its effect on aircraft acceleration. At low AUW the improved acceleration assists recovery. At aft centre of gravity positions the rudder is less effective because of its reduced moment arm.
- Altitude and temperature – Increases in altitude and/or temperature cause reduced engine thrust and, therefore, lower critical speeds. This alleviates asymmetric handling difficulties but reduces aircraft acceleration and climb performance. Corrections to critical speeds for these effects are 3.8 knots decrease per 1,000 feet increase in altitude at constant temperature, and 1.3 knots decrease per 1°C increase in temperature at constant altitude.

For reductions in altitude and/or temperature, the reverse effects and corrections apply.

Recovery actions

a) Landing gear down – If the landing gear is still down, control the yaw with rudder, if practicable, close both throttles and land back on the runway. If a landing is not practicable, take recovery action as for landing gear up.

b) Landing gear selected UP – If the landing gear has been selected UP:

1. Apply full rudder to oppose the yaw. Up to 10° of bank may then be applied towards the live engine. This not only reduces the minimum control speed but may also improve aircraft performance by reducing drag. If the yaw still continues, then thrust on the live engine must be reduced until the yaw is stopped.
2. Lower the nose to improve acceleration and confirm that the landing gear and flaps are retracted.
3. Climb away when the speed has increased to above safety speed. If thrust has been reduced, restore it slowly as speed increases further, trim as necessary and then carry out the appropriate engine failure drill. If a safe climb cannot be achieved, decide whether to eject or crash land.

Note: *Application of aileron before rudder affects recovery adversely.*

c) At and above safety speed, it should be possible to regain and maintain control, without reducing thrust on the live engine, provided that recovery action is taken immediately an engine failure is recognised. Below safety speed it is always necessary to reduce thrust on the live engine. If corrective action is taken quickly, it is possible to recover and climb away from an engine failure that occurs at 135 knots.

Climb

The optimum climbing speed is 330 knots until 0.72M is reached at about 20,000 feet. Thereafter maintain 0.72M until the desired altitude is reached.

When maximum rate of climb is required, the engines should, after take-off, be set at maximum RPM (10 minutes limit). If maximum rate of climb is not essential, use maximum continuous or intermediate RPM.

Engine handling in the climb

When climbing at maximum RPM with the jet pipe temperature controllers set at MAX, the JPT should be controlled automatically within the limitation of 750°C. At the maximum intermediate rating of 97.5% RPM, the JPT limitation is 720°C. The jet pipe temperature controllers can only control at datum settings of 705°C or 750°C, therefore at this RPM setting leave the controllers at MAX and restrain the JPT by careful throttle adjustment.

Engine handling in flight

Operate the throttles smoothly at all times and avoid slam accelerations. If required, however, rapid throttle movements may be made at any altitude. At low altitudes acceleration to maximum RPM from idling RPM can be achieved within five seconds, but great care in throttle handling is necessary to avoid developing asymmetric thrust.

Jet pipe temperature (JPT) controllers

Cruise – The jet pipe temperature controller is not designed for extreme conditions such as selecting CRUISE whilst at full throttle. If used in this manner, marked RPM underswing occurs. Before setting the datum selector switches to CRUISE, therefore, first adjust the throttles manually to give engine conditions similar to the cruise setting of the controllers, i.e. 705°C JPT. Selection to CRUISE then results in the JPT being controlled at 705°C.

Maximum – With the datum selector switches set to MAX, controlling occurs whenever the JPT reaches 750°C (approximately). When reselecting MAX after a period at CRUISE, make the switch selection before increasing RPM in order to avoid sudden over-fuelling. During rapid accelerations when the JPT may momentarily exceed the limiting conditions, the controllers assist in reducing the JPT to the limiting figure and thereafter should control satisfactorily.

GENERAL FLYING NOTES

Flying controls

The controls are well harmonised and smooth in operation at all altitudes.

The rudder control is powerful and sensitive and is to be used with care at all speeds. Artificial feel is provided and rudder loads increase progressively with increase of speed. The aircraft can be flown satisfactorily and comfortably with the autostabiliser switched off, but its use considerably improves the accuracy of heading keeping and lateral steadiness, particularly in turbulent conditions.

The ailerons are light and effective, with good response throughout the speed range. However, at speeds below about 200 knots it is important to use coordinating rudder and to avoid large, coarse, aileron inputs because they generate significant yawing forces in the direction of turn. In extreme cases, the rolling moment caused by these forces can markedly reduce the corrective power of the ailerons, causing difficulty in preventing bank angle increasing. It is particularly important to avoid coarse aileron usage in any circumstances where large rudder deflections are already required to maintain control, e.g. asymmetric flight.

At high Mach numbers and at high altitude, lateral oscillations are easily induced. Selection of ‘low altitude’ aileron gearing at high altitude aggravates this tendency and, for accurate flying, it is essential that the correct gearing is used. The use of ‘high altitude’ gearing at low altitudes is not detrimental to the handling characteristics apart from the appreciably heavier aileron forces involved.

The elevators are powerful and elevator forces are light, becoming heavier at high speeds and resulting in poorer elevator response at higher Mach numbers, although still remaining effective.

Trims

Tailplane incidence control is powerful at all speeds and becomes very sensitive at high speed. The rudder trim is powerful and quick in operation, requiring care in its use. The aileron trim is the least powerful trim.

Lateral trim is sensitive to asymmetric thrust and to rudder trim; a deliberate yawing of the aircraft produces a pronounced rolling motion in the direction of the yaw. At high Mach numbers, particularly at high altitude, accurate lateral trimming is difficult to achieve.

Changes of trim

Action	Effect
Landing gear down	Slight nose up
Landing gear up	Little change
Flaps down	Strong nose up
Flaps up	Strong nose down
Airbrakes out	Little change except for slight nose down at high speeds or Mach numbers
Airbrakes in	Little change
Flare doors open	Slight nose up (increased at high speeds)
Flare doors closed	Slight nose down

Airbrakes

At high airspeed the airbrakes are effective even when in the MID position, but below about 300 knots their effectiveness decreases until at approach speeds their effect is negligible. At high airspeed or Mach numbers their use causes increased buffet. Prolonged flight with airbrakes out at low altitude and high speed (e.g. when burning off fuel) is not recommended for reasons of airframe fatigue.

Operating in icing conditions

Anti-icing equipment is provided for the engines only; avoid flight in icing conditions whenever possible. Ice is particularly likely to form on the airbrakes when they are extended fully and on the flare doors if these are opened. The rate of ice accretion increases rapidly at true airspeeds above 250 knots.

Icing may occur both on the ground and in the air when the visible moisture content of the air reduces visibility to 1,000 metres or less, and the ambient air temperature is below +5°C, with a relative humidity of 90% or more.

With engine anti-icing in operation, all throttle movements must be made smoothly. There is a loss of thrust (approximately 10%) and economy and, usually, a rise of about 20°C in JPT. At full throttle the RPM decrease if the JPT controllers come into operation. Whenever anti-icing is used, two minutes should elapse after leaving icing conditions before switching anti-icing off.

