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PURPOSE

This student guide is designed to complement computer-aided instruction (CAI), mediated interactive lecture (MIL), and basic information found in the T-6B Flight Manual. It contains course objectives, references, assignments, graphics, and practice exercises. Before beginning each lesson, study the objectives. These tell you what you are expected to learn. The reading assignments preview the block of instruction and should be accomplished prior to CAI and MIL instruction. Graphics are intended to give you a personal, condensed version of the lesson with space provided for your notes. The practice questions are designed to give you an indication of how well you know the material and also provide an excellent review for the course test.
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OVERVIEW
This lesson discusses the location and function of components, indicators, and controls of the electrical system. This lesson is designed to provide you with basic knowledge of the electrical system in order to provide a foundation of understanding for electrical system operation.

REFERENCES
Personnel: None
Media Facilities: Student CAI Workstation
Support Resources: T-6B Flight Manual; T-6B Systems 2 Student Guide

STUDENT ASSIGNMENTS
Read applicable portions of T-6B Flight Manual, Section I.
Complete CAI lesson SY201, following along with this student guide.
Complete the practice questions provided.

LESSON OUTLINE
Topics in this lesson must be taken in sequential order. All topics must be completed prior to attempting the end of lesson quiz. The estimated time required to complete this lesson is 1.2 hours.
Introduction

T-6B Electrical System

Electrical System Overview

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Electrical System Components

The T-6B electrical system includes a 28 VDC, 300 ampere (amp) starter/generator, a 24 VDC lead acid battery, a 24 VDC auxiliary battery, and an external power receptacle.

Figure SY201-1 – Electrical System Components
Buses

The components of the electrical system are wired together through a battery bus and a generator bus. A bus tie switch allows isolation of these buses if required.

Circuit Breakers

Each electrical distribution circuit is protected by a circuit breaker. All circuit breakers are grouped on panels according to the bus on which they operate. These panels are located on side consoles in the front and rear cockpits.
**Primary Power**

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<td>Match primary power-generator system components to functions</td>
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<td>1.19.1.0.5</td>
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**Starter/Generator**

Primary aircraft electrical power is provided by the generator function of the starter/generator, located on the engine accessory gearbox at the rear of the engine.

**Generator Functions**

The generator provides 28 VDC power and is capable of supplying 300 amps. This capacity is sufficient to operate all equipment on both the generator and battery buses.

There is sufficient excess power from the generator to charge the battery and the aux battery to 24 VDC.
Generator Control Unit

The starter/generator is regulated and monitored by a generator control unit located under a panel in the aft cockpit.

This unit provides voltage regulation, overvoltage and undervoltage protection, and generator overload protection by tripping the generator offline in the event of malfunction.

Figure SY201-6 – GCU Location

Generator Control Switch

Power from the generator is controlled by a generator control switch, placarded GEN, located in the right front portion of each cockpit on the right forward switch panel.

Figure SY201-7 – Front and Rear Cockpit Right Forward Switch Panels
Generator Control Switch Operation

The generator control switches are magnetically held and electrically interlocked. This allows the generator to be controlled from either cockpit.

The occupant of either cockpit may move the respective generator switch to ON, which sets the switch in the other cockpit to OFF.

Once control has been transferred in this manner, generator function is controlled by whichever switch is set to ON.

Generator Control Power

Power for the generator control switches is provided by a circuit breaker labeled GEN SW on the front cockpit generator bus circuit breaker panel.

Figure SY201-8 – Generator Control Circuit Breaker
**Electrical Distribution**

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**Generator Bus**

T-6B electrical power is distributed across two buses, the generator bus and the battery bus.

The generator bus is divided into a front and rear bus for the respective cockpits.

The front cockpit generator bus powers the rear generator bus and the front cockpit avionics bus.

The rear cockpit avionics bus is powered by the forward generator bus through the front cockpit avionics bus.

*Figure SY201-9 – Generator Bus*
Front/Rear Generator Buses

The front cockpit generator bus controls power to aircraft systems and instruments listed in the top half of the table at right, as well as power to the rear cockpit generator bus.

The rear cockpit generator bus primarily carries power for rear cockpit systems and instruments listed in the bottom half of the table at right.

Avionics Bus

The avionics bus supplies power for those avionics listed in the table.
Generator Bus Control

The rear cockpit generator bus is controlled by a circuit breaker labeled AFT GEN on the front cockpit generator bus circuit breaker panel.

Both front and rear cockpit avionics buses are controlled by circuit breakers, labeled FWD AVI and AFT AVI, on the front cockpit generator bus circuit breaker panel.

Battery Bus

Like the generator bus, the battery bus also consists of a front and rear bus for the respective cockpits. Each cockpit battery bus has a bus for avionics.

The rear cockpit battery bus receives power from the front cockpit battery bus.

The rear cockpit avionics bus receives power from the front cockpit battery bus through the front cockpit avionics bus.
Front/Rear Battery Buses

The front cockpit battery bus controls power to aircraft systems and instruments listed in the top half of the table at right, as well as power to the rear cockpit battery bus.

The rear cockpit battery bus primarily carries power for rear cockpit systems and instruments listed in the bottom portion of the table at right.

Avionics Battery Buses

The front cockpit avionics bus supplies power for those avionics listed in the top portion of the table at right.

The rear cockpit avionics bus controls the avionics shown in the bottom portion of the table at right.

Figure SY201-14 – Battery Bus Systems

Figure SY201-15 – Battery Avionics Bus Systems
Battery Bus Control

The rear cockpit battery bus is controlled by a circuit breaker labeled AFT BAT on the front cockpit battery bus circuit breaker panel.

Both front and rear cockpit avionics battery buses are controlled by circuit breakers, labeled FWD AVI and AFT AVI, on the front cockpit battery bus circuit breaker panel.

Hot Battery Bus

The battery is also connected directly to and powers the hot battery bus whenever the battery is installed in the aircraft.

Regardless of the position of either battery switch, the hot battery bus provides continuous essential power to components which are required to operate continuously or may be necessary in an emergency. Each of these components is protected by individual circuit breakers.
Avionics Master Switch

Power for all avionics and radio systems in both cockpits (except the backup VHF control unit and VHF transceiver) is furnished through an avionics master switch labeled AVIONICS MASTER on the right forward switch panel in the front cockpit.

When the avionics master switch is placed in the ON position, it de-energizes relays, allowing the forward and aft avionics buses to be powered by the battery and generator buses.

Avionics Master Switch Power

A circuit breaker labeled AVI MSTR on the front cockpit battery bus circuit breaker panel allows the avionics master switch to be activated.

When the AVI MSTR circuit breaker is pulled, turning the avionics master switch to the OFF position will not turn off power to the avionics.
Bus Tie Switch

The bus tie switch (placarded BUS TIE) on the front right forward switch panel, is used to tie the battery and generator buses together for normal operation.

When the switch is engaged (NORM), the generator feeds both generator bus powered items and battery bus powered items.

Bus Tie Switch Open

If the bus tie switch is set to OPEN, or if the bus tie fails, the battery and generator buses are isolated and each powers only equipment attached to that bus.

In each cockpit, the yellow BUS TIE message on the CAS will flash, the MASTER CAUTION light will flash, and the warning tone will sound.

Circuit Breakers

| 1.19.3.0.3   | Identify circuit breaker system components |
| 1.19.3.0.4   | Match circuit breaker system components to functions |
| 1.19.3.0.5   | Identify characteristics of normal operations for circuit breaker system |
Circuit Breakers

Circuit breakers which protect systems and equipment operating from the battery bus are located on the left console panel in each cockpit.

Those protecting generator bus systems and equipment are located on the right console panel in each cockpit.

Circuit Breaker Groupings

Circuit breakers are grouped on each bus panel by systems and components protected.

Amperage Markings

Each circuit breaker is marked with the maximum current load, in amperes it will allow to pass before popping.
Normal Operation

All circuit breakers are normally left in, or activated, at all times.

If a component or circuit malfunction occurs, the affected circuit breaker should “pop”, or open, shutting off current flow to that component or circuit.

At right, the aft cockpit battery bus avionics circuit breaker has popped, indicating a problem in that particular circuit.

Secondary Power

| 1.19.4.0.3 | Identify secondary power system components |
| 1.19.4.0.4 | Match secondary power system components to functions |
| 1.19.4.0.5 | Identify characteristics of normal operations for secondary power system |

Secondary Power Components

T-6B secondary power components consist of:

- a 24 VDC, 42 ampere-hour battery
- a 24 VDC, 5 ampere-hour auxiliary battery
- an external power receptacle

Figure SY201-25 – Popped Circuit Breaker

Figure SY201-26 – Secondary Power Components
Battery Purpose

The primary battery provides power for engine starts and is capable of powering all electrical systems (except air conditioning which is automatically shed) in the event of generator failure with the bus tie closed.

Battery Switch

Battery power is controlled by the battery switch, labeled BAT, located on the right forward switch panel in each cockpit.
Battery Switch Operation

As with the generator control switches, the battery switches are magnetically held and electrically interlocked. This allows the battery to be controlled from either cockpit.

Inter-cockpit operation of the battery switches is identical to that of the generator switches.

Battery Switch Power

Power for the battery switches is provided through a circuit breaker labeled BAT SW, located on the battery bus circuit breaker panel in the front cockpit.
Auxiliary Battery

The auxiliary battery will power a minimum number of aircraft systems and avionics in the event of failure of the generator and primary battery.

Auxiliary Battery Control

The auxiliary battery is controlled by the auxiliary battery switch, placarded AUX BAT, on the right forward switch panel in the front cockpit.

Figure SY201-30 – Auxiliary Battery

Figure SY201-31 – Auxiliary Battery Switch
Auxiliary Battery Test

The auxiliary battery is tested - during COCKPIT checklist (after application of battery power) by the auxiliary battery test switch. This switch is labeled AUX BAT and is located on the left console test panel in the front cockpit. The AUX BAT test indicator light is above the switch.

Position the AUX BAT switch forward and hold for a minimum of five seconds, then release. Verify the AUX BAT test indicator light illuminates when the switch is moved to the forward position, remains illuminated while the switch is held forward, and extinguishes when the switch is released.

You will have an opportunity to practice this later during your checklist lessons.

Figure SY201-32 – Auxiliary Battery Test
External Power

An external power receptacle is installed in the bottom of the left, aft fuselage, below the left avionics bay door.

The external power system is capable of powering all T-6B systems, to include engine start.

External Power Control

External power is distributed on the battery bus, and is controlled by the battery switch (BAT) on the right forward switch panel. This switch must be set to ON for external power to be available in the aircraft.

A voltage sensor is located between the external power connector and the external power relay. If the external voltage level exceeds a nominal level, the overvoltage relay will automatically disconnect the external power from the aircraft electrical system.

Aircraft Lighting

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<td>1.19.5.0.4</td>
<td>Match aircraft lighting system components to functions</td>
</tr>
<tr>
<td>1.19.5.0.5</td>
<td>Identify characteristics of normal operations for aircraft lighting system</td>
</tr>
</tbody>
</table>
Interior Lighting

All instruments, control panels, and displays in both cockpits are lighted for operation during night or reduced light conditions.

In each cockpit, area (or flood) lights are provided near the circuit breaker panels, and a detachable utility light is installed at the rear of the right console.

Figure SY201-35 – Interior Lighting
Knee board lights are also mounted on the front of each forward and aft glareshield. These lights are controlled individually and are turned on when the assembly is rotated downward for use. Light intensity is adjusted using a rotating bezel assembly.

The light is turned off by rotating it back to the stowed position.

Interior Lighting Power

Power for instrument panel lighting is provided through a circuit breaker labeled INST on the battery bus circuit breaker panel in the front cockpit, and labeled INST LT on the battery bus panel in the rear cockpit.

Side console lighting power is provided through circuit breakers labeled SIDE (front cockpit) and SIDE LT (rear cockpit), both on the generator bus circuit breaker panels.

Power for area lighting (flood lights) is provided through a circuit breaker placarded FLDT located on the battery bus circuit breaker panel in each cockpit.
Interior Lighting Controls

Balanced light output from the instruments, control panels, and displays can be adjusted by using dimming controls on the trim control panel located on the forward left console in each cockpit.

Instrument panel lights are controlled through a knob labeled INST. This includes LSK and UFCP backlight illumination levels.

Side control panel lighting is controlled by a knob placarded SIDE. This includes the standby VHF control head.

Area lights are controlled by the knob labeled FLOOD.

MFD Lighting Controls

Independent lighting controls for the MFDs are mounted on the individual units.

Figure SY201-38 – Interior Lighting Controls

Figure SY201-39 – MFD Lighting Controls
UFCP Lighting Controls

The UFCP also has dedicated lighting controls.

The LGT-UFCP knob controls the brightness of the UFCP display windows W1 through W4.

The LGT-HUD knob controls the brightness of the HUD.

The LGT NIGHT/DAY/AUTO HUD switch controls the overall illumination intensity. Moving this switch in either cockpit changes the brightness for the MFDs (all 6), UFCPs and HUDs in both cockpits.

Changing the setting to LGT NIGHT sets all of this instrumentation to the brightest night setting of approx 10% illumination.

AOA Indexer Brightness

Brightness of the AOA indexer is controlled by the knob on the inboard side of the unit.
BFI Brightness

Although the BFI brightness is also controlled by the INSTRUMENT adjustment knob, it can also be adjusted independently through the M button on the bottom of the instrument bezel.

When the menu is showing, the adjustment knob (also known as the BARO knob) allows you to scroll through the menu options which include SET BRIGHTNESS.

Pressing the adjustment knob at this point selects the brightness option and allows you to use the same knob again to increase or decrease the brightness of the display.

Utility Lights

Utility lights are located on the right console in each cockpit. These lights can be detached and relocated to the right canopy rail for use as an area or map light, or hand-held for local light as required.

A variable dimmer control is integral to each utility light. The lights are powered through a coil cord allowing freedom of movement throughout the cockpit.

Figure SY201-42 – BFI Brightness

Figure SY201-43 – Utility Lights
Utility and Knee Board Light Power

Power for the utility lights and knee board lights is provided through circuit breakers labeled UTIL on the front cockpit battery bus circuit breaker panel, and on the rear cockpit battery bus circuit breaker panel.

Landing Light

The landing light is located aft and inboard of the left main landing gear strut, and is exposed as the landing gear is extended. Power to the landing light is controlled by a switch placarded LDG, located on the trim control panel in the front cockpit. After the switch has been turned on, the light will only come on when the gear is down and locked.

Note that the head of this switch has three bumps to assist you in identifying the switch by feel.

Figure SY201-44 – Utility and Knee Board Light Power

Figure SY201-45 – Landing Light and Control
Taxi Light

The taxi light is located aft and inboard of the right main landing gear strut, and is also exposed as the gear is extended. Power to the taxi light is controlled by a switch located on the trim control panel in the front cockpit and labeled TAXI. Like the landing light, the taxi light will only illuminate when the switch is on and the gear is down and locked.

The light is oriented to provide ground illumination and visibility during landing and taxi operations.

Landing and Taxi Light Power

The landing light power supply is provided through a circuit breaker labeled LDG, located on the battery bus circuit breaker panel in the front cockpit.

Power is supplied to the taxi light through a circuit breaker labeled TAXI, located on the generator bus circuit breaker panel in the front cockpit.
Nav and Anti-Collision Lights

The T-6B is equipped with navigation lights at the leading and trailing edges of each wing tip, as well as anti-collision strobe lights at each wing tip near the leading edge.

Figure SY201-48 – Navigation and Anti-Collision Lights

Nav and Anti-Collision Lights Cont

When switched on, both the red navigation light at the left wing tip and the green navigation light at the right wing tip are constantly illuminated.

The white position lights at the trailing edge of each wing tip are also constantly illuminated.

The anti-collision strobe lights at each wing tip flash synchronously at a rate of about 30 times per minute.
Nav and Anti-Collision Light Controls

The anti-collision strobe lights are controlled with a switch placarded ANTI-COLL on the front cockpit trim control panel.

Navigation lights are controlled by a switch labeled NAV, also on the trim control panel in the front cockpit.

Nav and Anti-Collision Light Power

The anti-collision lights receive power from a circuit breaker labeled COLL on the front cockpit battery bus circuit breaker panel.

A circuit breaker labeled NAV on the front cockpit generator bus circuit breaker panel provides power for the navigation lights.

Lesson Review Quiz
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. What electrical component allows isolation of the generator and battery buses? (B/1/1)
   a. Battery switch
   b. Bus tie switch
   c. Generator switch
   d. Circuit breakers

2. The starter/generator is regulated and monitored by a ______ located under a panel in the aft cockpit. (B/2/1)
   a. voltage regulator
   b. generator overvoltage monitor
   c. generator control unit
   d. starter/generator accessory box

3. Generator power is controlled by the ______ switch located on the right forward switch panel in each cockpit. (B/2/2)
   a. bus tie (BUS TIE)
   b. generator reset (GEN RESET)
   c. generator control (GEN)
   d. auxiliary battery (AUX BAT)

4. The rear cockpit avionics bus receives power through the ______. (B/3/1)
   a. front cockpit battery bus
   b. front cockpit avionics bus
   c. rear cockpit generator bus
   d. rear cockpit battery bus

5. Circuit breakers labeled FWD AVI and AFT AVI control front and rear cockpit avionics buses and are located on the front cockpit ______. (B/3/2)
   a. right forward switch panel
   b. battery bus circuit breaker panel only
   c. generator bus circuit breaker panel only
   d. battery bus and generator bus circuit breaker panels
6. A circuit breaker labeled AFT BAT on the front cockpit battery bus circuit breaker panel controls the ______. (B/3/3)
   a. aft battery
   b. rear cockpit generator bus
   c. rear cockpit battery bus
   d. auxiliary battery

7. Except for the backup UHF control head and UHF transceiver, power for all avionics and radio systems in both cockpits is furnished through ______ on the right forward switch panel in the front cockpit. (B/3/4)
   a. an avionics master switch
   b. a master battery switch
   c. an auxiliary battery switch
   d. a bus tie switch

8. A yellow ______ message on the CAS in each cockpit will indicate an open bus tie switch. (B/3/5)
   a. TIE OPEN
   b. BUS FAIL
   c. BUS TIE
   d. BUS OPEN

9. Circuit breakers protecting systems and equipment operating from the battery bus are located on the ______ in each cockpit. (B/4/1)
   a. right forward switch panel
   b. left console panel
   c. trim control panel
   d. right console panel

10. Each circuit breaker is marked with the ______ it will allow to pass before popping. (B/4/2)
    a. maximum current load in amperes
    b. maximum current load in volts
    c. maximum voltage load in amperes
    d. maximum voltage load in volts
11. Battery power is controlled through ______ on the right forward switch panel in either cockpit. (B/5/1)
   a. an avionics master switch
   b. a battery switch
   c. an auxiliary battery switch
   d. a bus tie switch

12. A switch labeled AUX BAT on the front cockpit left console test panel is positioned forward to test the ______ during preflight checks. (B/5/2)
   a. starter/generator
   b. battery charge circuits
   c. standby battery
   d. auxiliary battery

13. External power is controlled by the ______ and distributed on the ______. (B/5/3)
   a. generator control switch; generator bus
   b. avionics master switch; avionics bus
   c. external power switch; external power bus
   d. battery switch; battery bus

14. Lighting for the NAV, PFD, and EICAS units is adjusted using the knob labeled INSTR PANEL on the trim control panel. (B/6/1)
   a. True
   b. False

15. ______ lights can be detached and relocated to the right canopy rail for use as an area or map light. (B/6/2)
   a. Console
   b. Utility
   c. Instrument
   d. Knee board

16. The landing light will only come on when the landing light switch is activated and ______. (B/6/3)
   a. the landing gear switch is activated
   b. the landing gear is being extended
   c. the landing gear doors are opened
   d. the landing gear is down and locked
17. When switched on, white position lights at the trailing edge of each wing tip ______. (B/6/4)
   a. flash alternately with the anti-collision strobe lights
   b. are constantly illuminated
   c. are illuminated only at night
   d. flash alternately with the red and green navigation lights

LESSON REVIEW QUIZ QUESTIONS

1. The generator provides 28 VDC power, and is capable of supplying ______ amps.
   a. 100
   b. 200
   c. 300
   d. 400

2. The generator can be controlled from either cockpit through use of the generator ______.
   a. mode switch
   b. control switch
   c. switch panel
   d. transfer switch

3. Click on the switch that provides power for all avionics and radio systems in both cockpits (except the backup VHF control head).
4. If a component or circuit malfunctions, the affected ______ will open, shutting off current flow to that component or circuit.
   a. relay
   b. circuit breaker
   c. fuse panel
   d. breaker bar

5. The battery can be controlled from either cockpit through use of the ______.
   a. battery switch
   b. auxiliary battery test switch
   c. battery crossfeed switch
   d. master control switch

6. Light output from the instruments, control panels, and displays can be adjusted by using dimming controls located on the ______ in each cockpit.
   a. right forward switch panel
   b. generator control panel
   c. trim control panel
   d. annunciator panel

7. The taxi light is located aft and inboard of the ______.
   a. left main landing gear strut
   b. nose wheel strut
   c. left wingtip navigation lights
   d. right main landing gear strut

8. A fault occurs in the circuit controlling the anti-collision lights. The COLL circuit breaker will pop on the battery bus circuit breaker panel located on the ______.
   a. right side of the rear cockpit
   b. right side of the front cockpit
   c. left side of the rear cockpit
   d. left side of the front cockpit
9. The ______ message will display on the CAS if the bus tie switch is set to OPEN.
   a. BAT BUS
   b. BUS TIE
   c. GEN BUS
   d. IGN SEL

10. The starter/generator provides 28 volts DC, while the battery and auxiliary battery are ______ VDC units.
    a. 20
    b. 24
    c. 28
    d. 30
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OVERVIEW
This lesson is designed to provide you with basic knowledge of the T-6B fuel system in order to provide a foundation of understanding for fuel system normal operation. You will learn the location of the various fuel system components, indicators, and controls and how they function during the normal operation of the system.