Starting and taxiing – If icing conditions exist, switch ON anti-icing after starting engines and leave ON for taxiing.

Take-off – Anti-icing is cleared for use during take-off. Make allowance for a slightly longer take-off ground run.

Climb – Maintain climbing RPM and climb at 250 knots until a coincident speed of 0.72M is reached. If an alteration in RPM is essential, move the throttles smoothly.

Level flight – If icing conditions are met in level flight, climb or descend out of icing as quickly as possible, as continued flight in icing conditions may result in flame-out. If flame-out occurs, attempt an immediate relight. If this fails. a further attempt may be made within one minute. If the second attempt is unsuccessful, further attempts may damage the engine.

Descent and landing – Switch on the anti-icing before descending into icing conditions and maintain a minimum of 70% RPM (below 70% the air from the compressor is not hot enough to ensure successful anti-icing). Descend through the icing layer as quickly as possible, bearing in mind the airframe icing considerations given above. If icing conditions persist down to airfield level, keep RPM above 70%, if possible, until finally committed to landing. In the event of an overshoot the throttles are to be opened smoothly.

Flying at reduced airspeed

Reduce speed to approximately 150 knots and keep the flaps up.

Flying in severe turbulence

The recommended speeds for flight in severe turbulence are:

- 0 to 20,000ft – 270 to 330 knots
- 20,000ft to 35,000ft – 0.70M
- Above 35,000ft – 0.72M

Stalling

The approximate stalling speeds with throttles closed and at 40,000lb AUW are:

- Landing gear and flaps up – 96 knots
- Landing gear and flaps down – 83 knots

Warning of the approach to the stall is given by slight buffet which starts some 5 to 15 knots above the stalling speed, depending on aircraft configuration, and becomes moderate as the stall is reached. Just before the stall, either wing may drop gently. The use of aileron is effective in raising the wing but finally, as the stall occurs, the nose and either wing drop sharply. Use of aileron as the stall occurs aggravates the wing drop.

Recovery from the stall is straightforward on releasing backward pressure on the control column although, in the initial stage of the ensuing dive, slight buffet may again be encountered and care is required to avoid inducing a further stall through too harsh a recovery to normal flight.

If corrective action is taken at any time up to the stall, little or no height is lost. If it is taken after the stall has occurred, recovery can be achieved in about 1,500 feet without the use of engine thrust. The use of 90% RPM during recovery reduces height loss considerably. However, take care to achieve symmetrical thrust, particularly between 80 and 90% RPM. The stalling speed is not noticeably affected by extending the airbrakes and opening the flare doors, but buffet is increased.

At any time when G is applied or in a turn, ample warning of the approach of the stall is given by buffet which increases steadily down to the stall proper, at which there is a tendency for either wing to drop. Recovery is immediate upon releasing the pull force on the control column

If a stall occurs in a turn and a wing drops, the aircraft continues to roll in the direction of the dropped wing. Releasing the backward force on the control column and increasing RPM should assist the aircraft recovery. Take care to prevent yaw during recovery.

High speed flight

The limitations are laid down for structural reasons and are not to be exceeded. The high Mach number characteristics depend, particularly at high altitude, on the angle of dive (rate of increase of airspeed), on G-force and on the condition of the aircraft.

Below 15,000 feet the speed limitation is 450 knots or 0.83M, whichever is reached first. The aircraft is easily capable of exceeding its airspeed limitations, even in level flight. As speed increases there may be a slight change of longitudinal trim and at high Mach numbers buffet occurs. If a rapid longitudinal oscillation develops at or near the IAS or Mach number limitation, reduce speed as soon as possible until the oscillation ceases.

Between 15,000 and 25,000 feet the speed limitation is 0.83M. Above 25,000 feet, the speed limitation is the speed at which a strong nose-up change of trim occurs or 0.83M, whichever is reached first.

Up to about 35,000 feet, warning of the approach of severe compressibility is given by a strong nose-up trim change which is present as 0.83M is exceeded. Below this speed first symptoms are given by slight buffet which occurs at approximately 0.8M. At about 0.82M, buffet intensity increases and, immediately prior to the strong nose-up trim change, a slight nose-down change occurs. From the time that the nose-up change is encountered, the push force required to counteract it steadily increases. Lateral trim becomes sensitive and at these high speeds some lateral rocking is usually present.

Above 35,000 feet, warning of the approach of severe compressibility is similar to above, except that if speed is increased quickly the lateral rocking associated with the nose-up trim change is more marked, and above 45,000 feet the nose-up trim change tends to be more sudden.

As soon as compressibility effects become marked, irrespective of altitude but particularly at the highest altitudes, speed must be reduced, as the consequences of still further increasing speed are unpredictable and may be serious. Recovery from mild compressibility conditions is best made by throttling back, extending airbrakes to the MID position and easing the aircraft out of the dive. Take care to avoid high G which aggravates matters.

If control is lost, the engines must be throttled right back and the airbrakes extended to MID; on no account use OUT. About 10,000 feet may be lost before the Mach number has fallen to a figure at which control can be regained. During the recovery, G must be kept low to avoid overstressing the aircraft. Avoid use of the tail trimmer during recovery; take extreme care if it has to be used.

At all heights, if the engine thrust is high, only a shallow dive is needed to reach the speed limitation.

Descent

Emergency descent

The recommended technique for an emergency descent following cabin pressurisation failure at high altitude is to close the throttles, extend the airbrakes fully, open the flare doors if practicable and descend to FL400 at 0.79M; thereafter descend to an altitude below 25,000 feet at 0.75M/350 knots.

It is difficult to avoid over-controlling in pitch if the Mach meter is used as the main reference to initiate the descent. Initiate the descent by aligning the wings of the fixed aeroplane reference of the HGU approximately with the bottom of the green part of the horizon bar.

If the Mach number at which nose-up pitch occurs is exceeded, the rate of descent may well reduce to zero even if full forward control column movement is applied. In this case the Mach number reduces to about 0.75M before the descent can be re-established.

Rapid descent

To make a rapid descent, close the throttles, extend the airbrakes fully and descend at 0.79M to 25,000 feet, 0.75M/350 knots below. Higher speeds during a descent may cause damage to the integral tanks.

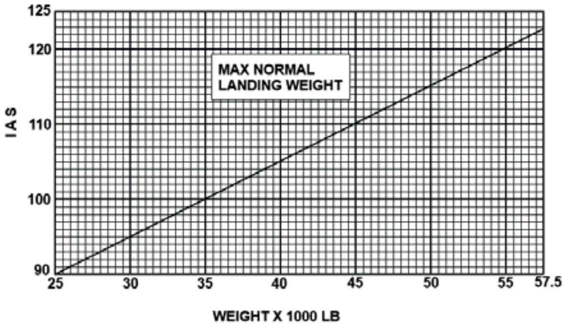
Normal descent

For a normal descent, close the throttles, extend the airbrakes to the MID position and descend at 0.75M until a coincident speed of 250 knots is reached; maintain this speed thereafter.

Circuit and landing procedures

Approach and landing

Carry out the **Before descent** and **Before landing** checks. Threshold speeds are shown below. These speeds may be increased by 5 to 10 knots when there is a strong surface wind or in gusty or turbulent approach conditions.