REFERENCES
Personnel: None
Media Facilities: Student CAI Workstation
Support Resources: T-6B Flight Manual; T-6B Systems 2 Student Guide

STUDENT ASSIGNMENTS
Read applicable portions of T-6B Flight Manual, Section I.
Complete CAI lesson SY202, following along with this student guide.
Complete the practice questions provided.

LESSON OUTLINE
This lesson is presented in three segments. The first segment is an introduction, segment two contains six academic subjects, and the final topic is an end of lesson quiz. Topics in this lesson must be taken in sequential order. All topics must be completed prior to attempting the end of lesson quiz. The estimated time required to complete this lesson is 1.0 hour.
Introduction

T-6B Fuel System

Fuel System Overview

<table>
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<td>Define terminology and concepts related to the fuel system</td>
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<tr>
<td>1.20.0.0.3</td>
<td>Identify major components of the fuel system</td>
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Fuel Intro 1

The T-6B fuel system uses three integral fuel tanks built into the single-piece wing to store approximately 1100 pounds of usable fuel.

The wing tanks are refueled either simultaneously by pressure refueling through a single point adapter on the left front fuselage, or individually by gravity fill through ports in each outer wing panel.

Figure SY202-1 – Fuel Storage and Refueling
Fuel is fed to the engine by a motive flow system. Motive flow results as fuel moves through the fuel lines creating a pressure differential between the fuel lines and fuel tanks. This pressure differential causes lower static pressure in the fuel lines and creates a “siphoning” effect that draws fuel from the tanks.

Jet pumps in the fuel tanks are driven by motive flow to provide fuel to engine-driven low and high pressure fuel pumps. An electric boost pump is provided for engine start or in case of engine-driven low pressure fuel pump failure.

A flip-flop valve in the central collector tank supplies fuel feed during negative-G flight operations.

The system is fitted with an auto-balancing system which maintains approximately equal fuel quantity in the two wing tanks.
Fuel Intro 3

The EICAS (Engine Indication and Crew Alerting System) on the instrument panel in both cockpits provides indications of fuel flow and fuel quantity.

Switches on the front cockpit right forward switch panel provide the pilot with control of the fuel system. Six messages indicate fuel system status.

Fuel Storage

| 1.20.1.0.3 | Identify fuel storage system components |
| 1.20.1.0.4 | Match fuel storage system components to functions |
| 1.20.1.0.5 | Identify characteristics of normal operations for fuel storage system |

Three Tanks

Fuel is stored in three separate tanks:

- Left wing tank
- Collector tank
- Right wing tank

Figure SY202-3 – Fuel Controls and Indicators

Figure SY202-4 – Fuel Tanks
Maximum and Usable Capacities

In aviation, fuel is referred to by weight (lbs) rather than by volume (gal). In the T-6B, it’s possible for the fuel tanks to hold a maximum of 1200 pounds (179 gallons) of usable fuel (JP-8). However, when using the primary T-6B refueling method, the total amount of usable fuel pumped into the tanks is reduced to approximately 1100 pounds. T-6B primary and secondary refueling methods are discussed in the next topic.

Individual Tank Capacities

Using the primary T-6B refueling method, the left and right wing tanks each will be fueled to approximately 530 lbs of fuel. Since the central collector tank stores approximately 40 lbs, you will have a total of about 1100 lbs of fuel.
Refueling

<table>
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<td>1.20.2.0.4</td>
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<tr>
<td>1.20.2.0.5</td>
<td>Identify characteristics of normal operations for fuel fill system</td>
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Single Point Refueling

The T-6B can be refueled by one of two methods, single point pressure or over the wing gravity refueling. Single point pressure refueling is the primary method of refueling the aircraft.

Single Point Adapter

The single point refueling/defueling adapter is located on the left side of the fuselage just in front of the wing.

Figure SY202-7 – Single Point Refueling

Figure SY202-8 – Single Point Refueling/Defueling Adapter
Simultaneous Fill

The single point adapter permits filling of the wing tanks simultaneously.

The collector tank normally remains full since most flights will not use the total volume of fuel. However, if it is depleted, fuel will gravity feed to the collector tank from the wing tanks.

Using pressurization (from a fuel truck or fuel pit) the tanks can be filled in approximately 3 to 5 minutes once the hose is attached to the refueling/defueling adapter.

Shutoff Valves

Refueling shutoff is automatically controlled by the level control pilot valves located at the outboard tip of each wing. These valves close when fuel reaches them which in turn cause the level control shutoff valves to close, halting fuel flow.
Pre-check valves next to the single point adapter route fuel directly to the respective pilot valve to test the automatic shutoff function. When each valve is opened by ground personnel prior to refueling, fuel flows directly to the respective pilot valve, which in turn will shut down refueling in a matter of seconds.

Defueling

Defueling, removal of fuel from the aircraft, is generally performed prior to extensive maintenance on the aircraft.

The aircraft can be defueled in approximately 5 minutes by applying suction through the single point adapter which causes the defuel valve in the collector tank to open. Fuel in the wing tanks gravity feeds to the collector tank.
Gravity Port Method

The secondary refueling method is over the wing gravity refueling. This method uses two ports, one located on the top of each wing tank.

Fuel capacity is approximately 50 pounds greater in each wing (100 lbs total) using this method if each wing tank is filled to the base of the filler neck.

Gravity Port Restrictions

There is no automatic shutoff for this method, and the aircraft cannot be defueled from the over the wing gravity refueling ports.

Engine Feed

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<tr>
<td>1.17.13.0.5</td>
<td>Identify characteristics of normal operations for FMU system</td>
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Figure SY202-11 – Over The Wing Gravity Refueling
Boost Pump and Manifold Valve

An electric boost pump located in the collector tank provides fuel delivery for initial engine startups. A redundant circuit in the starter relay activates the boost pump whenever the starter is activated, regardless of fuel pressure.

The boost pump also serves as a backup to the engine-driven low pressure fuel pump.

A manifold valve located at the front of the collector tank connects both the electric boost pump and the primary jet pump to the engine feed line.

Fuel Filter

The fuel is pumped through the engine feed line to the fuel filter, which is installed to prevent contaminants from reaching the main fuel pumps or engine.

The filter is equipped with a fuel bypass which enables fuel flow to the engine if the filter becomes restricted.
Shutoff Valves

The engine feed line incorporates two shutoff valves.

The firewall shutoff valve is actuated by the firewall shutoff handle in the front cockpit and stops fuel flow to the engine.

A maintenance shutoff valve is provided to isolate the fuel system for engine or fuel filter maintenance.

Fuel Pumps

From the fuel filter, fuel continues down the engine feed line to the engine-driven low pressure fuel pump.

The engine-driven low pressure fuel pump feeds fuel to the engine-driven high pressure fuel pump based upon engine requirements.
FMU

The engine-driven high pressure fuel pump routes fuel to the Fuel Management Unit (FMU) which controls fuel delivery to the engine.

Fuel Flow Transmitter

A fuel flow transmitter is activated and sends a signal to the Engine Indication and Crew Alerting System (EICAS). This will be covered in detail in the Fuel Controls and Indicators topic.
Purge Line

From the FMU, most fuel will be sent to the engine.

Excess fuel not used by the engine is sent from the engine-driven high pressure pump through a purge line back to the collector tank.

Motive Flow Line

Some fuel is routed from the engine-driven low pressure fuel pump down the motive flow line and used to drive the primary and transfer jet pumps. These pumps are discussed later in this topic.

A ten psi pressure switch senses fuel pressure in the motive flow line and activates the electric boost pump anytime fuel pressure drops below 10 psi and the PCL is above the start ready position. The switch will also illuminate the FUEL PX (low fuel pressure) annunciator.

This will also be covered in more detail in the Fuel Controls and Indicators topic.

Figure SY202-17 – Motive Flow Line
Primary Jet Pump

Fuel delivered by the motive flow line drives the primary jet pump which then begins to deliver fuel from the collector tank to the engine-driven low pressure fuel pump.

Transfer Jet Pumps

As fuel is drawn from the collector tank by the primary jet pump, transfer jet pumps in the wing tanks direct fuel from the wing tanks to the collector tank. This keeps the collector tank pressurized.
Venturi Flow

Both the primary jet pump and transfer jet pumps operate by venturi flow. Fuel is forced through a tapered restriction in the pumps, causing an increase in the velocity of the fuel flow. This creates a suction effect which draws additional fuel from the tanks.

Wing Dihedral

During normal flight, fuel flows toward the collector tank due to the dihedral of the wings. The primary jet pump, located near the bottom of the collector tank, is enveloped in fuel.

Inverted/Negative-G Flight

However, during inverted flight, the fuel flows into the wing tips away from the collector tank. The fuel in the collector tank flows by gravity to the top of the tank away from the primary jet pump.
Flip Flop Valve

The T-6B is equipped with a flip-flop valve in the collector tank which allows fuel to feed to the engine during inverted or negative G flight.

Because fuel in the wing tanks is pulled away from the collector tank and usable fuel is limited to that in the collector tank, inverted flight should be limited to 15 seconds.

Fuel Controls and Indicators

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<tr>
<td>1.20.5.0.5</td>
<td>Identify characteristics of normal operations for fuel indications system</td>
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Fuel Level Probes

There are 7 fuel level probes in the T-6B fuel tanks, 3 in each wing tank and 1 in the collector tank.

These probes send a signal to the Engine Indication and Crew Alerting System (EICAS) on the right side of the instrument panel for visual display of left and right wing tank FUEL QTY (fuel quantity).

The probe in the collector tank also provides temperature compensation and fuel density measurements.
Fuel Quantity Indication

FUEL QTY - Fuel quantity is displayed in the upper left corner of the EICAS. The numbered scales indicate fuel quantity (times 100 pounds) for the left and right fuel tanks. Fuel in the collector tank is split between the two wing tank indications.

The display at right indicates 800 pounds of fuel in the tanks (including the collector tank) since the left tape indicates a “4” (400 pounds) and the right tape indicates “4” (400 pounds).

The tapes are white until there are only 150 pounds remaining, at which time they turn yellow. Two yellow tapes indicate the total fuel quantity is below 300 pounds.

Fuel Low Level Sensors

Fuel low level sensors are located at the rear edge of the inboard ends of the wing tanks.

These sensors light the “L FUEL LO” or “R FUEL LO” messages when the fuel level falls below 110 pounds in the respective tank.
Fuel Flow Indicator

FF - The fuel flow display is located in the lower left side of the EICAS and receives its input from the fuel flow transmitter. It measures the number of Pounds Per Hour (PPH) that the engine is using at that particular moment. A readout of 350 PPH is normal for cruise.

Fuel System Messages

The six CAS messages displayed specify fuel system status.

FUEL PX - This message specifies low fuel pressure delivery to the engine, and is illuminated by activation of the low pressure switch (below 10 psi) on the motive flow line.

FP FAIL – This message indicates a fuel probe malfunction. Do not attempt to manually balance fuel load if amber FP FAIL caution is illuminated. With a probe failure, a fuel imbalance caution may not be correct, and manual balance attempts may cause or aggravate a fuel
imbalance.

FUEL BAL - This message specifies that the fuel imbalance has exceeded 30 pounds for more than two minutes and the automated balancing system has not corrected the condition. It also lights if a fuel probe fails. It will remain illuminated until the fuel system is reset.

L FUEL LO - This message specifies that fuel quantity in the left wing tank is low (110 pounds or less).

R FUEL LO - This message specifies that fuel quantity in the right wing tank is low (110 pounds or less).

BOOST PUMP - This message, when lit, specifies that the boost pump has been activated by either turning the boost pump switch ON, automatically by operation of the low pressure switch, or whenever the starter is activated.

M FUEL BAL - This message is displayed any time the fuel balance switch is NOT in the AUTO position.
Fuel System Switches

There are three fuel system related switches on the right forward switch panel in the front cockpit. They are the BOOST PUMP switch, FUEL BAL switch, and the MANUAL FUEL BAL switch. Each is shown here in its normal position.

Note that the rear cockpit switch panel has only the BOOST PUMP switch.

Figure SY202-28 – Fuel System Switches
Boost Pump Switch ARM

The boost pump switch operates the boost pump. It has two positions: ON and ARM.

The switch is normally set in the ARM position. When set in this position, the boost pump will come on during engine start to provide fuel for the starting sequence. Once the engine is running and motive flow has been activated, the boost pump is automatically turned off by the low pressure switch when fuel pressure exceeds 10 psi. Because pressurized fuel is being provided by the primary jet pump during engine operation, the boost pump is not needed and will not normally come on again during the mission.
Boost Pump Switch ON

When the switch is set to the ON position, the boost pump will operate continuously. Normally, this position should only be used if there is a failure of the engine-driven low pressure fuel pump.

Fuel Balance Switch

The FUEL BAL (fuel balance) switch is used when a fuel imbalance occurs and the auto-balancing system is not correcting the situation. It has two positions: MAN/RESET and AUTO.

The switch will normally be in the AUTO position. This allows the fuel system to automatically balance the fuel in the wings.

If a system malfunction should occur, place this switch in the MAN/RESET position and use the MANUAL FUEL BAL switch to manually balance the fuel. These procedures will be outlined for you in a future emergency procedures lesson.
Manual Fuel Balance Switch

The MANUAL FUEL BAL (manual fuel balance) switch has three positions: OFF, L, and R.

The switch is normally in the OFF (centered) position since the fuel system automatically balances the fuel.

This switch is NOT operational unless you have switched the FUEL BAL switch to the MAN/RESET position. This activates the M FUEL BAL message, indicating that the system is in manual balancing.

The switch is set to L or R (left or right), corresponding to the “lighter” tank as displayed on the fuel gauge. This activates the respective transfer (solenoid) valve and closes the motive flow line to the light tank.

Fuel Control Practice

Fuel Venting and Balance
Vacuum and Pressure Relief

The wing tanks are vented to the atmosphere through vent lines which provide vacuum and pressure relief for the tanks. The wing tanks are internally vented to each other through a cross vent line.

Figure SY202-31 – Vacuum and Pressure Relief

Float Valves

If the aircraft should be parked on a sloped surface, fuel will flow from the high wing to the low wing, causing an imbalance.

A float valve installed in the vent opening at the tip end of each wing tank will close when rising fuel reaches it. This prevents the fuel from draining to the outside.
Fuel Imbalance

The fuel balance system maintains balance within 20 lbs. If the imbalance exceeds 30 lbs for more than two minutes, the fuel balance message will light and the fuel gauge will show the fuel imbalance.

By comparing the amount of fuel indicated in each wing tank, you can determine the amount of the imbalance.

Auto Balance System

The fuel system incorporates an auto balance system which maintains the fuel load in each wing tank to within 20 pounds of the other wing.

If an imbalance is detected by the Engine Data Manager (EDM) of 20 pounds or more for more than 30 seconds, the appropriate transfer (solenoid) valve is activated to close the motive flow line to the light tank.

This stops fuel from the light tank being transferred to the collector tank. Fuel from the heavy tank will continue to be
transferred to the collector tank.

FUEL BAL Message

If the fuel imbalance is not reduced to less than 30 pounds within 2 minutes, the FUEL BAL message illuminates and the auto balance system will shut off. The FUEL BAL message will remain illuminated until the system is reset.

If the auto balance system shuts off without reducing the fuel imbalance to 30 pounds or less, the auto balance system may be reset to provide an additional 2 minutes to balance the fuel load. The system may require multiple resets to balance the fuel load.

Manual Balance

If the auto balancing system should fail, you can manually balance the system from the cockpit using the controls and switches previously discussed.

You’ll learn more on fuel
balancing in the systems review lesson.