Threshold speeds

Normal landing

Ascertain the threshold speed corresponding to the aircraft weight. Make the initial approach at a minimum of threshold speed plus 35 knots. Attain this speed by the time the aircraft is lined up with the runway and lower flaps as required at any time after the start of the final turn. Above about 125 knots full nose-down trim is required when flaps are fully down.

When the aircraft is lined up with the runway with flaps down reduce speed gradually, aiming to cross the runway threshold at threshold speed with power on. Do not allow the speed to fall below the minimum approach speed, i.e. threshold speed plus 15 knots, nor reduce RPM below 60% until the decision to land has been made. Close the throttles just before touchdown. At high AUW there is a marked tendency to undershoot if the throttles are closed prematurely or too quickly.

When the main wheels are firmly on the runway, lower the nose-wheel and, when appropriate, apply the brakes. Aerodynamic braking is not recommended for a normal landing.

When landing at high AUW, it is important to trim out the nose-down change of trim which occurs as speed is reduced in the final stages of the approach; this is to ensure that adequate elevator control is available for the round-out.

Approximate All-Up Weights

Crew only – 29,000lb

Full fuel – 51,500lb

Flapless landing

Before making a flapless landing, reduce AUW as much as practicable, using the normal fuel drill. Make the initial approach at the normal threshold speed plus 35 knots.
When lined up with the runway, reduce speed further to not less than 20 knots above the normal threshold speed. The approach should be longer and slightly flatter than normal.

Throttle back early, aiming to cross the threshold 10 knots faster than the normal threshold speed for the same weight. After touchdown, lower the nose-wheel onto the runway and, when below maximum braking speed, apply the brakes.

Aerodynamic braking has little effect in the flapless configuration and is not recommended unless a brake pressure failure has occurred prior to landing.
If aerodynamic braking is used, careful elevator control is necessary to avoid striking the tail-skid on the runway during the landing run.

Crosswind landing

A crosswind landing presents no special difficulty, and the ‘crab’ technique is recommended. The maximum recommended crosswind component for landing is 25 knots.

Braking

Normal maximum braking speed

Normal maximum braking speed (NMBS) is the highest speed, for given conditions, at which maximum continuous braking may be applied and the aircraft brought to rest without loss of braking efficiency and without damage to the brakes. NMBS is obtained from the ODM. The brakes should not be applied at speeds above NMBS except in an emergency.

General

Braking efficiency is improved, especially on wet runways and or at low AUW, if the control column is moved rearwards as braking commences, thus transferring weight onto the main wheels. When the nose-wheel has lowered onto the runway the brakes can be used, dependent upon runway conditions, as follows:

Dry runway

On dry surfaces the maxaret units normally prevent the wheels from locking when excessive brake pressure is applied, but unless the shortest possible run is required, gentler use of the brakes is recommended. The aircraft is to be firmly on the ground before the brakes are applied as the maxaret units do not operate unless the wheels are rotating.

As a safeguard against locking of the wheels during a bounce, the maxaret units remain operative for several seconds. If a slip, skid or difficulty is experienced in keeping straight, release the brakes momentarily. In normal circumstances it should not be necessary to apply the brakes at speeds above 90 knots.

Wet runway

Retardation may be considerably reduced depending on the degree of runway wetness and the type of runway surface. Maximum braking efficiency is obtained by making a firm touchdown and then applying light intermittent braking as soon as the aircraft is firmly on the ground and the wheels have had time to spin up.

Once positive braking action has been established, use continuous braking as necessary to bring the aircraft to rest using the full length of the runway. Although the maxaret units are designed to prevent skidding, under the worst conditions even light braking may cause the wheels to spin down and eventually to lock. If this is suspected, release the brakes and give the wheels time to spin up before reapplying brakes gradually.

Flooded surfaces

With an appreciable depth of water on the runway (i.e. 0.2 inch or more) friction between the tyres and the surface is drastically reduced and aquaplaning may occur. In these circumstances braking action is virtually nil and, even though the brakes are not applied, the wheels may spin down to a stop. The speed at which total aquaplaning occurs is dependent upon the type of runway surface and the tyre tread pattern but, given the right conditions, the tyres may aquaplane at groundspeeds above about 95 knots. At lower speeds partial aquaplaning may still be present but braking action improves as speed is reduced further.

Because of this drastic loss of braking effect, avoid flooded runways whenever possible. If, however, a landing must be made, the recommendations above still apply but use aerodynamic braking for as long as possible, depending upon runway length. If the brakes have been applied, release them before the aircraft enters a pool and, if the control column is being held back to transfer weight onto the main wheels, move it forward to prevent the nose from rising.

Icy runway

Avoid landing on icy runways whenever possible due to the certainty of the drastic reduction in braking effectiveness. However, if a landing has to be made, extreme caution is required. Use the brakes most carefully, as continuous application of excessive pressure can lead to wheel locking and subsequent tyre damage. Aerodynamic braking may be used for as long as possible, depending on runway length.

Approach

Two engine approach

Reduce speed to below 190 knots and carry out the **Pre-Landing** checks. Calculate the threshold speed (see the graph on page 139).

When the landing gear is down, set the required RPM (about 70% at 35,000lb – 75% at 40,000lb AUW) to maintain a minimum of threshold speed plus 45 knots. Only small RPM adjustments should be necessary until the threshold is reached.

Lower the flaps when the glidepath is intercepted and reduce speed to threshold speed plus 35 knots. To achieve the desired rate of descent and at the same time counteract the nose-up change of trim as the flaps travel down, a steady push forward on the control column is required until the flaps are fully down and the aircraft is trimmed into the descent. With full nose-down trim applied, a residual push force remains until the speed is below approximately 125 knots.

Maintain threshold speed plus 35 knots until about 500 feet AGL, then reduce speed gradually aiming to cross the runway threshold at threshold speed. Do not allow the speed to fall below threshold speed plus 15 knots or reduce RPM below 60% until committed to a landing.

Automatic ILS approach

General – It is assumed that the initial automatic ILS approach starts at a point approximately 10 to 15 miles from the runway threshold. Entry to this point may be from a high-level penetration or a low-level pattern; either may be flown manually or on normal autopilot. Use of the autopilot to effect height changes may result in a loss of precision. Always maintain the longitudinal trim within the ‘in-trim’ sector of the autopilot trim indicator.

Initial approach – At 10 to 15 miles from the downwind end of the runway on the approach side, check that the ILS is on, that the localiser transmitter is correctly identified and that the flags on the ILS indicator have disappeared. The autostabiliser should be ON. Reduce speed to threshold plus 45 knots with landing gear down and set the localiser QDM, corrected for drift, on the heading selector. When at an angle of less than 170° to the final approach heading, the TRACK switch may be pulled on. The aircraft should close the beam at about 70° to the QDM and then turn smoothly onto the centre line of the beam, with possibly one slight overshoot.

Final approach – When settled on the centre of the beam, make any corrections necessary to the setting on the heading selector to compensate for drift. When the glidepath needle begins to move away from the maximum 'fly up' position, select flaps DOWN and re-trim by applying full nose-down trim; the aircraft can still be flown satisfactorily although the autopilot indicator is at the extreme end of the 'in-trim' sector. The out-of trim force is 10 to 15lb nose up.

After lowering the flaps increase RPM by 5-7% to maintain a minimum speed of threshold plus 35 knots. When the glidepath needle indicates one dot 'fly-up', pull the GLIDE switch on. On intercepting the glidepath reduce speed to the threshold speed plus 20 knots. Hold the speed constant by use of throttles throughout the approach and monitor the trim indicator frequently. Scan the instruments and the ILS indicator as for normal instrument approaches to detect any malfunction of the autopilot. If any malfunction is suspected, disengage the autopilot immediately and continue the approach manually or break off as required. The approach is to be discontinued if the glidepath or localiser needles reach full-scale deflection before the decision altitude.

Decision altitude procedure – When decision altitude is reached, the autopilot should be disengaged and the approach completed manually. If the recommended speeds have been used, no difficulty should be experienced in landing normally on the ILS touchdown point. However, exercise great care to reduce speed to the correct threshold speed as quickly as possible after passing decision altitude.

Overshooting

An overshoot followed by an instrument approach and landing requires about 1,750lb of fuel.

Open the throttles smoothly to 90% RPM, checking carefully that symmetrical thrust is being obtained, particularly between 80 and 90% RPM; as RPM are increased there is a nose-up trim change. Select the landing gear and flaps up in quick succession to avoid exceeding the speed limitations (both systems travel together taking a total time of about 20 seconds to retract; the landing gear retracts in about 10 seconds). There is a strong nose-down change of trim during the last half of flaps travel, so anticipate this by progressive application of nose-up trim as the flaps retract. The aircraft accelerates rapidly and any tendency to sink is easily held.

If an engine malfunction occurs when RPM are being applied for an overshoot, raise the flaps immediately (above 200 feet AGL) and increase RPM on the serviceable engine within the limit of directional control only. If the malfunction occurs below 600 feet AGL the aircraft is to be landed, if possible on the runway and preferably with the landing gear down. The overshoot may only be continued if by 600 feet AGL the flaps are fully retracted and the speed is above the asymmetric initial approach speed.

Overshooting below 200 feet AGL is not recommended because of the possibility of an engine malfunction occurring during acceleration from low RPM, causing high asymmetric thrust and consequent directional control problems at low level with low airspeed.

Roller landing

Extreme care is necessary when carrying out a roller landing because of the risk of developing high asymmetric thrust. If it becomes necessary to go round again from the runway, careful throttle handling and engine monitoring is essential and the following precautions must be observed:

- After touchdown lower the nose-wheel onto the runway.
- Keeping the throttles together, increase RPM, slowly initially to allow the engines to accelerate at the same rate. This is particularly critical up to 80% RPM.
- At 90% RPM with the throttles aligned, compare JPT and check that symmetrical thrust is being obtained before opening the throttles further.
- Keep the nose-wheel on the runway until the engines are at 90% RPM and 'rotate' speed has been achieved (10 knots below unstick).
- If at any time prior to unstick an engine malfunction is suspected or there is any indication of asymmetric thrust, the throttles are to be closed immediately and the take-off aborted.

Checks after landing

Carry out the **After landing** checks.

Shutdown procedure

Before stopping the engines, trim the tailplane to fully nose down and then give one 'blip' up on the tail trim switch to ease tension on the tailplane microswitch spring.
This prevents ingress of moisture to the actuator jack.

Carry out the **Shutdown** checks.

Asymmetric flying

Stopping an engine in flight

If an emergency or malfunction necessitates shutting down an engine in flight or when practising emergency procedures, shut the HP cock and carry out the appropriate **Engine Fire in the Air** or **Engine Failure** drill (see the CHECKLISTS section). When shutting down an engine in flight in circumstances that do not require the immediate shutting of the HP cock, use the following sequence:

- Switch OFF the generator
- Check DC voltage and confirm that the other generator warning light is out
- Select the HP cock OFF
- Leave the engine master LP cock ON and switch OFF the appropriate LP pumps and engine air switch
- NEVER carry out simulated flame-out drills on approach

Flying on one engine

WARNING: In turbulent or gusty conditions, avoid coarse aileron application for lateral control because the significant yawing forces generated can call for balancing rudder in excess of that available when using asymmetric thrust.

The aircraft has good single-engine performance and the rudder trim is powerful enough to trim out all foot loads at normal cruising speeds. 90% RPM maintains a speed of about 375 knots in level flight below 5,000 feet.

Flight in icing conditions is to be avoided because of lack of protection on the dead engine.

Relighting an engine in flight

If an engine flames out and there are no indications of mechanical failure, an immediate relight may be attempted at any altitude and airspeed by pressing the relight button, leaving the throttle at its set position. A successful relight is indicated when the RPM stabilise and then begin to rise. It is probably necessary, particularly at high altitude, to close the throttle after the RPM have stabilised, in order to stop the JPT rising beyond the limits. If JPT increases without a corresponding increase in RPM, close the throttle and open it again slowly.

Engine failure on approach

If an engine failure occurs during a normal engine approach, proceed as follows:

Above 600 feet AGL – If above 600 feet AGL (VCH, visual committal height) decide whether to continue the approach or to overshoot. If possible, continue the approach, but an overshoot may be made provided that the flaps can be fully retracted and the initial asymmetric approach speed can be achieved with wings level by 600 feet AGL.

To overshoot use the procedure recommended above, selecting landing gear and flaps up together. To continue the approach to land, increase RPM on the live engine within the limits of directional control, raise the flaps immediately and recover to the normal glidepath at the appropriate asymmetric approach speed. Adjust RPM thereafter as required.

Below 600 feet AGL – If below 600 feet AGL the aircraft must be landed, if possible on the runway and preferably with the landing gear down. Increase RPM on the live engine within the limits of directional control to counteract any increase in the rate of descent, then:

- Above 200 feet AGL – If above 200 feet AGL raise the flaps immediately. As the flaps retract and the speed increases, adjust RPM to achieve and maintain the asymmetric final approach speed.
- Below 200 feet AGL – If below 200 feet AGL little advantage is gained by raising the flaps. However, at the normal minimum approach speed with flaps down it should be possible to apply sufficient RPM within the limits of directional control to make a safe landing.

Asymmetric approach, landing and overshoot

Carry out the **Before landing** checks but instead of calculating the threshold speed, use the asymmetric initial and final approach speeds for the AUW shown in the following table. A straight-in instrument approach is recommended. If a visual circuit is flown, extend the downwind leg to give a longer approach path. Start the finals turn so as to roll out between 650 and 750 feet AGL on the extended centreline and on the normal glidepath to allow sufficient time to stabilise the approach before reaching VCH.