Lesson Review Quiz

Figure SY202-34 – Manual Fuel Balancing
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. The motive flow system is normally driven by the electric boost pump. (B/1/1)
   a. True
   b. False

2. When using the primary refueling method, the total amount of usable fuel in the tanks is approximately ______ pounds. (B/2/1)
   a. 1050 lbs
   b. 1100 lbs
   c. 1180 lbs
   d. 1200 lbs

3. The collector tank holds a maximum of approximately ______ pounds of fuel. (B/2/2)
   a. 40 b.
   178
   c. 530
   d. 1100

4. What is the primary method of refueling the T-6B? (B/3/1)
   a. Over the wing gravity refueling
   b. Single point pressure refueling
   c. Combat refueling
   d. In-flight refueling

5. Using the single point pressure refueling method, approximately how long does it take to refuel the aircraft? (B/3/2)
   a. 1 to 3 minutes
   b. 3 to 5 minutes
   c. 5 to 7 minutes
   d. 7 to 10 minutes
6. The secondary or backup method for refueling the T-6B is called _____.
   (B/3/3)
   a. over the wing gravity refueling
   b. single point pressure refueling
   c. combat refueling
   d. in-flight refueling

7. The engine-driven high-pressure fuel pump is fed from the _____.
   (B/4/1)
   a. fuel flow transmitter
   b. low pressure vent line
   c. engine-driven low pressure fuel pump
   d. refuel/defuel valve

8. The motive flow line routes fuel to which of the following pumps? (B/4/2)
   a. Primary jet pump and high pressure pump
   b. Primary jet pump and transfer jet pumps
   c. High pressure pump and spill/vent pump
   d. Engine-driven fuel pump and high pressure pump

9. The collector tank is equipped with two fuel pumps for engine feed operations. Which one is
   used AFTER engine start? (B/4/3)
   a. Electric boost pump
   b. Engine-driven fuel pump
   c. Primary jet pump
   d. Transfer jet pumps

10. The transfer jet pumps ensure adequate fuel delivery to the collector tank during engine
    operations.

    The components highlighted on the graphic at right are the transfer jet pumps. (B/4/4)
    a. True
    b. False
11. During inverted flight, the flip-flop valve activates, providing the engine access to fuel located in the _____. (B/4/5)
   a. main wing tanks
   b. purge line
   c. collector tank
   d. motive flow line

12. Click on the component which sends a fuel flow signal to the EICAS. (B/4/6)

13. What is the quantity of fuel indicated by the left fuel quantity arrow in this graphic? (B/5/1)
   a. 250 lbs
   b. 300 lbs
   c. 350 lbs
   d. 400 lbs
14. What is the fuel flow, as indicated by the graphic? (B/5/2)
   a. 75 PPH
   b. 375 PPH
   c. 575 PPH
   d. 750 PPH

15. Once the engine is running and motive flow has been activated, the boost pump is automatically turned off by the low pressure switch. (B/5/3)
   a. True
   b. False

16. Click on and drag each switch label to its correct position on the right forward switch panel.

   When all labels are in place, click on the JUDGE button. (B/5/4)
17. The wing tanks are internally vented to each other by float valves. (B/6/1)
   a. True
   b. False

18. The fuel system incorporates an auto balance system which maintains the fuel load in each wing tank to within ______ pounds of the other wing. (B/6/2)
   a. 20
   b. 40
   c. 65
   d. 100

LESSON REVIEW QUIZ QUESTIONS

1. Using the primary refueling method, the maximum fuel quantity for one wing tank is ______ lbs.
   a. 500
   b. 530
   c. 560
   d. 620

2. What is the aircraft limitation for inverted flight?
   a. 15 seconds
   b. 30 seconds
   c. 45 seconds
   d. 60 seconds

3. Which method of refueling fills the wing tanks simultaneously?
   a. Tanker refueling
   b. Combat refueling
   c. Single point pressure refueling
   d. Over the wing gravity refueling
4. Click on the message that will light along with the BOOST PUMP message to indicate low fuel pressure delivery to the engine.

5. Which of the following maintains fuel balance by shutting off fuel flow to the light wing tank?
   a. Fuel flow transmitter
   b. Motive flow line
   c. Flip-flop valve
   d. Transfer (solenoid) valve

6. The primary and transfer jet pumps are operated by ______.
   a. the generator
   b. venturi flow
   c. the primary battery
   d. ram air flow

7. The FUEL BAL message is illuminated and you have switched the FUEL BAL switch to MAN/RESET. Click on the switch that you would move next to set the system to the “light” fuel tank.
8. How long does it take to defuel the T-6B through the over the wing gravity refueling ports?
   a. 10 minutes
   b. 15 minutes
   c. 25 minutes
   d. The T-6B cannot be defueled through the over the wing gravity refueling ports.

9. Fuel is routed from the engine-driven fuel pump to the primary jet pump through which line?
   a. purge line
   b. motive flow line
   c. pressure relief line
   d. cross vent line

10. The left and right fuel quantity arrows on the EICAS turn yellow when indicated fuel quantity in the respective tank is below ______.
    a. 75 pounds
    b. 115 pounds
    c. 150 pounds
    d. 185 pounds
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OVERVIEW
The Electrics and Fuel Review lesson provides you a review of the normal operation of the T-6B electrical and fuel systems as introduced in SY201 – Electrical System and SY202 – Fuel System. The lesson then covers characteristics of abnormal operation and failure indications for these systems.

REFERENCES
Personnel: MIL Instructor
Media Facilities: MIL Equipped Classroom
Support Resources: T-6B Flight Manual, SY201 Student Guide and SY202 Student Guide

STUDENT ASSIGNMENTS
Review SY201 and SY202 student guides.
Read applicable portions of T-6B Flight Manual, Section I.

LESSON OUTLINE
The Electrics and Fuel Review MIL lesson provides you a review of the normal operation of T-6B electrical and fuel systems, then covers the characteristics of abnormal operation and failure indications for these systems.
Introduction

Electrics and Fuel Review

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For lesson topic **Electrical System**, please refer to your student guide for SY201 – Electrical System

For lesson topic **Fuel System**, please refer to your student guide for SY202 – Fuel System
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Inoperative Generator

Loss of generator power to generator and battery buses, loss of battery charging

Indications:

- MASTER WARN switchlight flashing
- GEN warning message illuminated
- EICAS indications confirming generator failure
  - Less than 24 volts
  - Amps discharging

Figure SY203-1 – Generator Bus and Battery

Figure SY203-2 – Generator Failure Indications
Inoperative Generator (Cont’d)

With the generator failed and the Bus Tie open, you will lose all systems powered by the generator bus, including:

- UHF comm and VHF Nav/DME
- Left MFD
- Air conditioning and blowers
- Speed brake, NWS and TAD

Inoperative Generator Bus

Indications of generator bus failure:

- MASTER WARN and MASTER CAUTION switchlights flashing
- Messages lit:
  - ADC FAIL
  - GEN BUS
  - FUEL BAL
  - TAD FAIL
  - TAD OFF
  - ANTI ICE
  - Loss of left MFD

Figure SY203-3 – System Losses

Figure SY203-4 – Generator Bus Failure Indications
Battery Bus Inoperative

Indications of loss of battery bus or failure of current limiter on battery bus side:

MASTER WARN and MASTER CAUTION switchlights flashing

Messages lit:

BATT BUS
OIL PX HYDR
FL LO PMU
STATUS
TRIM OFF

Failure of right MFD

Figure SY203-5 – Battery Bus Failure Indications

Figure SY203-6 – Battery Bus Instrument Failures
Inoperative Bus Tie

Battery and generator buses disconnected at bus bar crosstie

Indications:

MASTER CAUTION switchlight flashes

BUS TIE message illuminates

Figure SY203-7 – Bus Tie

Figure SY203-8 – Inoperative Bus Tie Indication
Battery and Generator Failure

Loss of systems and instruments. The only operative instruments (AUX BAT ON) will be the standby instrument and associated lighting, FIRE 1 detection system, IRU, VHF radio and standby VHF control head.

Indications:

Inoperative systems including:

- OBOGS
- ICS
- All electronic displays
- PMU
- Starter
- CWS except FIRE 1
- Gear/flap indicators
- Probes anti-ice
- Interior and exterior lighting, except standby instrument floodlighting
- ECS
- VHF comm/nav and GPS
Low Fuel Pressure

Engine feed fuel pressure dropping or fluctuating; boost pump engages or cycles on and off.

Indications:

- MASTER WARN switchlight flashes
- FUEL PX message illuminates
- BOOST PUMP message may cycle on and off

Fuel Imbalance

Autobalance system fault, greater than 30 lb difference between left and right tanks for more than two minutes
Indications:

**MASTER CAUTION**
switchlight flashes

**FUEL BAL** message
illuminates

Fuel Probe Failure

If a fuel probe fails, the auto balance system will shut off.

Indications:

**MASTER CAUTION**
switchlight flashes

**FUEL BAL** message will
illuminate

**FP FAIL** will display on the
CAS.

The fuel quantity indication will continue to provide an accurate indication of minimum fuel level.
Fuel Probe Failure Gauge
Indications

   Outer Probe - Shows fuel level drop to middle probe

   Middle Probe - Normal level until fuel drops below outer probe

   Inner Probe - Normal level until fuel drops below middle probe

   Collector Tank Probe - Levels in both wing tanks drop by one-half gauged level of collector tank

Warning Reminder

   Whenever any of the previous abnormal conditions occur, the MASTER WARN and/or MASTER CAUTION switchlight(s) will flash, the appropriate messages illuminate, and the master warning tone sounds.
Fuel Leak

Indications: Visual signs of leakage, such as vapor trailing behind the wing, stain on top of wing from fuel cap or stain around bottom wing rivets.

A fuel leak from the wing will not activate the master warning/caution system.

Lesson Review Questions

Figure SY203-16 – Fuel Leak
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. During normal operation, while the bus tie is closed, which electrical buses does the generator supply? (B/1/1)
2. The GCU is located under a side panel in which cockpit? (B/1/2)
3. Generator and battery buses are tied together through which switch? (B/1/3)
4. Power for aircraft avionics is supplied by which bus? (B/1/4)
5. Battery bus circuit breakers are located on which side of the cockpit? (B/1/5)
6. Control of battery power is transferable between cockpits using what? (B/1/6)
7. True or false? The auxiliary battery will activate automatically upon failure of the primary battery. (B/1/7)
8. The landing and taxi lights are activated by the LDG and TAXI switches when the gear is _____. (B/1/8)
9. The navigation lights at the leading edge wing tips are what colors? (B/1/9)
10. Using single point refueling, the T-6B’s maximum usable fuel is how many pounds? (B/2/1)
11. Which refueling method allows more fuel to be pumped into the wing tanks? (B/2/2)
12. The primary jet pump and transfer jet pumps are operated by what means? (B/2/3)
13. Data from the fuel flow transmitter is displayed on what instrument? (B/2/4)
14. EICAS fuel quantity indications are derived from how many sensors in the fuel tanks? (B/2/5)
15. What is indicated if the M FUEL BAL message is displayed? (B/2/6)
16. True or false? The weight of fuel in the collector tank is included in the total fuel weight on the EICAS. (B/2/7)
17. Which component prevents fuel from draining from the wing tank? (B/2/8)
18. If tank loads are out of balance, the auto balance system stops flow to which tank? (B/2/9)
19. The FUEL BAL message will illuminate if the fuel weight difference between the left and right tanks exceeds what figure for more than two minutes? (B/3/1)
20. True or false? Indications of the current limiter and/or actual bus failure are shown on this CAS. (B/3/2)

![CAS Display](image)

21. The BOOST PUMP message is cycling on and off. This could be an indication of what? (B/3/3)

**LESSON REVIEW QUESTIONS**

1. The generator supplies what voltage to the generator and battery buses?
2. The anti-collision strobe lights are located where?
3. External power is distributed on which bus?
4. Gravity refueling adds how many total pounds to the T-6B normal capacity?
5. Generator bus circuit breakers are located on which side of the cockpit?
6. In addition to the indications shown, you have lost the left MFD. This is an indication of a failure of what component?

![MFD Display](image)
7. True or false? Single-point refueling fills all three tanks sequentially beginning with the collector tank.

8. The control for which shutoff valve is located in the cockpit?

9. Which message displays if the autobalance system has failed or if the difference in weight between the left and right tanks exceeds 30 pounds for more than two minutes?

10. Which electrical component provides power for engine starts?
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OVERVIEW
Propulsion 1 is the first of two lessons on the propulsion system. This lesson will focus on the engine and related systems, including the engine, engine exhaust, engine cowling, starter, ignition, oil, PCL, PMU, reduction gearbox, propeller, and PIU.

REFERENCES
Personnel: None
Media Facilities: Student CAI Workstation
Support Resources: T-6B Flight Manual; T-6B Systems 2 Student Guide

STUDENT ASSIGNMENTS
Read applicable portions of T-6B Flight Manual, Section I.
Complete CAI lesson SY204, following along with this student guide.
Complete the practice questions provided.

LESSON OUTLINE
Topics in this lesson must be taken in sequential order. All topics must be completed prior to attempting the end of lesson quiz. The estimated time required to complete this lesson is 1.8 hours.
Introduction

Engine Systems

Engine Cowling

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Cowling Purpose/Components

The engine cowlings are the metal panels that cover the engine compartment. These panels protect the engine components, decrease drag, and provide an engine air intake.

All of the panels are removable. Most of the panels can be opened with quick release latches. These latches provide quick access to the engine compartment.

Figure SY204-1 – Engine Cowling
Cowling Components/Functions

The engine cowling supplies the engine with essential airflow. Air enters the cowling through an opening in the front just below the nose piece.

This air is passed through the inertial separator prior to reaching the engine. The inertial separator causes the air molecules to turn 90° to the engine compartment. Heavier particles, such as water or debris, are not able to make the turn and are returned to the atmosphere through a bypass duct.

Engine System

| 1.17.0.0.1 | Define terminology and concepts related to the propulsion system |
| 1.17.0.0.3 | Identify major components of the propulsion system |
| 1.17.2.0.1 | Identify purpose of engine system |
| 1.17.2.0.2 | Describe engine system operating principles |
| 1.17.2.0.3 | Identify engine system components |
| 1.17.2.0.4 | Match engine system components to functions |
| 1.17.2.0.6 | Cite procedural steps to operate engine |

Engine Purpose

In order for the T-6B to fly, it needs forward movement. Forward movement is generated from thrust. The engine generates the power to turn the propeller, which produces thrust.
Engine Model

Here is a model of the T-6B engine.

Engine Type Part 1

The T-6B is equipped with a Pratt & Whitney PT6A-68 free turbine, reverse flow design, turboprop engine. What does all that mean?

Free turbine refers to the fact that the compressor and power turbines are not physically connected. Air movement from one turbine to the other provides power to the propeller.

Engine Type Part 2

Reverse flow design refers to the flow of air through the engine. Air enters the engine at the rear and moves forward during the combustion cycle.
Engine Operation

There are three elements necessary for engine operation. These elements are:

- Air
- Fuel
- Heat

Major Sections

The major sections of the engine are:

- accessory compartment
- gas generation section
- power turbine section
Accessory Compartment

The accessory compartment is located at the rear of the engine and contains several aircraft systems. Some of those systems are:

- accessory gearbox
- oil tank
- starter/generator
- battery

Accessory Compartment Functions

Most of the components in the accessory compartment are not directly related to engine operation. The exception is the starter. The starter turns the compressor turbine and compressor which provides air to the engine until it starts and is able to sustain itself.

Figure SY204-8 – Accessory Compartment
Gas Generation Section

The gas generation section is located between the accessory compartment and the power turbine section, and contains the following components:

- compressor inlet
- compressor
- combustion chamber
- compressor turbine

Gas Generation Functions 1

Inlet air enters the engine through the compressor inlet and is compressed by a four-stage axial flow compressor and a single stage centrifugal flow compressor.
Gas Generation Functions 2

The compressed air is transferred to the combustion chamber. In the combustion chamber the compressed air is mixed with fuel and ignited. Igniting the mixture causes the gases to expand. The expanding gases drive the compressor turbine, which perpetuates the cycle.

Power Turbine Section

The power turbine section is the front section and contains the following components:

- power turbines
- exhaust case
- reduction gearbox
- propeller shaft

Figure SY204-11 – Power Turbine Section 1
Power Turbine Section Functions 1

The power turbine section uses the expanding gases generated by the gas generation section to produce horsepower. After the expanding gases pass through the compressor turbine they drive the power turbines. Notice how the power turbine rotates in the opposite direction of the compressor turbine. This is possible because there is no physical connection between the two turbine sections.

Power Turbine Section Functions 2

The gases flow through the exhaust system and back into the atmosphere. The power turbine drives the reduction gearbox, which in turn drives the propeller shaft at a reduced RPM.

Figure SY204-12 – Power Turbine Section 2
## Engine Exhaust System

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<td>1.17.8.0.1</td>
<td>Identify purpose of exhaust system</td>
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<tr>
<td>1.17.8.0.3</td>
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</tr>
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### Exhaust Components

The engine exhaust system consists of the following components:

- exhaust ports
- exhaust stacks

### Exhaust Purpose/Location

Once the expanding gases have passed over the power turbine they are ready to be released back into the atmosphere. This is where the exhaust system comes into play.

As the gases come off the power turbine they are directed to the exhaust ports on either side of the engine. From the exhaust ports the gases make a 180° turn through the exhaust stacks before being released rearward. As the gases are released into the atmosphere they provide a small amount of additional thrust.

![Exhaust Components](image)
Engine Ignition System

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<td>Match ignition system components to functions</td>
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Ignition System Purpose

As mentioned earlier, three elements that must be present for proper engine operation are compressed air, fuel, and heat. The starter provides the initial air flow, the Fuel Management Unit (FMU) provides the fuel, and the ignition system produces the initial heat source.

The T-6B uses a dual spark ignition system to initiate combustion. This type of ignition system provides quick light ups over a wide range of temperatures.

Ignition Components/Location

The ignition system consists of an ignition exciter, two high voltage igniter cables, and two spark igniters.

The ignition exciter is mounted on the airframe. An igniter cable runs from the exciter to each spark igniter. The spark igniters are located at the 4 and 9 o’clock positions around the combustion chamber.

Figure SY204-14 – Ignition Components 1
Ignition System Operation

To create a spark the ignition exciter receives a low voltage input signal. The exciter transforms this signal to a high voltage output signal. Ignition cables carry this high voltage signal to each spark igniter. The spark igniters provide a spark to the air and fuel mixture in the combustion chamber.

Ignition Control Switch 1

An ignition control toggle switch is located on the right forward switch panel in each cockpit. Available switch positions are as follows:

- ON
- NORM

Figure SY204-15 – Ignition Components 2

Figure SY204-16 – Forward and Aft Ignition Switches
Ignition Control Switch 2

During autostart or normal operation the ignition switch should be placed in the NORM position.

With the ignition switch in the NORM position the igniters will initiate when the starter switch is moved to AUTO/RESET. The Power Management Unit (PMU) will energize and de-energize the igniters as required during the start sequence. A green IGN SEL message will illuminate when the igniters are activated.

The ON position is available for continuous igniter operation.

Ignition System Power

Power for the ignition system is provided through a circuit breaker labeled IGN, located on the battery bus circuit breaker panel in the front cockpit.

Figure SY204-17 – Front Battery Bus Circuit Breaker Panel
### Power Control Lever (PCL)

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<thead>
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<td>Identify purpose of PCL system</td>
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<td>1.17.10.0.2</td>
<td>Describe PCL system operating principles</td>
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<td>1.17.10.0.3</td>
<td>Identify PCL system components</td>
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<tr>
<td>1.17.10.0.4</td>
<td>Match PCL system components to functions</td>
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</table>

#### PCL Location/Purpose

The Power Control Lever (PCL) controls fuel flow to the engine, producing torque on the propeller, and ultimately controls the amount of engine power and aircraft speed.

PCLs are located on the left console panel in both cockpits.

#### PCL Model

Here is a model of the PCL.

---

**Figure SY204-18 – PCL Location**

**Figure SY204-19 – PCL Model**
PCL Operation

To operate the PCL, use your left hand to move the lever forward or aft.

Pushing the lever forward increases the amount of fuel to the engine, increasing aircraft power. Pulling the lever aft decreases the amount of fuel to the engine and reduces aircraft power.

Front to Aft Connection

The front and aft PCLs are interconnected with a push-pull rod, as shown in the graphic above. As one PCL moves the other follows. This provides identical control of the propulsion system from either cockpit.
PCL Connection to FMU

The front PCL is mechanically connected to the Fuel Management Unit (FMU) by a flexible cable. The PCL is electrically connected to the FMU by way of the PMU.

PCL movement physically moves the input lever on the side of the FMU. This fuel request displaces a cam in the FMU which releases the requested amount of fuel.

PCL Friction Adjust

The front cockpit PCL has a friction adjust knob. The friction adjust knob is used to change the PCL tension. Rotating the knob right increases tension and rotating the knob left decreases tension. Adjusting the PCL friction will keep the PCL from inadvertently moving due to aircraft vibrations.

Because the PCLs are connected, any adjustment made to the front PCL will also affect the aft PCL.
PCL Positions 1

The PCL has the following labeled positions:

MAX
IDLE
OFF

OFF is located at the aft most position. The OFF position is used for engine shutdown.

Figure SY204-23 – PCL Positions

PCL Positions 2

Engine power is distributed linearly between the other two positions, IDLE and MAX.

IDLE power is always the minimum operational power and MAX is 100% of available power. Any PCL position between IDLE and MAX is proportional to available power.

PCL Positions 3

An unmarked position located between OFF and IDLE is used during engine start.
To find the start position, move the PCL forward until a green ST READY light on the message panel illuminates.