MINIMUM ASYMMETRIC APPROACH SPEEDS		
	Below 45,000lb	**Above 45,000lb**
Initial approach speed to 600 feet AGL (VCH)	150 knots	160 knots
Final approach speed from 600 feet AGL until certain of landing	135 knots	145 knots

To avoid using high asymmetric thrust on an instrument approach, do not lower the landing gear until the start of the glidepath descent. About 75% RPM are required at an AUW of 35,000lb. When carrying out a visual circuit at high AUW, landing gear lowering may be delayed until near the end of the downwind leg. Whenever limited **Before landing** checks, excluding landing gear lowering, have been carried out, they are to be completed when the landing gear is selected down by confirming 'three greens' and checking the brakes.

For asymmetric approaches it is recommended that the rudder trim be set to neutral immediately before commencing final descent.

The approach should be made using a 3° glidepath. Do not reduce speed below the recommended initial approach speed, nor height below 600 feet AGL (VCH) until the final decision to land is made. When committed to a landing, reduce speed progressively by use of the throttle (minimum 60% RPM) to not below the recommended final approach speed. Maintain this speed until absolutely certain of crossing the threshold, then close the throttle. Flaps may then be lowered to reduce the landing run but must never be selected DOWN above 100 feet AGL. At speeds below 125 knots the nose-up change of trim as the flaps move fully down is negligible. However, the change of trim becomes progressively more marked at the increased speeds associated with higher AUW.

The calculation of threshold speed for asymmetric landing is considered unnecessary, since if the technique is correctly used the speed over the threshold is always above the flapless threshold speed.

An overshoot can be made safely provided that the wings are level, the flaps are up, the speed is at least 150 knots and height is 600 feet AGL (VCH) at the start of the overshoot. Great care must be taken when adjusting in the higher RPM range because the rate of change of thrust is large for small throttle movements. As soon as the decision to overshoot is made, maintain the speed at not less than the initial approach speed, by diving if necessary, ensure that the wings are level and then increase RPM on the live engine to not more than 85%, maintaining the slip ball central by progressive application of rudder.

Retract the landing gear and check that the flaps are up. Initiate the climb away, maintaining the speed at not less than the initial approach speed. If necessary, RPM may be subsequently increased further, provided directional control can be maintained (slip ball held central) by use of rudder.

The initial overshoot setting of not more than 85% RPM is normally sufficient for a climb back to circuit height. If 85% RPM does not produce a satisfactory climb performance for any reason, allow speed to increase so that additional RPM can be used safely or, if height is critical, apply up to 10° of bank towards the live engine.

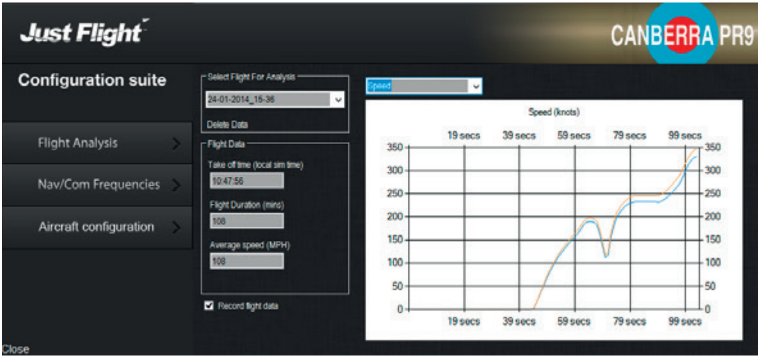
FLIGHT ANALYSIS TOOL

The Canberra Flight Analysis Tool can be accessed by going to **Start > Just Flight > Canberra PR9** (or by selecting the Windows Tile screen if you are using Windows 8).

The tool has three sections:

- Flight Analysis
- Nav/Com Frequencies
- Aircraft Configuration

Flight Analysis



This section displays information about all flights previously flown in the Canberra PR9.

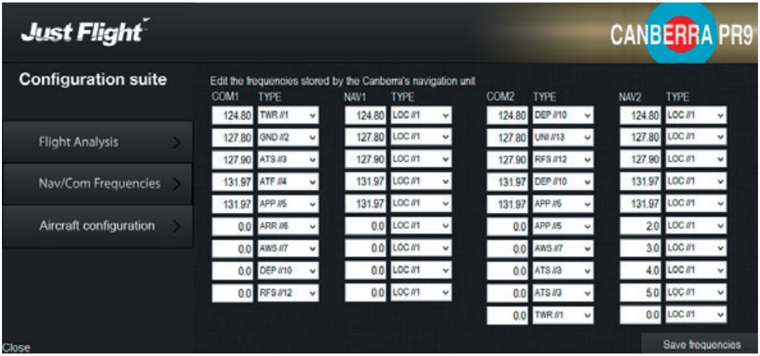
Flight data can be located by time and date using the 'Select Flight Data' drop-down list. The format for each entry in this list is 'Day – month – year – hours – minutes'.

Once a flight has been selected, the various graphs and data boxes will be populated with the relevant information. To cycle through the available graphs use the drop-down list located above the graphs.

If you do not wish to record flight data for the Canberra, please untick the 'Record Flight Data' box found below the Flight Data panel.

If you wish to delete any saved data from your PC, click on the 'Delete Data' text button. This will open up the folder where this data is located, allowing you to delete the relevant data.

Nav/Com Frequencies



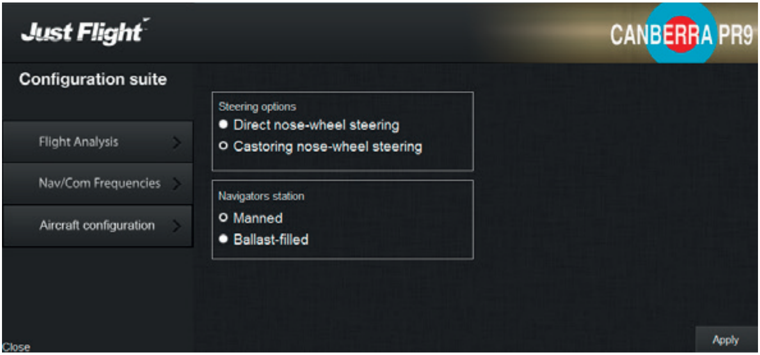
The GTN650 and SL30 units fitted to the Canberra have functionality which allows for the saving of commonly used frequencies (see pages 63 and 64 for more details on this function).

This section of the tool allows you to manage these saved frequencies by manually adding, modifying or removing data directly from the GTN 650 and SL30 memory.

Enter the frequency you wish to save into any of the COM1, NAV1, COM2 and NAV2 boxes. The corresponding TYPE dropdown menus are for assigning the frequency type reminder that will be shown on the unit.

No changes will be made until the ‘Save frequencies’ box in the bottom right corner has been clicked.

Aircraft Configuration



Steering options

Direct nose-wheel steering or Castoring nose-wheel steering.

This option will select between these two simulation methods of steering the Canberra on the ground.

Navigator's station

Manned or Ballast-filled.

Although the weight and ballast of the aircraft will not be affected between these two options, oxygen will only be active in the Navigator's station with the 'Manned' option selected.