PCL Cutoff Gate

A PCL cutoff gate is provided to prevent inadvertent engine shutdown. When the PCL is moved forward to the IDLE position during engine start, two roller bearings lock in place on the front side of the rocker cam detent to secure the gate.

To shutdown the engine, lifting the cut-off gate handle moves the rocker cam out of the way and allows the PCL to move to the cutoff position.

-Power Quadrant Assembly Modification
AYC-1641 was installed on aircraft serial numbers 166010 thru 166194; 166145 and after.

- This modification adds a finger lift guard to protect against unintentionally raising the PCL cutoff finger lift.

- Pushing the finger lift guard down and then raising the PCL cutoff finger lift, moves the rocker cam out of the way and allows the PCL to move to the cutoff position.
Proper Hand Position

Proper hand position will help protect against inadvertent engine shutdown.

AVOID resting your wrist or lower arm on the PCL with your fingers in the area of the cutoff gate release. From this position your fingertips may inadvertently catch and lift the cutoff gate release allowing you to potentially move the PCL to the cutoff position.

Figure SY204-24 – PCL Hand Position

Other PCL Components

You have probably noticed the PCL has several buttons, switches, and controls. The controls not covered yet and not directly related to the propulsion system are discussed in detail in their respective lesson.

Figure SY204-25 – PCL Components
## Power Management Unit (PMU)

<table>
<thead>
<tr>
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<td>1.17.0.0.3</td>
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<td>1.17.0.0.5</td>
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<tr>
<td>1.17.0.0.6</td>
<td>Match PMU system components to functions</td>
</tr>
</tbody>
</table>

### PMU Location/Purpose

The PMU is a computer unit located underneath the engine in the accessory compartment.

The PMU processes power requests from the PCL and keeps the engine and propeller within operating limits.

In addition, the PMU determines available power and provides a near linear power response between the PCL IDLE and MAX positions.

### Maintaining Limitations

As mentioned, one of the primary functions of the PMU is to keep the engine and propeller within operating limits.

The PMU continually interacts with other engine systems to automatically maintain Interstage Turbine Temperature (ITT), Torque, and RPM limitations (\(N_1\) & \(N_T\)).

![POWER MANAGEMENT UNIT (PMU)](image-url)
FMU Connection

As previously discussed, the PCL is mechanically connected to the FMU by a flexible cable and electrically connected to the FMU by way of the PMU.

Moving the PCL forward provides a physical input to the FMU via the flexible cable releasing a nominal amount of fuel from the FMU.

An electronic signal is transmitted to the PMU which fine tunes the power request and sends an electronic signal to the FMU.

The combination of these inputs produces a near linear power response.

PMU Effect

This graph shows the near linear power response produced by the PMU. It also shows engine operation with the PMU off or nonfunctional.
PMU Switch 1

Control of the PMU is provided through a toggle switch labeled PMU and located on the right forward switch panel in the front cockpit only. This switch has two available positions, NORM and OFF.

When in the NORM position all PMU functions are active.

PMU Switch 2

With the PMU switch in the OFF position, or if the PMU fails, all engine limitations must be monitored manually.

In addition, fuel delivery will be maintained solely through the mechanical connection between the PCL and FMU. A step change in engine power is likely if the PMU fails or is turned off in flight.

Figure SY204-29 – PMU Switch
PMU STATUS

Two messages are provided to indicate PMU functionality.

An yellow PMU STATUS message will illuminate after landing so that maintenance may be alerted that the PMU has accommodated a fault. A PMU STATUS message in flight indicates a fault or mismatch in the weight-on-wheels switches, alerting the pilot that the PMU will not revert to the ground mode upon landing.

In addition, the yellow MASTER CAUT light will illuminate, and an aural tone is heard.

PMU FAIL

The second message is a red PMU FAIL message. This message will illuminate anytime the PMU is nonfunctional.

Whenever the PMU FAIL message illuminates, it will be accompanied by the illumination of the PMU STATUS message.

In addition, the MASTER WARN and MASTER CAUT lights flash and an aural tone is heard.
PMU Power

The primary power source for the PMU comes from the Permanent Magnet Alternator (PMA) which is mounted on the reduction gearbox.

The PMA provides 32 VAC, which the PMU converts to DC. If the PMA fails, power is provided through the 28 VDC battery bus.

PMU Circuit Breaker

The PMU backup power circuit breaker is labeled PMU, and is located on the battery bus circuit breaker panel in the front cockpit.

Figure SY204-32 – PMU Power

Figure SY204-33 – Front Battery Bus Circuit Breaker Panel
Accessory Gearbox

Starter System

| 1.17.0.0.1 | Define terminology and concepts related to the propulsion system |
| 1.17.0.0.3 | Identify major components of the propulsion system |
| 1.17.4.0.2 | Describe starter system operating principles |
| 1.17.4.0.3 | Identify starter system components |
| 1.17.4.0.4 | Match starter system components to functions |

Starter Components/Location

The starter/generator is attached to the accessory gearbox. A shaft connects the compressor section and accessory gearbox.

During engine start, the starter/generator functions as a starter to turn the compressor section. Once the start is completed, the starter/generator functions as a generator, with the compressor turbine powering the starter/generator and the other accessories attached to the gearbox.

Starter Purpose

During engine start, the starter motor turns the compressor via linkage in the accessory gear box. This generates air flow and compression until the engine starts and is able to run at idle speed.

Figure SY204-34 – Starter/Generator Location
Once the engine is self sustained the starter becomes a generator. The generator is driven by the engine via linkage in the accessory gearbox. The generator provides 28 VDC power, which powers many of the aircraft systems and charges the battery and the auxiliary battery to 24 VDC.

**Starter Switch**

The starter is initiated by a switch on the right forward switch panel in each cockpit. Each switch has the following three positions:

- AUTO/RESET
- NORM
- MANUAL

**Starter Switch Operation**

The AUTO/RESET position will be used for most engine starts. To start the engine, momentarily place the starter switch in this position. The switch is spring loaded and will automatically return to the NORM position.
The MANUAL switch position is available, but is not used under normal circumstances. If a start attempt is automatically or manually aborted, the MANUAL switch position is selected to manually motor the engine by holding the starter switch in this position for 20 seconds with the PCL off.

**Engine Start Sequence 1**

When starting the engine, it is important to make sure that all preflight procedures have been completed.

When ready to start the engine, move the Power Control Lever (PCL) forward until the green ST READY message illuminates.

**Engine Start Sequence 2**

The ignition switch should be in the NORM position.

The final step in the start procedure is to move the starter switch to the AUTO/RESET position momentarily. A green IGN SEL message will illuminate when the igniters are energized. The engine will continue the start cycle on its own.

![Figure SY204-36 – Ignition/Starter Switches](image-url)
The messages will extinguish during the start sequence. You will learn the complete start sequence in detail in a later lesson.

Starter Power

Power for the starter is provided through a circuit breaker labeled START located on the battery bus circuit breaker panel in the front cockpit.

Oil System

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<td>6.4.17.0.1</td>
<td>Identify oil pressure values to be maintained during aerobatic and non-aerobatic flight</td>
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<td>1.17.6.0.1</td>
<td>Identify purpose of the oil system</td>
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<tr>
<td>1.17.6.0.2</td>
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</tr>
<tr>
<td>1.17.6.0.3</td>
<td>Match oil system components to functions</td>
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</table>

Oil System Purpose

The oil system provides a steady flow of filtered oil to the engine bearings, reduction gears, accessory drives, and propeller. Without proper lubrication, these systems would overheat, seize up, and fail to operate.

Figure SY204-37 – Front Battery Bus Circuit Breaker Panel
The oil system includes a pressure system, scavenge system, and cooling system. The oil system is designed such that oil pressure values are maintained during normal and aerobatic flight.

Oil System Components

The oil system is made up of several components.

Oil System Operation

Oil must be pressurized to ensure lubrication of the necessary parts. This is done by the pressure pump. The pressure pump must also supply pressure during inverted or negative G flight. There are two oil pickups inside the oil tank. The first pickup is in the center of the tank and is submerged in oil during normal flight operations.
A second pickup, located near the top of the tank ensures a constant flow of oil during inverted flight.

Oil Scavenge System

After the pressure pump supplies oil to the bearings, reduction gears, accessory drives, and propeller, a scavenge system returns the oil to the oil tank.

The system uses several pressure and scavenge pumps like the one shown here to replace the oil in the oil tank. Pumps are placed in various locations throughout the oil system.

Oil Cooler

This scavenged oil is then routed through the oil cooler before the oil is returned to the oil tank.
Oil Filters

Oil is filtered by a main oil filter in the oil tank. There are also several oil strainers located in the power, compressor, and accessory drive areas. If the main oil filter gets clogged, a filter bypass valve allows unfiltered oil to continue lubricating the engine.

Chip Detector

The oil system also incorporates a chip detector system. The chip detector sensor is located in the reduction gearbox. This sensor detects metallic particles in the oil and warns the pilot of possible gear damage.

If metal particles are detected in the oil, a red CHIP message illuminates, the MASTER WARN light illuminates, and an aural tone is heard.
Checking Oil Levels

Oil levels can be checked by removing the dipstick from the fill port and visually inspecting the oil levels on the dipstick. This method is only valid within 30 minutes of engine shutdown.

A second means for checking oil levels is provided through a sight glass on the side of the oil tank. This method is not used because it is not as accurate as the dipstick method.

Oil Servicing Caution

Figure SY204-45 – Oil Sight Glass/Dipstick

Figure SY204-46 – Oil Servicing Caution
Oil Pressure Signals

Oil temperature and pressure are measured at ports on the engine and sent to the EICAS display in each cockpit.

Oil temperature and pressure are measured by the same ports on the engine, but a signal is sent to both the EICAS display in each cockpit and a Signal Conditioning Unit (SCU) computer. The SCU computer contains logic to illuminate the central warning system under certain oil pressure conditions discussed in this topic.

Oil Pressure

During steady state conditions normal oil pressure should be between 90 and 120 psi (green area on display). Refer to abnormal operations if oil falls outside this range.

The exception to this is during aerobatics or spins. During aerobatics or spins, oil pressure should be between 40 and 130 psi. Oil pressure below normal should be corrected before next flight.
Oil Pressure Indicators 1

If engine power is at IDLE, and oil pressure falls below 15 psi, or if engine power is above IDLE, and oil pressure falls below 40 psi, a red OIL PX message will illuminate. In addition, the MASTER WARN light will illuminate, and an aural warning tone is heard.

Oil Pressure Indicators 2

A yellow OIL PX message will illuminate when oil pressure is between 15 and 40 psi at IDLE power or between 40 and 90 psi for 10 seconds above IDLE power.

If oil pressure is 15 psi or below at IDLE power, the yellow OIL PX message will extinguish and the red message will remain illuminated.

If oil pressure remains between 15 and 40 psi at IDLE power for 5 seconds or more, both messages will be illuminated.
A MASTER WARN or MASTER CAUT light will illuminate with each message and an aural warning tone is heard.

Oil Pressure Transducer Power

Power for the oil pressure transducer is provided through a circuit breaker labeled OIL TRX, located on the battery bus circuit breaker panel in the front cockpit.

Figure SY204-50 – Front Battery Bus Circuit Breaker Panel

Propeller System

| 1.17.0.0.1 | Define terminology and concepts related to the propulsion system |
| 1.17.0.0.3 | Identify major components of the propulsion system |
| 1.17.3.0.1 | Identify purpose of propeller system |
| 1.17.3.0.2 | Describe propeller operating principles |
| 1.17.3.0.3 | Identify propeller system components |
| 1.17.3.0.4 | Match propeller system components to functions |
| 1.17.5.0.1 | Identify purpose of reduction gear box system |
| 1.17.12.0.1 | Identify purpose of PIU system |
| 1.17.12.0.2 | Describe PIU system operating principles |
Propeller Purpose

The purpose of the propeller is to convert power into thrust. The T-6B uses a four blade, variable pitch, constant speed propeller. The PMU and the Propeller Interface Unit (PIU) control propeller speed ($N_p$) to maintain a constant propeller speed of 2000 RPM (100% $N_p$) and achieve varying levels of thrust by automatically adjusting propeller pitch.

100% torque is available from sea level to approximately 12,000 to 16,000 feet MSL on a standard day. Above 16,000 feet MSL, a decrease in the maximum torque available will be noted.

Reduction Gearbox

The propeller is driven by the power turbine, through the reduction gearbox (RGB). The reduction gearbox transfers power generated by the engine to the propeller, reducing engine output from 30,000 RPM to the propeller operating speed of 2000 RPM.
Propeller RPM

Propeller speed ($N_p$) is measured by a phase shift torque probe located in the reduction gearbox. Data from the torque probe is continually monitored by the PMU.

The PMU directs the PIU to maintain propeller RPM at 100% (2000 RPM) using an electronic governor. A backup mechanical overspeed governor will not allow propeller RPM to exceed 106% (2120 RPM).

If the PMU or PIU fails, propeller RPM is automatically regulated by the backup system. If this system is used, the mechanical flyweight overspeed governor will reset to maintain RPM at 100%.
SY0204
PROPULSION 1

± 2% (2000 RPM).

PIU Location/Purpose

Propeller pitch changes are based upon the changes in oil pressure. The PIU responds to power requests from the PMU by regulating oil pressure to the pitch change mechanism. Changes in oil pressure result in changes to propeller pitch.

Figure SY204-53 – Reduction Gearbox Location

Figure SY204-54 – Propeller Interface Unit
Three Pitch Conditions

There are three basic blade angle or propeller pitch conditions. These conditions are based upon the measure of the angle between the plane of rotation of the propeller and the chord line of the blade.

These conditions are:

- Feathered
- High pitch (coarse)
- Low pitch (flat or fine)

Prop Conditions

In the feathered condition, the blade is aligned nearly straight into the wind, approximately 86° from the perpendicular plane. This position produces the least amount of drag and no thrust. Without oil pressure, the counterweights and feathering spring force the propeller blades to this position.

High pitch is variable between feather and low pitch. The propeller will be in this position during most flight conditions.
In the low pitch condition, the propeller blades are approximately 15° from the perpendicular plane. The propeller blades produce some thrust and the most drag. The propeller will be in this position during low speed and low throttle flight.

Pitch Change Mechanism

The propeller is naturally pulled to the feathered position by the feathering spring and the counterweights.

The pitch change mechanism uses the oil system to force the propeller blades away from feather. Oil for this system is provided by the engine oil system and regulated by the PIU.

As the PIU increases oil pressure the sliding piston is forced forward, rotating the propeller blades toward low pitch.

Because the counterweights are connected to the blade root, they are also repositioned by the increased oil pressure.
Oil Pressure Loss

If there is an engine failure during flight, oil pressure to the pitch change mechanism will be lost and the propeller will move toward feather.

However, if any residual oil pressure remains from windmilling, the PIU will attempt to maintain propeller pitch and the propeller may not feather. To feather the propeller, place the PCL in the OFF position. This position triggers a microswitch which activates the feather dump solenoid valve. The valve dumps oil pressure which allows the feathering spring and counterweights to feather the propeller.

Valve Power

The feather dump solenoid valve receives power through a circuit breaker labeled PROP SYS, located on the battery bus circuit breaker panel in the front cockpit.

Figure SY204-57 – PROP SYS Circuit Breaker
Automatic Adjustment

Since the adjustment of the propeller pitch is automatic, the T-6B pilot only needs to adjust the PCL to the desired level of engine power. The propeller system will use this input, as well as temperature, altitude and other conditions, to determine the necessary propeller pitch.

Lesson Review Quiz
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. The engine cowling does all of the following except ______. (B/1/1)
   a. protects the engine components
   b. decreases drag
   c. includes an air inlet to the engine
   d. secures the engine to the frame

2. The purpose of the inertial separator is to ______. (B/1/2)
   a. separate cool incoming air and hot exhaust gases
   b. remove water that may get in the fuel tanks
   c. keep debris away from the engine
   d. distribute air evenly over the wings

3. The compressor and power turbines are physically connected. (B/2/1)
   a. True
   b. False

4. What three elements are necessary for engine operation? (B/2/2)
   a. Heat, smoke, and fire
   b. Air, oil, and fuel
   c. Gas, oil, and heat
   d. Air, fuel, and heat

5. As exhaust is released, additional thrust is provided. (B/3/1)
   a. True
   b. False

6. Once the engine is started, and the ignition switch is in the ON position, igniters are automatically energized and de-energized by the PMU. (B/4/1)
   a. True
   b. False
7. The primary purpose of the ignition system is to ______. (B/4/2)
   a. mix fuel and compressed air in the combustion chamber
   b. turn the compressor turbine until engine start
   c. ignite the air and fuel mixture in the combustion chamber
   d. turn the starter motor until combustion

8. Friction control settings made to the front PCL affect the aft PCL. (B/5/1)
   a. True
   b. False

9. When starting the T-6B, the PCL should be ______. (B/5/2)
   a. in the START/IDLE detent position
   b. in the IDLE position
   c. pushed forward until a green ST READY message is illuminated
   d. pushed forward until a green IGN SEL message is illuminated

10. The PMU is located ______. (B/6/1)
    a. underneath the engine, in the accessory compartment
    b. on the reduction gearbox, next to the propeller interface unit
    c. in the left avionics bay
    d. in the front cockpit

11. The PMU performs the following functions, except: (B/6/2)
    a. maintains operating limits
    b. processes power requests
    c. determines available power
    d. releases the correct amount of fuel

12. The PMU STATUS message illuminates after landing when the PMU ______. (B/6/3)
    a. is regulating normal fuel flow
    b. is ready for operation
    c. needs maintenance
    d. is monitoring engine operation

13. After engine start, the starter becomes a generator. (C/1/1)
    a. True
    b. False
14. The MANUAL starter switch position will be used under normal circumstances. (C/1/2)
   a. True
   b. False

15. With the engine above IDLE power a red OIL PX message illuminates when oil pressure falls below ______ psi. (C/2/1)
   a. 35
   b. 40
   c. 50
   d. 55

16. If oil pressure remains between 15 and 40 psi at IDLE power for more than 5 seconds, ______ will be illuminated. (C/2/2)
   a. the yellow OIL PX message
   b. the red OIL PX message
   c. both the yellow and red OIL PX messages
   d. neither OIL PX message

17. The chip detector sensor is located ______. (C/2/3)
   a. in the oil tank
   b. in the cool oil return line
   c. in the cooling assembly
   d. in the reduction gearbox

18. The oil system provides filtered oil to all of the following systems, EXCEPT ______. (C/2/4)
   a. propeller
   b. reduction gears
   c. engine bearings
   d. wheel brakes

19. The reduction gearbox reduces engine output from ______ RPM to propeller speeds of ______ RPM. (D/1/1)
   a. 4000; 1000
   b. 5000; 1000
   c. 20,000; 2000
   d. 30,000; 2000
20. The phase shift torque probe monitors _____ (D/1/2)
   a. starter/generator torque
   b. compressor turbine torque
   c. propeller speed
   d. blade angle torque

21. The PIU _____ (D/1/3)
   a. connects the propeller to the propeller shaft
   b. sends propeller data to each cockpit
   c. regulates oil pressure to the pitch change mechanism
   d. none of the above

22. If the propeller pitch change mechanism loses oil pressure, the propeller will automatically move towards the _____ position. (D/1/4)
   a. feathered
   b. low pitch
   c. high pitch
   d. medium pitch

23. Varying levels of thrust are achieved by _____. (D/1/5)
   a. changing propeller pitch
   b. changing compressor turbine speed
   c. changing propeller speed
   d. changing power turbine speed

LESSON REVIEW QUIZ QUESTIONS

1. The PMU _____.
   a. displays available power in each cockpit
   b. records flight data
   c. keeps the engine and propeller within operating limits
   d. processes all data for the EICAS
2. If the oil filter gets clogged ______.
   a. the system uses unfiltered oil
   b. an OIL FIL message illuminates
   c. oil is routed through a new oil filter
   d. oil pressure will be lost

3. In straight-and-level flight, for PCL positions above IDLE, oil pressure should be maintained between ______ and ______.
   a. 40; 90 psi
   b. 50; 80 psi
   c. 90; 120 psi
   d. 90; 140 psi

4. The phase shift torque probe is located ______.
   a. on the compressor turbine
   b. in the reduction gearbox
   c. in the compressor section of the engine
   d. in the propeller nose cone

5. Propeller pitch refers to ______.
   a. the angle of the propeller blades
   b. the sound the propeller makes
   c. size of the propeller blades
   d. the direction of rotation

6. Which propeller position produces the least amount of drag?
   a. High pitch
   b. Low pitch
   c. Medium pitch
   d. Feather

7. The propeller pitch change mechanism is able to change propeller blade angle by ______.
   a. hydraulic pressure
   b. a stepper motor
   c. oil pressure
   d. air pressure
8. The PMU directs the PIU to maintain propeller RPM at ______.
   a. 1900
   b. 2000
   c. 2100
   d. 2200

9. The power turbine is driven by ______.
   a. the starter motor
   b. the propeller
   c. a mechanical connection to the compressor turbine
   d. expanding gases

10. During aerobatic flight, oil pressure should be maintained at or above ______.
    a. 30 psi
    b. 40 psi
    c. 50 psi
    d. 90 psi
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OVERVIEW
The Propulsion 2 lesson will discuss engine displays and indicators, including the Engine Indication and Crew Alerting System (EICAS), and the Fire Warning System. The purpose, location, function, and interpretation of each display will be covered.