CHECKLISTS

Note: *These checklists are also available on an interactive 2D panel in the aircraft. Please refer to the Panel Guide section for more details.*

Initial

External power	OFF
Landing gear selector	DOWN, 3 greens
Top tanks cock	OFF
Canopy demist	OFF
Battery	OFF
External power	ON, 28v

External

Engine blanks	REMOVED
Landing gear locks	REMOVED
Aileron locks	REMOVED
Pressure head covers	REMOVED
Static vent plugs	REMOVED

Internal

Dump switch	DUMP, check light, NORMAL
Battery (if no external power)	ON
Avionics master	ON
Audio Panel	NORMAL, volume set
Canopy	Selected OPEN
Battery	OFF
Internal lighting	As required
Anti-icing	ON
Canopy jettison handle	Cover flat
External lights master	ON
External lights	As required
Flare doors	OPEN
Anti-icing	Check MIs are WHITE then OFF
JPT controllers	ON, CRUISE
Throttle levers	Full and free movement, HP cocks OFF
Dump switches	NORMAL

Flaps	Selected UP
Landing gear selector	DOWN, 6 greens
Emergency gear handle	IN
Autostabiliser	OFF
Airbrakes	Selected IN
Emergency lamps	Tested then OFF
Demist handle	IN
Aileron gear	LOW ALT, MI black
Rudder and aileron fail lights	ON
Cabin pressure warning light	Tested
Fire warning lights	Tested then OUT
Standby AI	Test on STANDBY then to NORMAL
Autopilot trim indicator	Central
Ready and engage MIs	Check BLACK
Oil pressure MIs	Check WHITE
Generator warning lights	Check ON
Electric starter enabled/engaged lights	TEST
Roll damper	OFF
Radio altimeter	OFF
Pitot heat	As required
Vent valve heaters	OFF
Master LP cocks	ON
Integral tank cocks	NORMAL
Cabin altimeter	Check reading ZERO
Hydraulic pressures	Check reading ZERO
Compass/D GYRO switch	COMPASS
Engine air switches	OFF
Cabin air	HOT
Autopilot	OFF, channels OUT
No. 2 inverter ground test switch	OFF
Start master/ignition switches	OFF
Fuel contents	CHECKED
Rear tank cocks	OFF
Rear tank LP pumps	ON, check fuel pump warning lights ON
Rear tank cocks	ON, check fuel pump warning lights OFF
NAV/COM (1/2)	Frequency selected
Generator CBs	CLOSED
Generator switches	ON
Inverter selector switch	No. 2, guarded
AC voltmeter switch	No. 1
Rudder feel pressure	Check ZERO

Starting

Start clearance	Obtained
Parking brake	ON, check pressure 1,500 PSI
Strobe lights	Upper RED
Left engine	Clear
Left start master switch	ON
Standby inverter MI	Check WHITE
HGU flag	Check BLACK
Standby AI	Check flag clear
No. 1 inverter	Check 115v, 400Hz
Right engine	Clear
Right start master switch	ON
Right electric start enable switch	ON
Right electric start enable light	Check ON
Volt meter (avionics panel)	Check 124v DC minimum
Ignition switches	ON
HP cocks	OFF
Belly LP pumps	ON
Fuel pump warning lights	OUT
Right HP cock	OFF
Right starter button	PRESS
Electric starter motor engaged light	Check ON
Right HP cock	OPEN when RPM 12-14%
RPM	Check rising
JPT	Below 700°C
Fire warning lights	Check OUT
Oil pressure	MI black
Generator warning light	Check OUT
Electric starter motor engaged light	Check OFF
Standby inverter MI	Check BLACK
Flare doors	CLOSED
Idling RPM	31-34%
JPT	Below 625°C
Hydraulic pressures	2,650 to 2,750 PSI
Rudder/aileron fail lights	check 100% OFF, 50% ON
Left electric start enable switch	ON
Left electric start enable light	Check ON
Left HP cock	OFF
Left starter button	PRESS
Electric starter motor engaged light	Check ON

Left HP cock	OPEN when RPM 12-14%
RPM	Check rising
JPT	Below 700°C
Fire warning lights	Check OUT
Oil pressure	MI black
Generator warning light	OUT
Electric starter motor engaged light	Check OFF
Idling RPM	31-34%
JPT	Below 625°C
Rudder/aileron fail lights	Check OFF
Electric start switches	OFF

After start

External power	DISCONNECT
AC volt meter	No. 2, check 115v, 400Hz
Battery	ON, check 28v
Canopy	As required
Anti-icing	As required
Flaps	Selected UP
Trims	NEUTRAL
Airbrakes	IN
Entrance ladder	Removed
HGU	Erect, button out and free
HSI	Power failure flag clear
No. 6 inverter	ON
Compasses	MRG, G4B and E2B checked
LP pumps	Belly and integrals ON
Radio altimeter	ON, 50ft selected
Navigator hatch	CLOSED
Pitot heat	ON
Hydraulic pressures	2,650-2,750 PSI
Engine air switches	As required
Feel simulator pressures	160-200 PSI
Flying controls	Full and free movement
Autopilot	OFF, channels OUT
COM2	Tested
Altimeter	As required, test STBY and RESET
Transponder	GROUND
TaxI clearance	Obtained

Taxi

Taxi lamps	As required
Brakes (on moving)	Check drop and then rise to 2,750 PSI
Flight instruments	All checked

Before take-off

Parking brake	ON
Canopy	Locked
Taxi lamps	ON
Flare doors	CLOSED
Anti-icing	As required
JPT controllers	OFF and MAX
Flaps	Selected and indicated UP
Autostabiliser	STANDBY
Trims	NEUTRAL
Airbrakes	Selected and indicated IN
Aileron gear	LOW ALT, check MI BLACK
HGU	Erect, button free, flag BLACK
Altimeter	STBY
Standby inverter MI	Check BLACK
Compasses	Check readings
HSI	Flags clear, mode selected
Standby AI	Flags clear
Engine instruments	Check
Oil pressure MIs	Check BLACK
Generators	Lights out, 28v
Roll damper	OFF
Radio altimeter	Tested
Take-off panel	All switches UP
Hydraulic pressures	2,650-2,750 PSI
Engine air switches	ON
Cabin air	As required
Oxygen	As required
Autopilot	OFF, channels OUT
AC volts/frequency	Check 115v, 400Hz
Feel simulator pressures	160-200 PSI
Fuel contents	Checked
Top tanks cock	ON
Rear tank cocks	ON

LP pumps	All ON
Flying controls	Check full and free
Rudder/aileron fail lights	OUT
Transponder	As required
Strobe lights	As required
Pins	Stowed
Safety speed	150kts at 90%, 170kts at 100%

After take-off

Wheel brakes	ON then OFF
Landing gear	UP
Safety speed	Climbing RPM set
170 knots	Landing gear lights out
Landing lamp	OFF
JPT controllers	Check JPT, ON and MAX
Autostabiliser	ON below 250 knots at safe height

Transition altitude

Altimeter	STBY
LP pumps	As required
Taxi lamps	As required

Climbing

Oxygen	Contents and flow checked
Electrics	Check AC 115v, 400Hz, MI black, DC 28v
Engines	Within limits
Fuel distribution	Checked
Cabin pressure	Checked