REFERENCES
Personnel: None
Media Facilities: Student CAI Workstation
Support Resources: T-6B Flight Manual; T-6B Systems 2 Student Guide

STUDENT ASSIGNMENTS
Read applicable portions of T-6B Flight Manual, Section I
Complete CAI lesson SY205, following along with this student guide.
Complete the practice questions provided.

LESSON OUTLINE
Topics in this lesson must be taken in sequential order. All topics must be completed prior to attempting the end of lesson quiz. The estimated time to complete this lesson is 1.1 hours.
Introduction

Engine Indicators/Displays

ENGINE DATA MANAGER

<p>| | |</p>
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<tbody>
<tr>
<td>1.22.0.0.4</td>
<td>Identify purpose of engine data manager</td>
</tr>
<tr>
<td>1.22.0.0.5</td>
<td>Identify location of engine data manager</td>
</tr>
</tbody>
</table>

EDM Purpose/Location

The Engine Data Manager (EDM) is a computer unit located in the right avionics bay that monitors and processes engine operation data.

The EDM performs several engine related tasks. It monitors engine operating parameters and provides discreet alerts to each IAC when necessary.

There are also several non-engine related functions performed by the EDM. They are:

- Fuel balancing
- Fuel quantity indication
- Determination and display of:
  - DC volts

Figure SY205-1 – EDM Location
DC amps

Hydraulic pressure Cockpit

pressure altitude Cockpit

differential pressure

EDM Power

Redundant power is supplied to the EDM through circuit breakers, labeled EDM, located on the battery bus circuit breaker panel and the generator bus circuit breaker panel in the front cockpit only.

Figure SY205-2 – EDM Circuit Breakers

ENGINE INDICATION AND CREW ALERTING SYSTEM (EICAS) DISPLAY

| 1.22.10b.0.1 | Identify purpose of engine indication and crew alerting system operating system |
| 1.22.10b.0.2 | Describe engine indication and crew alerting system operating principles |
| 1.22.10b.0.3 | Identify engine indication and crew alerting system components |
| 1.22.10b.0.4 | Match engine indication and crew alerting system components to functions |
| 1.22.10b.0.8 | Interpret engine indication and crew alerting system displays |
EICAS Location

Both of the cockpits in the T-6B feature an Engine Indication and Crew Alerting System (EICAS) display.

The EICAS provides engine and auxiliary instrument information. All of the indications on the EICAS are processed by the Engine Data Manager (EDM) channels EDM A and EDM B, then sent to the Integrated Avionics Computers (IAC) for display.

EICAS Display 1

The left side of the EICAS displays the following information:

- Fuel quantity
- Bingo
- Fuel flow
- Indicated outside air temperature
- Current amperage draw
- Bus Voltage
- Cockpit pressure altitude
- Cockpit differential pressure
Fuel Displays

The fuel quantity gauge receives information from fuel probes to generate a visual display of the amount of fuel (in pounds) in the wing tanks and the collector tank.

When the total fuel quantity drops below the specified bingo quantity, an aural alert sounds. While the bingo fuel gauge defaults to 400lbs on initial power up, the pilot may adjust this quantity using the UFCP to any setting between 0-1200.

The fuel flow gauge, labeled FF, measures the amount of fuel (in pounds per hour) being supplied to the engine. The EDM calculates fuel flow and sends the information to the EICAS via the IAC.

Figure SY205-5 – Fuel Display
IOAT Display

The Indicated Outside Air Temperature (IOAT) is measured by the T-1 probe, a sensor located under the engine cowling at the air inlet. Readings are displayed as a white digital readout. The IOAT will change to amber if the temp is 3 degrees C or less and the PROBES ANTI-ICE is not ON.

Electrical Displays

DC amperage is measured by the EDM. Normally, a discharge (negative value) is shown while under battery or ground power, and a positive draw while on generator power. Amperage draws above 30 amps are considered high.

DC voltage is also measured by the starter/generator voltage regulator. The DC voltage readout is amber up to 21.9 volts, white from 22.0 to 29.5, amber from 29.6 to 32.2, and red at 32.3 volts and above.
Cockpit Pressure Altitude Display

The cockpit pressure altitude display, labeled CKPALT, provides the pilot with the altitude (in feet) maintained in the cockpit due to pressurization.

Anytime the CKPALT display exceeds 19,000 feet, the digital readout turns amber. In addition, an amber CKPT ALT message illuminates, the MASTER CAUT switchlight flashes, and an aural tone sounds.

Cockpit Differential Pressure Display

The cockpit differential pressure (ΔP) display measures the difference between the air pressures inside and outside the cockpit.

If ΔP exceeds 3.9 ± 0.1 psi, the digital readout turns red. In addition, a red CKPT PX message illuminates, the MASTER WARN light flashes, and an aural tone sounds.

Figure SY205-8 – Cockpit Pressure Altitude Display

Figure SY205-9 – Cockpit Differential Pressure Display
EICAS Display 2

The middle column of the EICAS displays the following information:

Torque

Interstage turbine temperature

Gas generator speed readings more than 104%.

Torque Display

Torque is measured by the phase shift torque probe located in the reduction gearbox and represents a percentage of maximum rated torque.

In-limits ranges from 0 - 100% with the maximum of 100% indicated by the red radial on the analog scale. Out-of-limits are readings more than 100%, and are accompanied by a change in color, the flashing MASTER WARN light, and an aural tone.
ITT Display

Interstage Turbine Temperature (ITT) provides the pilot with an indication (in degrees Celsius) of the temperature between the compressor turbine and the power turbine. This reading is obtained from a sensing system around the combustion chamber.

With the exception of the startup sequence where ITT should not exceed 1000° C, ITT normal operating limits are between 200° C and 820° C. Out-of-limits readings are more than 820° C.

N1 Display

The gas generator speed (N1) represents the speed of the compressor turbine in the gas generator section of the engine. N1 is measured by a magnetic pulse sensor in the accessory gearbox.

As represented by the green arc on the analog scale, normal operating limits ranges from 60 - 104%. Out-of-limits are readings more than 104%.

Figure SY205-72 – Interstage Turbine Temperature (ITT)

Figure SY205-83 – N1 Display
The right side of the EICAS displays the following information:

- Propeller RPM (NP)
- Oil Pressure
- Oil temperature
- Hydraulic pressure

NP Display

The Propeller RPM (NP) is automatically controlled by the engine Propeller Interface Unit (PIU) and is designed to maintain a constant speed of 2000 RPM (100% NP).

NP indications are white text on a red background when operating in the ground resonance limit range of 62% to 80% NP, or in exceedance range of 102% or greater.
Oil Pressure Display 1

Oil pressure is measured by transducers located on the engine oil pressure line.
Normal operating limits range from 90 to 120 psi.

A red OIL PX indication on the CAS, accompanied by an aural tone and Master Warn, will occur under the following conditions:
- 40 psi or below above IDLE power
- 15 psi or below at IDLE power

Oil Pressure Display 2

The amber and/or red OIL PX annunciators will illuminate with associated MASTER WARN or MASTER CAUT switchlights, and aural tones for the conditions and oil pressure ranges shown on this table.

Figure SY205-116 – Oil Pressure Display 1

Figure SY205-127 – Oil Pressure Display 2
<table>
<thead>
<tr>
<th>PCL Position</th>
<th>Oil Pressure Condition</th>
<th>Time Delay</th>
<th>Annunciator</th>
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<tbody>
<tr>
<td>IDLE</td>
<td>Oil Pressure between 15 and 40 psi</td>
<td>None</td>
<td>Amber OIL PX</td>
</tr>
<tr>
<td>IDLE</td>
<td>Oil Pressure between 15 and 40 psi</td>
<td>5 Seconds or more</td>
<td>Red OIL PX, Amber OIL PX</td>
</tr>
<tr>
<td>IDLE</td>
<td>Oil Pressure 15 psi or below</td>
<td>None</td>
<td>Red OIL PX</td>
</tr>
<tr>
<td>Above IDLE</td>
<td>Oil Pressure between 40 and 90 psi</td>
<td>10 Seconds</td>
<td>Amber OIL PX</td>
</tr>
<tr>
<td>Above IDLE</td>
<td>Oil Pressure to 40 psi or below</td>
<td>None</td>
<td>Red OIL PX</td>
</tr>
</tbody>
</table>

**Figure SY205-127B Oil Pressure Ranges**

**Oil Temperature Display**

Oil temperature is sensed by transducers on the engine oil pressure line downstream from the oil cooler.

Normal operating limits ranges from 10 - 105° C. Cautionary limits, depicted by the amber color, ranges from 105 - 110° C. Out-of-limits are readings more than 110° C. Recall that out-of-limits will be accompanied by a color change, flashing MASTER WARN light, and an aural tone.

**Figure SY205-138 – Oil Temperature Display**
Hydraulic Pressure Display

Hydraulic pressure is measured by a pressure sensor located on the power pack reservoir.

Normal operating limits for this gauge ranges from 2880 to 3120 psi. If hydraulic pressure falls below 1800 psi or rises above 3500 psi, the display will change color to amber to indicate caution, and there will be a flashing MASTER CAUT light and an aural tone.

Figure SY205-149 – Hydraulic Pressure Display

CREW ALERTING SYSTEM (CAS)

| 1.22.10b.0.1 | Identify purpose of engine indication and crew alerting system |
| 1.22.10b.0.2 | Describe engine indication and crew alerting system operating principles |
| 1.22.10b.0.3 | Identify engine indication and crew alerting system components |
| 1.22.10b.0.4 | Match engine indication and crew alerting system components to functions |
| 1.22.10b.0.8 | Interpret engine indication and crew alerting system displays |
CAS Display

The bottom portion of the EICAS serves as the Crew Alerting System (CAS). This panel is reserved for caution, advisory, and status alert messages.

Messages display as follows:

Warnings - red

Cautions - amber

Status - green

Conditions - white

In addition to the messages, an aural tone sounds to direct pilot attention to any alerts.
MASTER WARN/CAUT Panel

The MASTER WARN, MASTER CAUT, and FIRE warning switchlights display in each cockpit on a panel to the left of and adjacent to the UFCP.

When a warning or caution message displays on the CAS, the corresponding switchlight flashes on this panel.

In addition to the messages, an aural tone sounds to direct pilot attention to any alerts.

MASTER WARN/CAUT Rearm

Pressing the MASTER WARN or MASTER CAUT switchlight in either cockpit extinguishes the lamp and rearms the mechanism for additional malfunctions or failures. Acknowledged advisories remain steady on the CAS display until the malfunction or failure is corrected.

Any new advisories will flash and be accompanied by a new audio warning.
FIRE WARNING SYSTEM

| 1.17.9.0.1 | Identify purpose of engine fire warning system |
| 1.17.9.0.2 | Identify engine fire warning system operating principles |
| 1.17.9.0.3 | Identify engine fire warning system components |
| 1.17.9.0.4 | Match engine fire warning system components to functions |

Purpose/Location on Engine

The T-6B is equipped with a fire warning system. The system is designed to monitor both average and discrete temperatures.

The system consists of redundant sensor tubes containing core material and responder assemblies located on the exterior of the engine as shown here.

Fire Warning Components

The warning system consists of a core element, sensor tube, and responder assembly. The sensor tube is filled with pressurized helium gas. Inside this tube is a core element filled with hydrogen gas. The core element responds to localized heat caused by fire or hot gases. The sensor tube responds to average temperatures for overheat sensing.

The tubes are built such that kinks, twists, or dents don’t affect system reliability.
Fire Warning Operation 1

As average or localized temperatures rise the helium gases expand, creating pressure inside the responder. When pressure in the responder reaches or exceeds the preset limit, a signal triggers the overheat/fire alarm.

Figure SY205-26 – Fire Warning Operation 1

Fire Warning Operation 2

The hydrogen charged inner core is designed to respond to highly localized temperatures caused by fire or hot gases. As the temperature of the core element increases it releases hydrogen gas into the sensor tube. The mixture of these gases causes the helium gas pressure to increase. When pressure limits are exceeded in the responder, it generates an overheat warning.

Figure SY205-27 – Fire Warning Operation 1
Warning Indications

If preset temperature limitations are exceeded, the pilot is notified by the red FIRE annunciator in each cockpit. In addition, the MASTER WARN annunciator will illuminate and an aural warning tone is heard.

FIRE Test Switch

The two fire warning systems may be tested for system integrity and lamp operation by a switch labeled FIRE, located on the system test panel in the front cockpit.

To test the system, select the #1 switch position. If the FIRE and MASTER WARN annunciators illuminate and the aural warning tone sounds, the system is ready for flight. If the annunciator does not illuminate, the system is not flight ready. Repeat the process for the #2 switch position.
Firewall Shutoff Handle

In the event of a fire a Firewall Shutoff Handle is available. The handle is located on the left console panel in the front cockpit. The shutoff handle mechanically shuts off hydraulic fluid and fuel flow to the engine, as well as bleed air flow from the engine. Valves may be reset by pushing the handle back in.

Figure SY205-150 – Emergency Firewall Shutoff Handle

Fire Warning Power

Power for the #1 fire warning system is provided through a circuit breaker labeled FIRE 1, located on the battery bus circuit breaker panel in the front cockpit.

Power for the #2 fire warning system is provided through a circuit breaker labeled FIRE 2, located on the generator bus circuit breaker panel in the front cockpit.

Figure SY205-31 – Fire Warning Circuit Breakers

Lesson Quiz Questions
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. All of the functions performed by the engine data manager (EDM) are engine related. (B/1/1)
   a. True
   b. False

2. The EDM is located ______. (B/1/2)
   a. in the front cockpit
   b. on the accessory gear box
   c. in the environmental control systems compartment
   d. in the right avionics bay

3. Identify the fuel flow gauge. (B/2/1)

4. On the EICAS display, ΔP measures _____. (B/2/2)
   a. the difference between cockpit altitude and outside altitude
   b. the difference between cockpit pressure and outside pressure
   c. the fuel difference between wing tanks
   d. the difference between optimal and actual hydraulic pressure
5. Identify the ITT gauge. (B/2/3)

6. In the event of an out-of-limits torque indication, the EICAS display will warn the pilot by all of the following methods except ______. (B/2/4)
   a. an aural tone
   b. a change in color
   c. the flashing MASTER WARN light
   d. a 3-second blank screen

7. Pressing the MASTER WARN switchlight extinguishes the lamp and the message on the CAS display. (B/3/1)
   a. True
   b. False

8. Shutoff valves activated by the Firewall Shutoff Handle may be reset bny pushing the handle back in. (B/4/1)
   a. True
   b. False

9. When testing the integrity of the fire warning system, you will know the system is working properly if ______ and the aural tone sounds. (B/4/2)
   a. a green FIRE DET annunciator is illuminated
   b. the MASTER CAUT annunciator illuminates
   c. the FIRE DET switch returns to the neutral position
   d. the FIRE and MASTER WARN annunciators illuminate
LESSON QUIZ QUESTIONS

1. The engine data manager does not _____.
   a. monitor engine operating parameters
   b. illuminate appropriate advisory, caution, or warning annunciators
   c. drive the primary, alternate, and engine/systems/NACWS displays
   d. control all electronic displays in the cockpit

2. The Engine Indication and Crew Alerting System _____.
   a. records engine data for aircraft analysis
   b. governs engine operating parameters
   c. provides each cockpit with a visual indication of engine operations
   d. transmits engine data to the control tower

3. The engine data manager is located _____.
   a. underneath the engine, near the PMU
   b. on the reduction gearbox
   c. in the right avionics bay
   d. on the engine shaft, next to the PIU

4. This display shows torque at _____.
   a. 15%
   b. 70%
   c. 72%
   d. 75%
5. The engine indication display provides_____.
   a. torque, RITT, N1, fuel qty, and fuel flow
   b. N1, Np, IOAT, cockpit altitude, and delta P
   c. torque, ITT, N1, Np, and IOAT
   d. fuel flow, fuel qty, oil pressure, oil temperature, and IOAT

6. The EICAS display does not_____.
   a. display outside environmental conditions in each cockpit
   b. display collision warnings
   c. display engine data in each cockpit
   d. display electrical system data in each cockpit

7. This display is the_____.
   a. alternate engine data display
   b. engine/systems/NACWS display
   c. engine indication and crew alerting system display
   d. electronic horizontal situation indicator

8. All data presented on the engine indication display is processed by the PMU.
   a. True
   b. False

9. The FIRE switch located in the front cockpit is used to_____.
   a. switch between fire warning and engine overheat functions
   b. turn the fire warning system on and off
   c. switch between the primary and backup system
   d. test the integrity of the fire warning system
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OVERVIEW
This lesson reviews material covered in Propulsion 1 & 2 and is divided into four segments. The first segment is a lesson introduction. Segment B reviews normal operations of engine systems, and engine indicators and displays. Segment C discusses potential abnormal operations related to the engine system. The final segment contains review questions.