Before descent

Weather and airfield state	Checked
Fuel distribution	Checked
Radios	Frequencies selected
Altimeter	As required, to STBY
Radio altimeter	ON, scale and limit set
Demist controls	As required

Safety altitude	Checked
Taxi lamps	As required
Anti-icing	As required
JPT controllers	OFF
Autostabiliser	As required
Aileron gear	LOW ALT, check MI BLACK
Roll damper	OFF
Autopilot	OFF
Airbrakes	MID
Airspeed	Hold 250kts/0.75M

Before landing

Anti-icing	As required (minimum 70% in icing)
Airbrakes	IN
Landing gear	DOWN, 3 greens (190kts MAX)
Fuel contents	Checked
LP pumps	Minimum two ON per engine
Brakes	OFF (2,650 PSI minimum)

After landing

Transponder	GROUND
Strobe lights	Upper RED
Taxi lamps	As required
Landing lamp	As required
Anti-icing	As required
Trims	As required
Cabin air	HOT
Engine air switches	OFF
Dump switches	Both NORMAL
Canopy	As required
Flaps	UP
Demister	OFF
Fire warning lights	OUT
Radio altimeter	OFF
LP pumps	As required
Take-off panel	Heaters as required
Autopilot	OFF

Shutdown

Parking brake	ON
Anti-icing	OFF
Tailplane	Full nose down, one blip UP
Right throttle lever	HP cock OFF
Flare doors	OPEN
Flaps	DOWN
Main hydraulic pressure	2,650-2,750 PSI
Aileron 50% fail light	Check ON
Left throttle lever	HP cock OFF
Start master and ignition switches	OFF
LP pumps, top tanks and rear tank cocks	OFF
No. 6 inverter	OFF
Pitot heat and vent valve heaters	OFF
NAV/COM (1/2)	OFF
JPT controllers	OFF
Autostabiliser	OFF
Strobe lights	OFF
External lights	OFF
E2B light dimmer	OFF
Parking brake	OFF
Rudder/aileron fail lights	Check ON
Master LP cocks	OFF
Internal lights	OFF
Avionics master	OFF
Battery	OFF

Engine fire in the air

Immediate actions

HP cock	OFF
Master LP cock	OFF
LP pumps	OFF
Fire extinguisher button	Press

Subsequent actions

Re-check Immediate actions	
Generator	OFF
Electrics	Shed load

Transponder	EMGY
Engine air switch	OFF
DC volts	Monitor

Engine mechanical failure

Immediate actions

HP cock	OFF
Master LP cock	OFF
LP pumps	OFF
Fire warning light	Monitor

Subsequent actions

Re-check Immediate actions

Generator	OFF
Electrics	Shed load
Engine air switch	OFF
DC voltage	Monitor
Transponder (if necessary)	EMGY

Do not relight, watch for indication of fire

Flame-out (no indication of mechanical failure)

Immediate relight

Press relight button with throttle at set position, then keep JPT within limits by throttling back if necessary.

If no relight within 20 seconds

HP cock	OFF
LP pumps	OFF

Subsequent actions

Re-check HP cock and LP pumps	OFF
Generator	OFF
Electrics	Shed load
Engine air switch	OFF
DC voltage	Monitor

Attempt **Normal relight**

Double flame-out

1. If below maximum altitude for relight (see below), first switch on another LP pump
2. Attempt an immediate relight on one engine
3. If this is unsuccessful, complete Flame-out drill for both engines, but reduce electrical load to minimum
4. Descend below maximum relight altitude. Maintain at least 150 knots during descent
5. Attempt Normal relight (see below) on each engine in turn

Normal relight (after completion of Flame-out drill)

Altitude/speed	Within limits (above)
Master LP cock	ON
LP pump	ON, FPWL out

Press relight button while moving throttle to HP cock ON, throttle closed

When RPM start to rise

Relight button	Released
Throttle	Moving slowly to half open
Fire warning light	OUT
JPT and oil pressure	Normal

When RPM and JPT stabilise

Throttle	Set as required
Generator	ON, warning light out
DC voltage	28v
Engine air switch	ON

Resume electrical services in stages

Failure to relight

If no relight is obtained within 20 seconds of pressing relight button, set HP cock to OFF. Repeat relight procedure after one minute at lower altitude and lower airspeed.

Fire on the ground

HP cocks	OFF
Master LP cocks	OFF
LP pumps	OFF
Fire extinguisher button(s)	Press
Inform ATC if possible	
Battery	OFF

Leave the aircraft (see **Emergency Evacuation on the Ground**)

Emergency evacuation on the ground

HP cocks	OFF
Battery	OFF
Safety pins	Safe for parking (if time permits)
Leave the aircraft by normal exits	
When safe to do so, make aircraft	Safe for parking

Hydraulic systems failures

1.

Rudder failure light	Aileron failure light
AMBER	-

Probable cause

Services system failure (Hydraulic Pressure below 2,250 PSI).

Probable effect

Loss of normal control of main services. No further reserve system available for rudder power.

Recommended actions:

A. See Notes 1, 2 & 3. Land as soon as practicable

B. Use UC emergency lowering handle and pump landing gear down

C. If necessary use hand pump to build up brake pressure

2.

Rudder failure light	Aileron failure light
-	AMBER

Probable cause

Right system failure (Hydraulic Pressure below 2,250 PSI).

Probable effect

No further reserve system available for rudder power.

Recommended action

Land as soon as practicable.

3.

Rudder failure light	Aileron failure light
AMBER	AMBER

Probable causes

Left system failure

or

Right and services system failure (Hydraulic Pressure below 2,250 PSI).

Probable effects

No further reserve system available for rudder or aileron controls

or

as in **1.** above and no further reserve for aileron controls.

Recommended actions

A. Land as soon as practicable
B. Check hydraulic pressure
C. If services system unserviceable, proceed as per **1.** above

4.

Rudder failure light	Aileron failure light
RED	**AMBER**

Probable cause

Left and services system failure (Hydraulic Pressure below 2,250 PSI).

Probable effects

Total loss of rudder control. No further reserve system for aileron control. Loss of normal operation of main services.

Recommended actions

A. (See Notes 1 & 3) Determine, at altitude, whether able to land safely with control available. If not, eject

B. If landing, proceed as per **1.** above

5.

Rudder failure light	Aileron failure light
AMBER	**RED**

Probable cause

Left and right systems failures.

Probable effect

Total loss of all aileron control.

Recommended action

Eject.

6.

Rudder failure light	Aileron failure light
RED	RED

Probable cause

Total hydraulic failure.

Probable effect

Total loss of rudder and aileron control and normal use of main services.

Recommended action

Eject.