REFERENCES
Personnel: Instructor
Media Facilities: MIL Classroom

STUDENT ASSIGNMENTS
Complete SY204, SY205, and SY206 lessons
Review T-6B Flight Manual, Sections I & III
Review T-6B Systems 2 Student Guide

LESSON OUTLINE
Topics in this lesson will be presented in sequential order. Follow along with the instructor using the Student Guides provided for SY204 and SY205.
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Normal Engine Operations

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For lesson topic **Engine Systems**, please refer to your student guide for SY204 – Propulsion System 1

For lesson topic **Engine Displays/Indicators**, please refer to your student guide for SY205 – Propulsion System 2
Abnormal Operations

Abnormal Start

6.2.1.0.2 Identify indications of an abnormal start

Types of Abnormal Start

Hot
Hung
No start

Normal Start Sequence

ITT
N₁
Nₚ

Figure SY206-1 – Normal Start Sequence
Hot Start

Possible Indications
- High/Rapidly rising ITT
- Lower N₁
- Lower Nₚ

Possible Causes
- PMU failure
- FMU failure
- Incorrect air/fuel mixture
- Low battery

Figure SY206-2 – Hot Start

Hung Start

Possible Indications
- Slow rising ITT
- Lower N₁
- Lower Nₚ

Possible Causes
- PMU failure
- FMU failure
- Incorrect air/fuel mixture
- Ignition system failure
- Starter failure
- Low battery

Figure SY206-3 – Hung Start
No Start

Possible Indications

- No ITT indication
- Lower N₁
- No Np indication
- No torque indication

Possible Causes

- PMU failure
- FMU failure
- Starter failure
- Ignition system failure
- Incorrect air/fuel mixture

Figure SY206-4 – No Start

Engine Failure In-flight

| 6.4.1.0.1 | Identify indications of engine failure in flight |
Indications of Engine Failure

Initial Indications:

- Loss of power and airspeed
- Rapid decay of $N_1$, torque, and ITT
- MASTER WARN lights and tone
- Propeller moves toward feather

Accompanying Indications:

- Rapidly decreasing ITT, $N_P$
- Lower-than-normal oil pressure
- Engine noise
- GEN, FUEL PX, OIL PX, OBOGS FAIL messages
- Possibly PMU FAIL and CKPT PX messages

Possible Causes

- Fuel starvation
- Mechanical failure
- Compressor stall

Apply Appropriate Procedure

Given indications of engine
failure in-flight, proceed with appropriate emergency procedure.

PMU Failure

6.4.13.0.1 Identify indications of a PMU failure

Indications of PMU Failure

Possible Indications

Power step change
PMU FAIL and PMU STATUS messages
MASTER WARN light
Aural tone

Possible Causes

System failure
System malfunction

Apply Appropriate Procedure

Given indications, proceed with PMU failure procedure.

Uncommanded Feather

6.4.5.0.1 Identify indications of uncommanded feather

Figure SY206-6 – PMU Failure
Uncommanded Feather

Possible Indicators

High torque
Lower $N_P$
Possible PMU FAIL/PMU STATUS messages
Engine vibration
Engine noise

Possible Causes

Feather dump solenoid malfunction
Loss of oil pressure
PIU failure
Oil blockage

Apply Appropriate Procedure

Given indications, proceed with uncommanded propeller feather procedure.

Engine Fire In-flight

6.4.7.0.1 Identify indications of engine fire in-flight
Engine Fire In-flight

Possible Indicators FIRE message MASTER

WARN light Aural tone

Fluctuating oil pressure, oil temperature, or hydraulic pressure

Excessive turbine temperature

Visual indications (smoke or flames)

Erratic engine operation

Roughness or vibration

Possible Causes

Fuel or oil leaks

Fire getting outside the engine

Figure SY206-8 – Fire In-flight

Apply Appropriate Procedure

Given indications, proceed with fire warning in-flight procedure.
Lesson Review Quiz
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)
1. What three elements are necessary for engine operation? (B/1/1)
2. Given indications of abnormal start, what should you do? (C/1/1)
3. What are the types of abnormal start? (C/1/2)
4. What are the indications of a hot start? (C/1/3)
5. What are the indications of a hung start? (C/1/4)
6. What are the indications of no start? (C/1/5)
7. What are some possible display indications of engine failure in-flight? (C/2/1)
8. What are the indications of PMU failure? (C/3/1)
9. What are the indications of uncommanded propeller feather? (C/4/1)
10. What are some sensory indications of engine fire in-flight? (C/5/1)

REVIEW QUESTIONS
1. The display below shows ITT at ______.

![Display Image]

2. The power turbine is driven by ______.
3. What does FEVER stand for?
4. What are the three engine sections?
5. What are the three types of abnormal start?
6. What functions are performed by the PMU?
7. What is the purpose of the PIU?
8. What can you tell about $N_1$ from looking at this display?
9. What are some possible causes of engine failure in-flight?

10. This display shows hydraulic pressure at ______.

11. What are the engine fire warning indicators?

12. What are some possible causes of uncommanded feather?

13. What three elements are necessary for engine operation?

14. What are some possible indications of engine fire in-flight that may be seen on the engine displays?
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OVERVIEW
This lesson discusses the various components which make up the T-6B environmental system, including ventilation, heating, defogging, and air conditioning systems. This lesson is designed to provide you with an understanding of basic operation of these components so they can be used effectively in-flight.

REFERENCES
Personnel: None
Media Facilities: Student CAI Workstation
Support Resources: T-6B Flight Manual; T-6B Systems 2 Student Guide

STUDENT ASSIGNMENTS
Read applicable portions of T-6B Flight Manual, Section I.
Complete CAI lesson SY207, following along with this student guide.
Complete the practice questions provided.

LESSON OUTLINE
Topics in this lesson must be taken in sequential order. All topics must be completed prior to attempting the end of lesson quiz. The estimated time required to complete this lesson is 0.8 hours.
Introduction

Environmental System

System Overview

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<td>Identify major components of the environmental system</td>
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System Introduction

The T-6B has several environmental systems which provide the pilots both comfort and survival.

This lesson will cover the environmental control panel and the pilot comfort systems:

- ventilation
- heating
- canopy defogging
- air conditioning

Oxygen and pressurization systems will be covered in the second environmental systems lesson.
System Components 1

The environmental control panel, located on the front cockpit right side console, provides the pilot with control of all environmental systems.

The rear cockpit is equipped with only an evaporator blower control switch on the engine/electrical switch panel on the right side console.

Figure SY207-1 – System Control Components

System Components 2

Fresh air ventilation is provided through an inlet duct during ground operations and unpressurized flight. Air flow is supplied by a blower on the ground and by ram air in flight.

Cockpit heating and canopy defogging are provided by engine bleed air. The engine also supplies bleed air for the pressurization, anti-G and OBOGS systems which are discussed in the next environmental system lesson.

Figure SY207-2 – System Operation Components
Cockpit air conditioning and avionics cooling is supplied by an engine-driven vapor cycle system. This is a separate system that does not use engine bleed air. It draws in cockpit air, cools it, and discharges it back into the cockpit.

### Environmental Control Panel

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Environmental Control Panel

The environmental control panel (ECP) is installed in the front cockpit on the right side console. There are four toggle switches and two rotary switches.

Bleed Air Inflow Control Switch

A bleed air inflow control switch controls the position of the bi-level flow control and shutoff valve, determining how much hot engine bleed air will be provided to the system.
The switch has three positions, OFF, NORM, and HI.

Ram Air Flow Control Switch

The ram air flow control switch controls the position of the motor driven fresh air valve. The three positions are OFF (closed), NORM (mid open), and HI (full open).

Evaporator Blower Controls

The evaporator blower controls provide power to the front and rear cockpit blowers which supply airflow through the air conditioning vents.

The EVAP BLWR switches have positions from OFF to HI which provide variable speed control of the respective blowers.

Note that the EVAP BLWR control is the only environmental control located in the rear cockpit.

Figure SY207-4 – Evaporator Blower Controls
Temperature Control Switch Knob

The temperature control switch knob operates the motor driven heat exchanger bypass valve. This valve determines the amount of warm bleed air to be mixed with the cooled air supplied by the heat exchanger before ducting to the cockpit.

This rotary switch operates in either the AUTO or MANUAL mode.

Temperature Control

Cockpit air temperature is automatically adjusted between 60° and 90° Fahrenheit with the TEMP CONTROL switch set to AUTO.

The cockpit air temperature can be manually adjusted by placing the TEMP CONTROL switch in the MANUAL position. In this position, the TEMP CONTROL switch is spring loaded to the center (OFF) position and must be rotated and held to either the COLD or HOT settings to achieve the desired temperature.

Figure SY207-5 – Manual Temperature Control
Air Conditioning Switch

A toggle switch placarded AIR COND controls the air conditioning compressor. When the switch is set to ON, the compressor is engaged. When set to OFF, the compressor is disengaged.

The air conditioner compressor will also be engaged if the DEFOG switch is set to ON.

**Ventilation System**

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Ventilation System Introduction

Fresh air ventilation is available for the cockpit during ground operations and unpressurized flight.

This ventilation air is provided on the ground by a blower, or in flight through the ram air inlet on top of the cowl. It is then ducted back through the firewall into the cockpit.
Ground Operation

On the ground, the weight-on-wheels switch activates a blower in a duct inside the cowling. The airflow from this blower flows into the air inlet duct, to the fresh air valve, and then to the main inflow duct just forward of the firewall.

Figure SY207-6 – Ventilation On Ground

Air Operation

Once the aircraft is off the ground, the weight-on-wheels switch shuts off the blower. The spring-loaded flapper valve at the top of the inlet duct opens and airflow is supplied to the fresh air valve through the ram air inlet.

Figure SY207-7 – Airborne Ventilation
Ram Air Flow Switch

The amount of fresh air ventilation is controlled by the position of the fresh air valve for both ground operations and unpressurized flight. The position of the fresh air valve is controlled by the RAM AIR FLOW switch on the environmental control panel in the front cockpit.

The valve has three positions:

- closed (switch OFF)
- mid open (switch NORM)
- full open (switch HI)

This switch is overridden and the fresh air valve is closed when the aircraft reaches an altitude of about 8000 feet MSL and the pressurization system begins to operate.

Distribution

When cockpit ventilation is selected during unpressurized flight, the fresh air flows through the firewall shutoff valve into the main cockpit duct.

Depending on the position of the front cockpit vent control lever, the fresh air will flow to either the footwarmers or the defog vents, or both, if placed in the mid-range.
## Heating System

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### Heating System Introduction

Cockpit heating is supplied by engine bleed air which is tapped from the engine compressor right side P3 port. All or part of this warm bleed air is routed through a heat exchanger and/or a heat exchanger bypass valve, through the firewall, and into the cockpit.

In the cockpit, the heated air is divided and supplied to either the footwarmers or defog ducts in both the front and rear cockpits.

### Bleed Air Supply 1

Hot engine bleed air is tapped from the right side of the engine compressor section at the P3 port and is routed back to the bi-level flow control and shutoff valve in the aft engine compartment.

![Figure SY207-10 – Bleed Air Supply](image_url)
Bleed Air Supply 2

The position of the bi-level flow control and shutoff valve determines how much bleed air, if any, is supplied to the environmental system. The position of the valve is controlled by the BLEED AIR INFLOW switch on the environmental control panel.

Heat Exchanger 1

If the BLEED AIR INFLOW switch is placed in NORM or HI, the bi-level flow control and shutoff valve opens and hot bleed air is routed to the heat exchanger.

Cool air flows into the heat exchanger from a blower (on the ground) or from the ram air inlet on top of the cowling (in flight), draws heat from the bleed air, and is exhausted through a vent in the lower portion of the right aft cowling.

Heat Exchanger 2

The cooled bleed air is then routed from the heat exchanger to the cockpit ducting.
Heat Exchanger Bypass 1

A motor-driven heat exchanger bypass valve is installed in a bypass duct forward of the heat exchanger and is operated by the temperature controller on the environmental control panel.

Heat Exchanger Bypass 2

With the temperature controller in the AUTO position, the bypass valve diverts a portion of the warm bleed air around the heat exchanger to be mixed with cooled air downstream of the heat exchanger, thus controlling the temperature of the air entering the cockpit.

Heat Exchanger Bypass Cool

As the temperature control is turned toward COLD, the heat exchanger bypass valve closes down and more cool air from the heat exchanger passes into the cockpit.

Figure SY207-13 – Heat Exchanger Bypass

Figure SY207-14 – Heat Exchanger Bypass - Cold
Heat Exchanger Bypass Hot

Moving the temperature control toward HOT causes the heat exchanger bypass valve to open up allowing more warm air to bypass the heat exchanger and pass through the bypass valve and into the cockpit.

Temperature Range

This system automatically controls cockpit temperature between 60° and 90° Fahrenheit using inputs from the temperature controller and temperature sensors. If the duct temperature exceeds 165° F at any time, the heat exchanger bypass valve is closed and maximum bleed air is forced through the heat exchanger.

Manual Temperature Control

Cockpit air temperature can be manually adjusted by placing the temperature controller in the manual position and holding the controller toward either cold or hot until the desired temperature is reached. This will manually adjust the heat exchanger bypass valve position and raise or lower cockpit temperature.

Figure SY207-15 – Heat Exchanger Bypass - Hot
Firewall Shutoff Valve

You previously learned that when the Firewall Shutoff Handle is activated, it mechanically shuts off hydraulic fluid and fuel flow to the engine, and bleed air flow from the engine.

Activating this valve after an engine shutdown situation prevents fumes from the engine compartment being drawn into the cockpit.

Cockpit Distribution

From the firewall, the conditioned air flows into the cockpit ducting. With the front cockpit vent control lever set to FOOT, a control valve in each cockpit is set to divert the airflow to the footwarmers below the instrument panel.

This air is also used by the defog system (discussed later in this lesson).
Temperature Sensors

The environmental system has two temperature sensing sources to alert the pilot of overtemperature conditions in the ducting. A temperature switch is in the duct near the firewall shutoff valve. The other temperature switch is located at the aft defog control valve in the front cockpit.

These temperature switches will light the DUCT TEMP caution message if the inflow air temperature exceeds 300° F at any time.

Heating System Power

Electrical power for the inflow system fans and motors is provided by a circuit breaker labeled INFLOW SYS on the front cockpit battery bus circuit breaker panel.

Cockpit temperature sensors are controlled by a circuit breaker labeled CKPT TEMP on the front cockpit generator bus circuit breaker panel.
Defogging System

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<td>Identify characteristics of normal operations for defogging system</td>
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</table>

Defogging System Introduction

Warm engine bleed air is used for defogging of the windshield and front and rear canopies.

Controls for the defogging system are located in the front cockpit on the environmental control panel and on the vent control panel.

Canopy defog outlets are located at the front of the front cockpit instrument panel and along both canopy rails.

Bleed Air Supply 1

As with the heating system, hot engine bleed air is tapped from the P₃ port on the right side of the engine compressor section.

Figure SY207-20 – Defog Bleed Air Supply
Bleed Air Supply 2

For defogging of the windshield and canopy, set the DEFOG switch to ON. This action opens the bi-level flow control bypass valve (defog valve) and provides a higher volume of bleed air flow to the system. The bleed air is then routed through or around the heat exchanger (depending on the position of the heat exchanger bypass valve) and on downstream to the heating system ejector.

Heating System Ejector

The higher volume of bleed air passing over the ejector venturi draws in ambient cockpit air. The ambient air is mixed with the bleed air in the main cockpit duct and passes downstream to the cockpit.

You must also place the vent lever in the CANOPY position. This causes the valve at the front cockpit assembly to direct the warm air into the windshield defog duct. The valve at the rear cockpit assembly directs the air into the canopy side defog ducts.
Vent Lever Settings

Note that a mid-position selection on the vent control lever will direct the airflow to both the defog vents and footwarmers in ratio to the position of the lever.

A setting above the mid-position will direct more airflow to the canopy defog vents.

Conversely, a setting below the mid-position directs more airflow to the footwarmers.

**Figure SY207-23 – Vent Lever**

---

**Warning**

The canopy/windshield defogging system may not clear the windshield during an icing encounter.

**Figure SY207-24 – Defog System Warning**

---

**Caution**

During an icing encounter, the windshield may become completely opaque and restrict forward visibility. Increased pilot workload may occur during the landing phase of flight.

**Figure SY207-25 – Defog System Caution**
Temperature Control

Defog air temperature control is automatically maintained by the position of the environmental control panel TEMP CONTROL switch.

In the AUTO position, this switch controls the position of the heat exchanger bypass valve by using inputs from the temperature sensor in the inflow duct and the cockpit space temperature sensor located behind the rear seat.

Placing the switch in the MANUAL position will allow manual adjustment of the heat exchanger bypass valve and temperature control.
DUCT TEMP Caution Message

If the bleed air temperature at the aft defog control valve exceeds 300° F with the system in DEFOG mode, the amber DUCT TEMP annunciator will illuminate.

Also, if bleed air temperature in the environmental systems duct exceeds 300° F AT ANY TIME, the yellow DUCT TEMP caution message will illuminate.

Air Conditioning System

| 1.21.4.0.3 | Identify air conditioning system components |
| 1.21.4.0.4 | Match air conditioning system components to functions |
| 1.21.4.0.5 | Identify characteristics of normal operations for air conditioning system |

Air Conditioning System

Introduction

The T-6B air conditioning system is a vapor cycle system and operates similar to the system in your automobile. It includes:

- a belt-driven compressor at the front of the engine
- a condenser and blower in the aft fuselage
- front and rear cockpit evaporator and blower modules
- service fittings
The air conditioning system only operates when the engine is on and functioning with the generator on-line and the AIR COND or DEFOG switch is ON. The cockpit blowers are available any time the generator bus is powered.

Compressor and Condenser

The engine-driven compressor pumps refrigerant in vapor form to the condenser which is located in the upper fuselage above the baggage compartment. The condenser converts the vapor to a high pressure liquid.

A blower located in front of the condenser operates from the generator bus and cools the condenser during operation.

Condenser to Cockpit

The liquid refrigerant flows from the condenser to the front and rear cockpit evaporator modules.

Figure SY207-28 – Air Conditioning System
Evaporator Operation

In the evaporator modules, the liquid refrigerant is metered into the evaporator coil. The evaporator blower draws warm cockpit air through the coil and the refrigerant changes back to a vapor as it absorbs heat from the air.

Cooled air from the evaporator module is then discharged from an “eyeball” outlet in the cockpit center console and through ductwork to outlets on the glareshield.

The blowers will produce airflow at up to 350 cubic feet per minute at the HI setting.

Cockpit to Compressor

The vaporized refrigerant is pumped from the cockpit evaporator modules back to the engine-driven compressor and the cycle is repeated.

Refrigerant Recharge

A panel in the right side of the fuselage forward of the wing leading edge allows access for maintenance personnel to recharge the system refrigerant when necessary.
Air Conditioner Power

Power for the air conditioning system is provided through a circuit breaker labeled AIR COND on the generator bus circuit breaker panel in the front cockpit.

Figure SY207-31 – Air Conditioner Power

Lesson Review Quiz
Figure SY207-32 – Environmental System
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. Which T-6B environmental system is an engine-driven vapor cycle system? (B/1/1)
   a. heating
   b. canopy defogging
   c. air conditioning
   d. ventilation

2. Click on the control which determines how much hot engine bleed air is provided to the environmental system. (B/2/1)

3. Click on the control which determines the amount of warm bleed air to be mixed with cooled air supplied by the heat exchanger for ducting to the cockpit. (B/2/2)

4. In order for the air conditioner compressor to be engaged, both the AIR COND and DEFOG switches must be in the ON position. (B/2/3)
   a. True
   b. False

5. The ______ controls provide power to the front and rear cockpit blowers which supply airflow through the air conditioning vents. (B/2/4)
   a. evaporator blower
   b. evaporator condenser
   c. fresh air blower fan
   d. temperature
6. On the ground, the fresh air blower is activated by the ______. (B/3/1)
   a. TEMP CONTROL switch
   b. weight-on-wheels switch on the landing gear
   c. RAM AIR FLOW switch
   d. EVAP BLWR switch

7. Fresh air is distributed to the main cockpit duct and then output through the ______. (B/3/2)
   a. footwarmers or defog vents
   b. cockpit side panel vent
   c. air conditioner outlets
   d. instrument panel vents

8. While in flight, cool air from the ______ passes through the heat exchanger, draws heat from
   the bleed air, and is then exhausted through a vent in the lower right cowling. (B/4/1)
   a. cockpit
   b. ram air inlet
   c. heating system ejector
   d. engine compressor

9. As the temperature control is turned toward COLD, the heat exchanger bypass valve opens
   up and more cool air from the heat exchanger passes into the cockpit. (B/4/2)
   a. True
   b. False

10. Which control, when activated, prevents engine compartment fumes from entering the
    cockpit through the environmental system after an engine shutdown situation? (B/4/3)
    a. Auto temperature control
    b. EVAP BLWR switch
    c. Firewall shutoff handle
    d. BLEED AIR INFLOW switch

11. Cockpit air temperature is automatically adjusted between ______ Fahrenheit with the TEMP
    CONTROL switch set to AUTO. (B/4/4)
    a. 40° and 70°
    b. 50° and 85°
    c. 60° and 90°
    d. 70° and 95°
12. When the DEFOG switch is ON and the Vent Control Lever is set to CANOPY, a higher volume of bleed air in the system causes ambient cockpit air to be drawn into the heating system ejector, mixed with bleed air in the main cockpit duct and flow downstream to the windshield and canopy defog ducts. (B/5/1)
   a. True
   b. False

13. Placing the vent lever in the _____ position causes the valve at the front cockpit assembly to direct the warm air into the windshield defog duct. (B/5/2)
   a. HEAT
   b. CANOPY
   c. FOOT
   d. NORM

14. Click on the control which opens the bi-level flow control bypass valve and provides a higher volume of bleed air flow to the heating system ejector. (B/5/3)

15. The air conditioning system only operates when the engine is on and functioning with the _____ and the ____. (B/6/1)
   a. generator on-line; AIR COND or DEFOG switch ON
   b. battery switch ON; AIR COND or DEFOG switch ON
   c. generator on-line; AIR COND and DEFOG switch OFF
   d. battery switch ON; AIR COND and DEFOG switch ON
16. Click on the air conditioner component which converts vaporized refrigerant to a liquid.  
(B/6/2)

17. A panel in the ______ side of the fuselage allows access for maintenance personnel to recharge the system refrigerant when necessary. (B/6/3)
   a. aft left  
   b. aft right  
   c. forward left  
   d. forward right

18. The ______ will produce airflow at up to 350 cubic feet per minute at the HI setting. (B/6/4)
   a. evaporator blowers  
   b. foot warmers  
   c. ejector bypass valve  
   d. ram air blower

LEsson Review Quiz QUESTions

1. Engine bleed air for the cockpit heating system is supplied from the ______.  
   a. left side engine compressor P3 port  
   b. right side engine turbine P3 port  
   c. left side engine turbine P3 port  
   d. right side engine compressor P3 port

2. The engine-driven air conditioner compressor pumps refrigerant in vapor form to the ______.
   a. evaporators  
   b. condenser  
   c. heat exchanger  
   d. blower fan
4. Placing the Defog switch to ON opens the _____ which causes a higher volume of bleed air to pass through the heating system ejector.
   a. bleed air flow control and shutoff valve
   b. ram air inlet
   c. bi-level flow control bypass valve
   d. heat exchanger bypass valve

5. Click on the control at right which is the only environmental control located in the rear cockpit.

6. When the engine is running and the generator is on-line, the air conditioner compressor is engaged when the _____ switch is set to ON.
   a. BLEED AIR INFLOW
   b. DEFOG
   c. HEAT
   d. RAM AIR FLOW
7. In the cockpit, the air to ducted controls the position through the fresh air valve, main liquid refrigerant.
   a. cool cockpit air
   b. cooled ram air
   c. conditioned bleed air
   d. warm cockpit air

8. Click on the message that will display if the inflow air temperature exceeds 300° Fahrenheit.

9. After takeoff, fresh air is supplied through the _____.
   a. ram air inlet on top of the cowling
   b. air duct direct from the fresh air blower
   c. ram air inlet on the left side of the cockpit
   d. adjustable canopy vents

10. The temperature control switch knob on the environmental control panel controls the position of the _____.
    a. vent control lever
    b. heat exchanger bypass valve
    c. ram air flow switch
    d. weight-on-wheels switch

11. The ECS has two temperature sensors to alert the pilot of ______ conditions in the ducting.
    a. overtemperature
    b. under temperature
    c. excessive airflow
    d. reduced airflow

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OVERVIEW
This lesson is a continuation of the discussion of the T-6B environmental system, and covers aircraft pressurization, anti-G, OBOGS (On-Board Oxygen Generating System), and emergency oxygen systems. This lesson is designed to provide you with an understanding of basic operation of these components so they can be used effectively in flight.

REFERENCES
Personnel: None
Media Facilities: Student CAI Workstation
Support Resources: T-6B Flight Manual; T-6B Systems 2 Student Guide

STUDENT ASSIGNMENTS
Read applicable portions of T-6B Flight Manual, Section I.
Complete CAI lesson SY208, following along with this student guide.
Complete the practice questions provided.

LESSON OUTLINE
Topics in this lesson must be taken in sequential order. All topics must be completed prior to attempting the end of lesson quiz. The estimated time required to complete this lesson is 30 minutes.
Introduction

Environmental System 2

Pressurization System

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Pressure Source 1

The pressurization system uses the same engine bleed air from the engine right side P₃ port used in the heating and defogging systems.

Figure SY208-1 – Bleed Air Source

Pressure Source 2

As you will recall, the bleed air is routed through the bi-level flow control and shutoff valve, heat exchanger (or the heat exchanger bypass valve), ejector bypass, and firewall shutoff valve. It then flows into the front and rear cockpits through the footwarmers or defog vents.

It is this bleed air which provides an air supply for cockpit pressurization.

Figure SY208-2 – Pressurization Bleed Air Flow
Cockpit Pressure Seal

The T-6B cockpit is pressure sealed by the firewall, pressure flooring, and aft pressure bulkhead, along with the pressure seal around the bottom of the canopy.

Pressure Control

A control valve regulator in the aft pressure bulkhead monitors the cockpit pressure and automatically adjusts the position of the pressurization control valve.

Figure SY208-3 – Cockpit Pressure Seal

Figure SY208-4 – Pressure Control
Cockpit Altitude

Starting at 8000 feet pressure altitude, the pressurization control valve maintains cockpit pressure altitude at 8000 feet until a cockpit pressure differential of 3.6 ± 0.2 psi is reached at 18,069 feet.

This differential is maintained from 18,069 feet to an aircraft altitude of 31,000 feet where the cockpit pressure altitude is 16,600 feet.

Instrument Indications

Cockpit pressure altitude and pressure differential are shown on the lower left side of the EICAS.

Figure SY208-5 – Cockpit Altitude

Figure SY208-6 – EICAS Display
Delta P Regulator

The cockpit pressure differential is monitored by a delta P regulator also located in the aft pressure bulkhead.

If the pressure differential exceeds 4.0 psi, the regulator sends a signal to the safety valve.

Safety Valve

The safety valve is normally closed. It opens to relieve overpressure in the cockpit when it receives a signal from the ΔP regulator.
Dump Solenoid

A dump solenoid is connected to the pressurization control valve. While the aircraft is on the ground, the weight-on-wheels switch removes power from the solenoid, leaving the pressurization control valve open.

After takeoff with weight off the wheels, power is applied and the solenoid closes, allowing the control valve to regulate cockpit pressure as the aircraft approaches 8000 feet pressure altitude.

Cockpit Pressure Dump

The PRESSURIZATION switch on the environmental control panel is used to dump cockpit pressure if the situation warrants.

The DUMP position terminates electrical power to the dump solenoid which allows the pressurization control valve to open and depressurize the cockpit. Bleed air inflow will continue but the fresh air valve remains closed and ram air is not provided to the cockpit.
Cockpit Pressure Ram Dump

The RAM/DUMP position opens the fresh air valve and terminates electrical power to the dump solenoid, opening the pressurization control valve. This depressurizes the cockpit and allows ram air into the cockpit.

To eliminate another source of bleed air from the engine, defog (defog valve) is automatically turned off when RAM/DUMP is selected.

With the BLEED AIR INFLOW switch in the NORM or HI positions bleed air inflow is not affected and continues. With RAM/DUMP selected, placing the BLEED AIR INFLOW switch to OFF will stop bleed air inflow and allow an increase of ram air flow into the cockpit.

Warning and Caution Messages

Two messages indicate abnormal pressurization status.

If cockpit pressure altitude exceeds 19,000 feet, the yellow CKPT ALT caution message displays.

If the cockpit pressure differential should exceed 3.9 to 4.0 psi, the red CKPT PX warning message displays.
Anti-G System

| 1.21.12.0.1  | Identify components of anti-G system |
| 1.21.12.0.2  | Match components of anti-G system to functions |
| 1.21.12.0.3  | Identify characteristics of normal operation of anti-G system |

Purpose

The T-6B anti-G system provides the pilots protection against physiological effects of high G maneuvers.

With increasing G force in a maneuver, the system increases the pressure in the pilots’ anti-G suit proportionally, helping to maintain normal blood circulation to the upper portions of the body.

Pressure Source 1

Bleed air is routed from the engine right side P₃ port through a pneumatic system shutoff valve connected to the BLEED AIR INFLOW switch on the ECP.

The air is then routed through a heat exchanger for cooling and into the cockpit.
Pressure Source 2

After passing through the firewall, the bleed air flows through a line on the left side of the fuselage and is passed through a water separator to protect against system contamination.

A safety valve in the flow line automatically relieves system pressure if it exceeds 7 psi.

The air then flows to an anti-G valve in the left side console in each cockpit.

Anti-G valve

The pilot’s anti-G suit hose is connected to the anti-G valve which consists of a weighted rod with an orifice.

As positive G force increases during maneuvers, the rod moves downward exposing more of the orifice and allowing more of the pressurized air into the anti-G suit.
System Test

The control panel at the rear of the left console in each cockpit also provides a test button to check the system. In the front cockpit the button is labeled “HI FLOW”; in the rear cockpit it is labeled “TEST.”

Pushing the button allows bleed air to flow through the anti-G valve and inflate the anti-G suit.

Figure SY208-17 – Anti-G System Test

OBOGS

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Bleed Air Source

Bleed air is tapped from another P3 port on the left side of the engine and sent through an oxygen system shutoff valve, an OBOGS heat exchanger, high temperature and low pressure switches, and into the OBOGS unit in the fuselage right side avionics bay. This unit extracts oxygen from the conditioned engine bleed air.

Figure SY208-18 – OBOGS Bleed Air Source
OBOGS Unit

A concentrator in the OBOGS unit automatically adjusts the oxygen concentration for the current altitude based on the current cockpit pressure.

The oxygen then flows from the OBOGS unit to a plenum.

Plenum

The plenum functions as a holding tank between the OBOGS unit and the regulators. It is a small container located out-of-view below the concentrator.

In the event of OBOGS system failure, the plenum will provide a very limited supply of oxygen (approximately one breath) for the aircrew until the emergency oxygen system is activated. The duration of this supply depends on factors such as cockpit pressurization, aircraft pressure altitude, pilot regulator settings, and pilot demand.
Regulators

Oxygen regulators are installed in the right side console in each cockpit and control OBOGS electrical power and oxygen flow.

Figure SY208-20 – OBOGS Regulator

Regulator Supply Lever

The oxygen pressure regulator supply lever controls system electrical power and oxygen flow.

The lever has two positions, ON and OFF. If either cockpit regulator is set to ON, OBOGS is operative. Both supply levers must be OFF in order to disable OBOGS. The respective supply lever must be ON to receive oxygen in each cockpit.

Figure SY208-21 – Regulator Supply Lever

Regulator Concentration Lever

The regulator concentration lever provides control of the oxygen concentration level.

When the lever is set to NORMAL, the OBOGS concentrator provides the proper concentration for the current altitude.

Figure SY208-22 – Regulator Concentration Lever
With the lever in the MAX position in either cockpit, the concentrator will provide the highest concentration possible to both regulators. Also, the maximum concentration light just above the lever will illuminate.

Regulator Pressure Lever

The regulator pressure lever controls the pressure of the oxygen flow to the pilot’s mask.

In the NORMAL position, the regulator adds a slight positive pressure to the flow demanded by the pilot.

The EMERGENCY position supplies positive pressure for emergency conditions, such as, when experiencing hypoxia symptoms.

TEST MASK is used to check the face-to-mask seal with a highly pressurized flow.

Figure SY208-23 – Regulator Pressure Lever
Regulator Flow Indicator

The flow indicator gives a visual indication of oxygen flow through the regulator and displays white with each breath the pilot takes.

Anti-Suffocation Valve

An anti-suffocation valve is installed in the oxygen hose attach fitting on the right console in each cockpit.

This valve allows the pilot to continue breathing ambient cockpit air if OBOGS should fail.

OBOGS FAIL Warning Message

OBOGS status is indicated by two messages on the CAS in each cockpit.

The red OBOGS FAIL warning message will light when the low pressure switch is closed. This occurs whenever there is low bleed air pressure before the concentrator, such as, prior to engine start or in the event of a loss of bleed air.
OBOGS Note

The OBOGS system is designed to operate with properly secured oxygen masks. OBOGS operation with mask down or loose fitting may induce OBOGS fail annunciation. If OBOGS fails with mask down or loose, secure mask.

Figure SY208-27 – OBOGS Note

OBOGS TEMP Caution Message

The yellow OBOGS TEMP caution message will light if the temperature in OBOGS ducting exceeds 200° Fahrenheit.

Built-In-Test (BIT)

When OBOGS is activated, the system automatically enters a power up Built-In-Test (BIT) mode for about three minutes. During this time, the OBOGS FAIL warning message is inhibited.

At the end of the three minutes, the OBOGS FAIL warning message will display if OBOGS fails the BIT check.

Figure SY208-28 – OBOGS BIT
Initiated Built-In-Test (I-BIT)

The pilot can also use the BIT button on the regulator to start an Initiated OBÖGS BIT (I-BIT) at any time after engine start and system warm-up.

Pushing the BIT button on the regulator opens a valve in the oxygen concentrator and allows ambient air to enter the system. When the concentration drops below normal, the OBÖGS FAIL warning message will display.

When the valve closes and the concentration returns to normal, the message disappear.

Emergency Oxygen System

| 1.21.11.0.3 | Identify emergency oxygen system components |
| 1.21.11.0.4 | Match emergency oxygen system components to functions |
| 1.21.11.0.5 | Identify characteristics of normal operations for emergency oxygen system |

Cylinder Location

The emergency oxygen cylinder is located on the left side of the seat bucket.

Tubing runs from the cylinder across the back of the seat bucket to the right side, and then connects to the pilot’s CRU-60/P.

Figure SY208-29 – Emergency Oxygen Location
Contents Gauge

A cylinder contents gauge is visible through a hole on the left side of the seat bucket beneath the seat pad.

The cylinder is checked during the Before Exterior Inspection check and is considered adequately charged if the pointer is anywhere in the black band (1800-2500 psi).

Maintenance should be notified if the cylinder charge is insufficient.

Activation

In the event of an OBOGS failure, the cylinder is manually activated by pulling up on the green, looped handle on the left side of the seat bucket.

Once flow is started, it cannot be shut off. The cylinder will supply oxygen for approximately 10 minutes.

The cylinder is also automatically activated during ejection and provides oxygen until seat/pilot separation.

Figure SY208-30 – Emergency Oxygen Contents Gauge

Figure SY208-31 – Emergency Oxygen Activation

Lesson Review Quiz
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. Cockpit pressure altitude is maintained by the control valve at _____ feet until a cockpit pressure differential of 3.6 ± 0.1 psi is reached at 18,069 feet. (B/1/1)
   a. 8000
   b. 10,000
   c. 12,000
   d. 15,000

2. Click on the PRESSURIZATION switch position which opens the control valve, allows bleed air inflow to continue but does not open the fresh air valve. (B/1/2)

   ![Control Valve Diagram]

3. The safety valve receives a signal from the ΔP regulator if the cockpit pressure differential exceeds _____ psi. (B/1/3)
   a. 3.6
   b. 3.9
   c. 4.0
   d. 4.3

4. The anti-G valve on the left side console in each cockpit is opened by _____ during maneuvers. (B/2/1)
   a. increasing negative G force
   b. decreasing negative G force
   c. increasing positive G force
   d. decreasing positive G force
5. The T-6B anti-G system helps maintain _____ during high G maneuvers. (B/2/2)
   a. flight control coordination
   b. normal blood circulation
   c. aircraft attitude
   d. aircraft altitude

6. Click on the regulator lever which controls system electrical power and oxygen flow. (B/3/1)

7. An _____ is installed near each regulator which allows the pilot to continue breathing ambient cockpit air if OBOGS should fail. (B/3/2)
   a. ambient air supply valve
   b. anti-fail valve
   c. anti-suffocation valve
   d. oxygen cutoff valve

8. Approximately three minutes after OBOGS is activated, the _____ message will display if there is a system failure during the system self test. (B/3/3)
   a. OBOGS TEST
   b. OBOGS TEMP
   c. OBOGS FAIL
   d. BIT FAIL

9. The emergency oxygen cylinder is considered charged if the pointer is at 1500 psi or above. (B/4/1)
   a. True
   b. False
LESSON REVIEW QUIZ QUESTIONS

1. A control valve regulator in the aft pressure bulkhead monitors the ______ and automatically adjusts the position of the ______.
   a. cockpit pressure; safety valve
   b. cockpit pressure; control valve
   c. atmospheric pressure; ejector valve
   d. atmospheric pressure; control valve

2. OBOGS extracts oxygen from engine bleed air tapped from the ______.
   a. P₃ port on the left side of the engine
   b. P₅ port on the left side of the engine
   c. P₃ port on the right side of the engine
   d. P₅ port on the right side of the engine

3. In the event of an OBOGS failure, the emergency oxygen cylinder is manually activated by pulling up on the ______ located on the ______ side of the seat bucket.
   a. green looped handle; right
   b. orange knob; right
   c. orange knob; left
   d. green looped handle; left

4. Cockpit pressure altitude and pressure differential are shown on the ______ on the lower right side of the instrument panel.
   a. EICAS
   b. CAS
   c. PFD
   d. cockpit pressure data display

5. Click on the regulator concentration lever position which will cause the OBOGS concentrator to provide the highest oxygen concentration possible.
6. Placing the environmental control panel PRESSURIZATION switch in the _____ position opens the control valve and fresh air valve, depressurizes the cockpit, allows ram air into the cockpit and continues bleed air inflow into the cockpit.
   a. RAM DUMP
   b. DUMP
   c. NORMAL
   d. RAM AIR

7. Click on the regulator pressure lever position which will cause the regulator to add a slight positive pressure to the flow demanded by the pilot.

![Regulator Control Panel]

8. Tubing from the emergency oxygen cylinder runs from the cylinder across the back of the seat bucket to the right side, and then connects to the _____.
   a. oxygen regulator
   b. anti-suffocation valve
   c. pilot’s CRU-60/P
   d. pilot’s oxygen mask

9. Click on the message that displays when the pilot presses the BIT button on the regulator to start an Initiated OBOGS BIT (I-BIT) after the oxygen concentration subsequently falls below normal.

![Regulator Control Panel]

Version 0.3 January 15
10. The yellow CKPT ALT caution message will display when cockpit pressure altitude exceeds _____ feet.
   a. 18,000
   b. 19,000
   c. 20,000
   d. 21,000

11. Click on the control used to test the anti-G system by allowing bleed air to flow through the anti-G valve and inflate the anti-G suit.
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OVERVIEW
This lesson discusses the functions, components, indicators, and controls of the T-6B canopy systems. This lesson is designed to provide a foundation for proper canopy system operations.

REFERENCES
Personnel: None
Media Facilities: Student CAI Workstation
Support Resources: T-6B Flight Manual; T-6B Systems 2 Student Guide

STUDENT ASSIGNMENTS
Read applicable portions of T-6B Flight Manual, Sections I and V.
Complete CAI lesson SY209, following along with this student guide.
Complete the practice questions provided.