Diagnosis of faults indicated by the rudder and aileron warning lights, and the appropriate action to be taken:

Note 1: *To conserve hydraulic fluid and pressure (cases 1 and 4), leave airbrakes in, flare doors closed.*

Note 2: *Before lowering the landing gear (cases I and 2), consider distance to go, fuel state, landing conditions and runway suitability, and balance against the likelihood of further failure.*

Note 3: *With a services hydraulic system failure, do not operate the wheel brakes before landing; land flapless and then use continuous progressive braking. Do not taxi.*

Note 4: *In cases 4, 5 and 6 some hydraulic power may remain for a short time after the warning lights have come on, due to residual pressure in the hydraulic accumulators. The duration of this power is unpredictable and the failures described must still be regarded as imminent.*

Brakes

- Raise pressure with hand pump if possible
- Do not operate brakes before landing
- Reduce weight by normal fuel drill
- HP cocks OFF at touchdown
- Touchdown at lowest practical speed, then hold nose up as long as possible (use tail trim)
- Use hand pump to maintain pressure whilst holding single application of brakes. Avoid maxaretting.

Note: *Flaps probably not available; use longest runway available.*

AIRCRAFT DATA

Take-off data

AUW (lb)	Approx. Fuel (lb)	Unstick Speed	EMBS Flaps Up	EMBS Flaps Down
42,000	12,000	120	111	120
45,000	15,000	125	107	115
48,000	18,000	130	104	110
53,000	22,000	138	98	104
56,000	25,000	142	96	99
57,500	26,000	145	95	97

All speeds based on 8,000ft runway, 1013mb and 15°C. For conditions other than these, correct as follows:

EMBS (Flaps up)

For every 10mb above 1,013mb + 1 knot
For every 10mb below 1,013mb - 1 knot
For every 4°C above +15°C - 1 knot
For every 4°C below +15°C + 1 knot
Add half the headwind component and subtract one and a half of the tailwind component.

EMBS (Flaps down)

From the above table, take the difference between EMBS flaps up and flaps down; add to corrected EMBS (flaps up).

Stop speed

Add 15 knots to corrected EMBS (flaps up) speed. Apply runway length correction:
For every 1,000ft above 8,000ft + 4 knots
For every 1,000ft below 8,000ft - 4 knots

Wet runway

Subtract 3 knots from all corrected stop speeds.

Take-off RPM (basic = 90%)

Temperature effect:

For every 6°C above +10°C	Add 1%
For every 6°C below +10°C	Subtract 1%

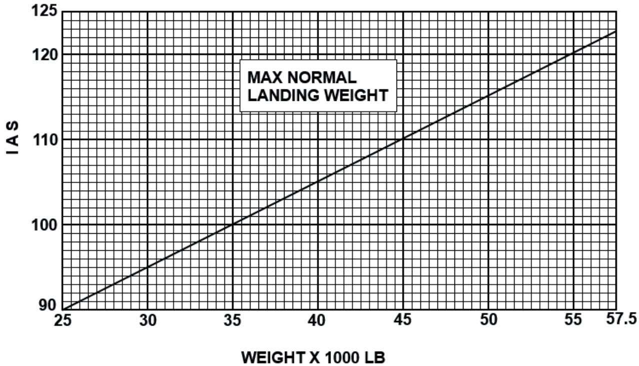
Pressure effect

For pressure variations of up to ±50mb from 1,013mb, the correction required is less than 10% RPM. For variations greater than 50mb, refer to the ODM.

Descent

	Normal	Rapid
Throttles	Closed (in icing 70% RPM min.)	Closed
Airbrakes	MID	OUT
Speed	0.75M / 250 knots	0.75M to FL400 then 0.75M/350 knots

Threshold speeds



Normal approach speeds

Minimum initial approach speed	Threshold + 35 knots
Minimum approach speed	Threshold + 15 knots

Flapless landing

Minimum initial approach speed	Normal threshold + 35 knots
Minimum approach speed	Normal threshold + 20 knots
Threshold speed	Normal threshold + 10 knots

Asymmetric approach speeds

	Below 45,000lb AUW	Above 45,000lb AUW
Minimum to 600ft AGL (VCH)	150 knots	160 knots
Minimum from 600ft AGL (VCH) until certain of landing	130 knots	145 knots

Warning: *Flaps must not be lowered above 100 feet AGL.*

Engine limitations

Rating	Time limit per flight	%RPM	Max. JPT ºC
Take-off	10 minutes (combined total)	100±0.5* (max.)	750**
Intermediate	30 minutes	97.5 (max.)	720
Maximum continuous	Unrestricted	95 (max.)	705
Ground idling	Unrestricted	31 to 34	625

* During climbs using the Take-off and Operational Necessity rating, the governed speed may be permitted to rise to 102.5%.

** Maximum JPT may be exceeded for a period of not more than 15 seconds during rapid acceleration.

Fuel management drill

Stage	Condition	Top tanks cock to belly tank	Belly tank pumps	Rear Tank		Integral Tanks	
				Pumps	Cocks	Pumps	Cocks
Tanks full		OFF	OFF	OFF	ON	OFF	NORMAL
1	Start up and taxi	OFF	ON	OFF	ON	OFF (ON for taxiing)	NORMAL
2	Take-off, climb and initial cruise	ON (Note 2)	ON (Note 2)	ON	ON	ON (OFF) (Note 1)	NORMAL
3	When top tanks read 6,000lb	ON	OFF	ON	ON	OFF (Note 3)	NORMAL
4	When rear tank reads 1,000lb	ON	ON	OFF	ON	OFF	NORMAL
5	When top and belly tanks combined read 3,000lb	ON	OFF (Note 3	OFF	ON	ON	NORMAL
6	When integral tanks read 500lb each, transfer to rear tank	ON	ON (one pump)	ON (one pump)	ON	ON (until transfer complete)	TRANSFER
7	When rear tank reads 750lb or the belly tank reads 1,750lb and for landing	ON	ON	ON (OFF when empty)	ON (OFF when empty)	OFF (Note 4)	TRANSFER (Note 4)

Note 1: *During stage 2, integral tank pumps are selected OFF when integral tank gauges show a drop.*

Note 2: *During stage 2, monitor that the top tanks reduce.*

Note 3: *In low temperatures, exercise and check operation of LP pumps (stage 4 integral, stage 5 for belly) for 5 minutes at 30-minute intervals.*

Note 4: *An integral tank pump may be ON with the associated cocks at NORMAL for landing if associated tank contains more than 500lb.*

Speed limitations

Condition	Maximum IAS (knots)	Maximum IMN
Clean or with airbrakes in MID position	450 (Note 1)	0.83 or when strong nose-up trim change occurs, whichever is reached first
Airbrakes fully out	400 below 12,500ft (Note 1)	0-75 12,500ft to 25,000ft 0-79 above 25,000ft
Landing gear down	190	
Flaps down	160	

Note 1: *362 knots in turbulence at AUW below 42,600lb.*

Maximum weights

Take-off and all permitted forms of flying: 53,300lb

Normal for landing: 40,000lb

Note: *In emergency the aircraft may be landed at higher weights but care must be taken to reduce landing shock to a minimum and in the use of brakes.*

G-force limits

	With negligible aileron		With aileron applied	
Condition	Integral tanks or more full	Integral tanks less than full	Integral tanks or more full	Integral tanks less than full
Up to 48,000lb	3.2G	3.2G	2.0G	1.5G

Note: *The application of negative G is to be avoided.*

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For more information about Midair Squadron and forthcoming flying dates for Canberra XH134, see the website at www.midair-squadron.com.

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NOTES

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