LESSON OUTLINE
Topics in this lesson must be taken in sequential order. All topics must be completed prior to attempting the end of lesson quiz. The estimated time required to complete this lesson is 42 minutes.
Introduction

Canopy Systems and Operations

Canopy Assembly/Components

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Major Components

The T-6B is equipped with a single, side-opening, manually operated canopy. The canopy consists of four major components:

- Canopy frame assembly
- Forward windscreen
- Front cockpit transparency
- Rear cockpit transparency

Figure SY209-1 – Major Canopy Components
Birdstrike Protection

To provide enhanced protection against possible birdstrikes, the forward windscreen and front transparency are thicker than the rear transparency. These two transparencies have been designed to withstand a 4-pound birdstrike at up to 270 KIAS.

Basic Canopy Operation

The canopy opens from the left side of the aircraft and is fully hinged along its right side. It is held open by a canopy lock that must be released to close the canopy. Although it is quite heavy, a single person can easily open or close it without any form of power assist.

Oil Struts

Mechanical advantage is provided by oil-filled struts attached to the hinged side of the canopy assembly. During opening and closing operations, these struts bear the weight of the canopy and enable a single operator to move the entire assembly using about 30 pounds of force.
Canopy Systems Overview

The T-6B canopy system incorporates several important assemblies including the:

- Locking/latching system
- Sealing system
- Defog system
- Canopy Fracturing System (CFS)

Locking/Latching System

The locking/latching system ensures that the canopy is fully closed and locked. This system includes an electrical sensing system that verifies the latched condition.

Figure SY209-5 – Locking/Latching System
Sealing System

To prevent cockpit pressurization leaks, the T-6B has a canopy sealing system. The sealing system includes a non-inflatable weather seal and an inflatable pressure seal. Both these seals loop around the entire perimeter of the canopy.

The one-piece seamless pressure seal is pneumatically inflated using cooled engine bleed air tapped off the anti-G system.

The seal automatically inflates when bleed air inflow is available and weight is off the right main landing gear.

The bleed air inflow switch must be in the NORM or HI position for the anti-G system and canopy seal to operate.

Defog System

In the event that the canopy fogs over, the defog system uses warm bleed air routed from the engine to windshield defog outlets and through tubes along the sides of the canopy. The warm air is distributed through a series of flow control holes to control fogging and improve visibility.
Defog is activated by setting the front cockpit vent control lever to CANOPY and the DEFOG switch to ON.

Canopy Fracturing System

The last system, the Canopy Fracturing System or CFS, is used for ejection or emergency ground egress if the canopy cannot be opened normally or if the situation requires a right side ground egress. The system employs explosive charges which split the canopy transparencies while separating them from the canopy frame.

Figure SY209-8 – Canopy Fracturing System
A CFS safety pin is located in each cockpit and must be removed and stowed before each flight and re-installed after flight.

Stow the safety pins in the storage box located beside the rear ejection seat.

Normal Canopy Operations

| 1.23.0.0.4 | Identify canopy crosswind limitations |
| 1.23.1.0.5 | Identify characteristics of normal operations for canopy/assembly system |
| 1.23.3.0.1 | Identify purpose of canopy/latching system |
| 1.23.3.0.3 | Identify canopy/latching system components |
| 1.23.3.0.4 | Match canopy/latching system components to functions |
| 1.23.3.0.5 | Identify characteristics of normal operations for canopy/latching system |

Canopy Wind Limitation

When opening the canopy, you need to be aware of the winds. High winds can cause damage to the canopy assembly or even cause it to slam shut and injure someone.
To prevent this from happening, DO NOT OPEN THE CANOPY IF SURFACE WINDS EXCEED 40 KNOTS

Open Canopy From Outside

The canopy can be opened or closed from outside or inside the cockpit. A canopy lock, canopy unlock button, and exterior canopy handle are located on the left side of the aircraft to provide exterior operation.

To open the canopy from outside:

1) Press and hold the unlock button while slowly rotating external canopy handle clockwise to placard OPEN position.

2) Lift canopy open

Close Canopy From Outside

To close the canopy from outside, follow these steps:

1) Pull the canopy lock release lever in either cockpit and hold.

Figure SY209-10 – Exterior Canopy Controls

Figure SY209-11 – Canopy Lock Release Lever
The canopy is held in the open position by a canopy lock, which must be released to close the canopy. A canopy lock release handle is located on the right side panel in each cockpit.

2) Pull the canopy over center, release canopy lock release handle.

3) Make sure external canopy handle is rotated to full OPEN (clockwise) position and slowly lower canopy rail to canopy sill.

4) Slowly rotate external canopy handle counterclockwise with a slow steady motion until resistance is felt in lock mechanism. Reverse direction just until pressure is relieved, then continue to rotate external canopy handle counterclockwise to CLOSE position.

Close Canopy From Inside

Closing the canopy from inside the aircraft is accomplished by the following steps:

1) Pull the canopy lock release handle in either cockpit and hold.
Caution

Avoid applying abrupt and/or excessive force to the canopy locking handle at all times. Excessive force in any direction may damage the canopy locking mechanism.

Figure SY209-13 – Canopy Locking Mechanism

Close Canopy From Inside 2

2) Pull the canopy over center, release canopy lock release handle.

Warning

Make sure only one occupant is operating the canopy handle, to avoid pinching fingers or hand.

Figure SY209-14 – Canopy Warning
3) Make sure internal canopy handle is rotated full OPEN (aft) position and slowly lower canopy rail to canopy sill.

4) Rotate internal canopy forward with a slow steady motion until resistance is felt in lock mechanism. Reverse direction just until pressure is relieved, then continue to rotate internal canopy handle forward to LATCHED position.

5) Check proper engagement of canopy hooks by lifting lock release lever. Make sure canopy light and master warning illuminate and internal canopy handle does not rotate aft.


7) Check canopy lock by gently attempting to rotate internal canopy handle aft. When properly locked, internal canopy handle cannot be rotated aft without raising lock release lever.

8) Verify mechanical green indicators visible.
When the green tab is visible, the canopy has been properly latched.

Canopy Warning

The canopy’s latch mechanism drives five overcentering hooks through a continuous drive rod. To be considered properly held, the hooks must be in position, the connecting rod fully extended, and the lock must be latched against the lock plate. To alert you of a possible unlocked canopy, an electrical sensing system is installed which uses microswitches to indicate the position of the canopy, the latch rod and proper engagement of the lock.

If the canopy is not down and locked, the CANOPY warning advisory illuminates on the CAS, the MASTER WARN annunciator flashes (front and back cockpit), and an aural warning tone sounds.
Open Canopy From Inside

When you are ready to exit the aircraft, you will also use another interior canopy control, the lock release lever, located aft of the internal canopy handle. You can open the canopy with the following steps:

1) Raise the lock release lever located aft of internal canopy handle.

2) Hold lock release lever in UNLOCK position while slowly rotating internal canopy handle aft to placarded OPEN position.

3) Lift the canopy open.

Emergency Canopy Operations
Canopy Fracturing System

The Canopy Fracturing System (CFS) is designed to provide emergency fracturing of the canopy for emergency egress in the event there is a problem with the normal canopy latching system, such as may result from a crash or ditching situation or the situation requires a right side ground egress. The CFS functions automatically during ejection or can be activated by the internal CFS handles.

Figure SY209-19 – Canopy Fracturing System
Operation of the CFS system does not cause or preclude firing of either ejection seat.

Figure SY209-20 – Canopy Fracturing System Note
Interior CFS Controls

An internal CFS handle is located on the left console in each cockpit and allows activation of the fracturing system for the respective transparency.

Figure SY209-21 – Internal CFS Controls

Interior CFS Control Procedures

To operate the CFS system from inside the cockpit, follow these steps:

1) Rotate the CFS handle 90° counterclockwise.

2) Pull up using 15 - 25 pounds of force.

These actions will activate the canopy explosives for your emergency egress. As you exit the aircraft, use caution for...
broken glass and sharp edges.

Exterior CFS Controls

The external CFS handles are located on both sides of the aircraft. Initiating the CFS system externally will activate the explosives for both the front and the rear cockpit transparencies.

Exterior CFS Control Procedures

To initiate the CFS externally, open the spring loaded access door for either the left or right emergency ground egress handle, and remove the T handle. Walk away from the airplane and extend the CFS lanyard to its full length of ten feet, facing away from the plane. Keep in mind that there is a clearance zone of 10 feet in radius from the cockpit of the plane.

Pull the cable to initiate the fracturing system. Keep your face away from the plane until both canopies have completely fractured. Proceed to assist the
pilot(s).

CFS Operation 1

The CFS includes piezoelectric crystals and a bank of flash lamps contained within a housing mounted to the canopy sill. The benefit of using piezoelectric crystals is that these devices can be mechanically activated and do not require electricity to work.

Figure SY209-25 – CFS Crystals and Lamps

CFS Operation 2

When a CFS handle is pulled, the piezoelectric crystals produce an electric charge which fires the flash lamps, which in turn provide a light source.

The light excites a laser rod contained in the assembly which then sends laser energy to front and rear cockpit optical detonators mounted at canopy sill.

Figure SY209-26 – CFS Optical Detonators
When the optical detonator is activated by the laser, it fires a plunger across the gap between it and the CFS acceptor assembly mounted on the canopy.

CFS Explosive Cords 1

When the CFS acceptor assemblies are activated by the plungers, mild detonating cords along the rear edges of the respective canopy panels are initiated, which in turn detonate two types of CFS explosive cords.
CFS Explosive Cords 2

Flexible Linear Shaped Charge (FLSC) The FLSC is installed around the periphery and down the centerline of the front transparency. FLSC is powerful, and can cut through the increased strength and thickness of the front transparency.

Mild Detonation Cord (MDC) MDC is installed around the periphery and in a diamond-shaped pattern along the centerline of the rear transparency. MDC is not as powerful as FLSC, but provides sufficient explosive force to cut the transparency since the rear transparency is thinner than the front.

Emergency Egress

To complete the function, each explosive cord severs its respective transparency to provide emergency egress.

Fracturing Explosive System Demo
Warning

Failure to secure the external canopy fracture system latches prior to flight could cause damage to the aircraft. Do not open the external canopy fracture system (CFS) doors or attempt to activate or yank on the external CFS handle. Damage to the canopy and injury to personal may occur.

Figure SY209-30 – External CFS Warning

Lesson Quiz Questions
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. Which canopy section(s) provide enhanced birdstrike protection? (B/1/1)
   a. Windscreen only
   b. Windscreen and front transparency
   c. Front and rear transparencies
   d. All sections

2. Click on and drag the system titles below to the correct blanks in the statements. When all titles are placed, click the Judge button. (B/1/2)
   - canopy fracturing system
   - sealing system
   - defog system
   - locking/latching system
   a. The ______ locks and unlocks the canopy.
   b. The ______ prevents cabin air leaks.
   c. The ______ can be used for emergency egress if the canopy can not be opened.
   d. The ______ controls condensation and improves pilot visibility.

3. Click on the graphic that shows the canopy lock release handle. (B/2/1)
4. Read the following steps. Select the choice that identifies what these steps allow you to do. (B/2/2)

1. Press and hold the unlock button while slowly rotating external canopy handle. clockwise to placarded OPEN position.
2. Lift the canopy to its full 90° open position.
   a. Open the canopy from the outside.
   b. Close the canopy from the outside.
   c. Open the canopy from the inside.
   d. Close the canopy from the inside.

5. When closing the canopy from the inside, the canopy has been properly latched when the _______. (B/2/3)
   a. mechanical red indicator is visible
   b. latch handle cannot be moved
   c. mechanical green indicator is visible
   d. CANOPY CAS advisory changes from red to green

6. What indications will you get if the canopy is unlocked? (B/2/4)
   a. MASTER CAUTION annunciator, CANOPY CAS caution advisory, and aural tone
   b. MASTER CAUTION annunciator, UNLOCK CAS caution advisory, and aural tone
   c. MASTER WARN annunciator, CANOPY CAS warning advisory, and aural tone
   d. MASTER WARN annunciator, UNLOCK CAS warning advisory, and aural tone

7. The canopy shall not be opened on the ground when surface winds exceed ______ knots. (B/2/5)
   a. 10
   b. 20
   c. 30
   d. 40

8. The CFS functions automatically during ejection or can be activated by ______ CFS handles. (B/3/1)
   a. only internal
   b. only external
   c. internal or external
   d. neither internal nor external
9. Which control will fracture the front cockpit canopy transparency only? (B/3/2)
   a. Rear cockpit CFS handle
   b. Right external CFS handle
   c. Front cockpit CFS handle
   d. Left external CFS handle

10. In order for the CFS to be activated, aircraft electrical power must be available. (B/3/3)
    a. True
    b. False

11. FLSC is used on the front transparency instead of MDC because _____ . (B/3/4)
    a. FLSC is more powerful than MDC and can cut the thicker front transparency
    b. FLSC, though less powerful than MDC, is sufficient to cut the thinner front transparency
    c. MDC causes electrical interference with front cockpit instruments
    d. FLSC is “see through” allowing better front cockpit visibility

12. Click on the control that activates the CFS system for this cockpit. (B/3/5)
LESSON QUIZ QUESTIONS

1. What are the major systems of the T-6B canopy?
   a. Locking/latching, sealing, defog, and fracturing
   b. Locking/latching, pressurization, exterior vent, and ejection
   c. Open, close, lock, and unlock
   d. Locking/latching, opening, egress, and CAS advisories

2. The purpose of the CFS is to _____.
   a. provide latching of the canopy
   b. maintain proper sealing of the canopy
   c. provide emergency egress if the canopy will not open normally
   d. provide control over canopy fogging

3. What does the CANOPY warning advisory on the CAS indicate?
   a. All 10 of the canopy locks are fully open.
   b. The canopy seal is not maintaining pressure.
   c. The CFS computer has failed.
   d. The canopy is not properly locked.

4. Activating the forward internal CFS handle will _____.
   a. activate the explosives for both the front and rear cockpit transparencies
   b. activate the explosive for the front cockpit transparency
   c. activate the explosive for the rear cockpit transparency
   d. jettison the forward windscreen

5. Opening the canopy on the ground with winds greater than _____ knots is prohibited.
   a. 25
   b. 30
   c. 35
   d. 40

6. To safely activate the fracturing system using an external CFS handle _____.
   a. face towards the aircraft and pull the CFS lanyard to its full length of 10 feet
   b. face away from the aircraft and pull the CFS lanyard to its full length of 10 feet
   c. facing away from the aircraft, simultaneously press the external lock and unlock buttons on the left side of the aircraft
   d. none of the above, the external CFS has been rendered inoperative
7. An internal CFS handle located on the left console in the front cockpit allows activation of the fracturing system for the _____.
   a. rear cockpit transparency only
   b. front and rear cockpit transparencies
   c. front cockpit transparency only
   d. front cockpit transparency and windshield

8. The pneumatic canopy pressure seal inflates when _____.
   a. engine bleed air inflow is available
   b. the internal canopy lock is placed to CLOSED
   c. weight is off the right main landing gear
   d. A and C above
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OVERVIEW
This lesson covers the T-6B seat ejection system. You will become familiar with ejection seat components, pilot controls, ejection propellant components, considerations for ejection, and ejection sequence.

REFERENCES
Personnel: None
Media Facilities: CAI workstation
Support Resources: T-6B Flight Manual
T-6B Systems 2 Student Guide

STUDENT ASSIGNMENTS
Read applicable portions of T-6B Flight Manual, Sections I and III.
Complete CAI lesson SY210, following along with this student guide.
Complete the practice questions provided.

LESSON OUTLINE
This lesson is presented in four segments. The first segment is an introduction to the lesson. The second segment presents information about the ejection seat components and controls, while the third segment covers general ejection considerations and procedures. The fourth segment contains a lesson review quiz. Topics in this lesson must be taken in sequential order, and all topics must be completed prior to attempting the end of lesson quiz. The estimated time required to complete this lesson is 1.0 hour.
Introduction

Ejection Seat

Ejection System Components and Controls

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<td>Identify parachute/container and harness system components</td>
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<td>1.23.6.0.4</td>
<td>Match parachute/container and harness system components to functions</td>
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<td>1.23.6.0.5</td>
<td>Identify characteristics of normal operations for parachute/container and harness system</td>
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<tr>
<td>1.23.19.0.1</td>
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Seat Type

The T-6B is equipped with Martin-Baker ejection seats. Each seat is fully automatic, designed to provide rapid escape from zero altitude and zero speed, up to 35,000 feet and 370 KIAS.

Figure SY210-1 – Ejection Seat
Ejection Handle

Ejection is initiated by pulling upward on the yellow and black striped ejection control handle on the front of the seat bucket between the pilot’s thighs.

![Figure SY210-2 – Ejection Handle](image)

Ejection Safety Pin

To prevent inadvertent activation of the ejection seat handle, a safety pin looped with a red streamer is provided for insertion directly into the ejection handle mechanism.

Ejection seats must be pinned whenever the canopy is not securely down and/or locked. Intentional or inadvertent operation of the ejection seats with the canopy open or unlocked may result in serious injury or death to personnel in, on, or near the aircraft.

After removal, the pin is stowed in the interior canopy latch handle.

![Figure SY210-3 – Ejection Seat and Safety Pin](image)
MOR Handle

The Manual Override (MOR) handle, is marked with yellow and black stripes and is labeled MOR. It is located on the right side of the seat next to the seat bucket.

The MOR handle is used to manually initiate seat/pilot separation under two circumstances:

If the automatic system fails, or

If seat/pilot separation is desired above 14,000 - 16,000 feet MSL, such as in mountainous terrain.

The MOR handle is activated by pushing the button and raising the handle. It cannot be activated while the seat is still in the aircraft. It will only work after the seat has been ejected.

Figure SY210-4 – MOR Handle
MOR Warning

Restraining Devices

Each time you prepare for flight, one of the first actions you take will be to properly secure yourself to the aircraft ejection seat.

When properly secured, you will be restrained with torso harness connections to the upper Koch fittings, lap belt connections, and leg restraints (leg restraint lines and leg garters).

Figure SY210-5 – MOR Warning
Torso Harness

The PCU-56/P torso harness is put on before you enter the aircraft. It is used in conjunction with the lap belt connections, shoulder harness and personal survival kit attachments to the seat.

SSK Attach

Your seat contains a Seat Survival Kit (SSK). Attaching the mini Koch fittings on the torso harness to the left and right lap belt assemblies connects you to the SSK.
SSK Note

The ELT is automatically activated during seat/seat kit separation during the ejection sequence. If the seat kit is not properly connected to the pilot, it may not separate from the seat and the ELT would not be activated.

Lap Belt Connection

When you connect your left lap belt, ensure the anti-G hose remains clear and routed above the lap belt.

You will also add the Koch fittings of the parachute’s risers to the left and right fittings on your torso harness.

Figure SY210-8 – SSK Note

Figure SY210-9 – Lap Belt Connections
Leg Garters

Leg restraint garters reduce the chance of injury during ejection. The leg restraint garters are attached just above the boots, and prevent your legs from flailing during ejection. They must fit snugly and not have any slack in the leg lines.

They are designed to allow freedom of movement during normal operations. During ejection, as the seat rises, the leg lines are pulled tight, drawing your legs towards the seat. Attachment shear rings, located on the leg lines, will break, freeing the lines from the aircraft. Your legs will remain secured until the leg lines are released when harness release occurs.

Figure SY210-10 – Leg Garters
Garter Quick Release

The leg garters can be released for ground egress by operating the latch for each garter, or by moving the quick release lever forward to release both restraint lines from the seat simultaneously.

Figure SY210-11 – Quick Release Lever
Harness Reel/PIRD

The seat contains a shoulder harness reel that ensures you are positioned and locked in the correct posture for ejection. The reel is integrated into a device called the Powered Inertia Retraction Device (PIRD).

The PIRD and harness reel work in similar fashion to the inertial reels in automobile seatbelts. When there is rapid aircraft deceleration, the reel will lock, preventing forward movement of the pilot. When the deceleration load is reduced the reel releases to the normal free state.

PIRD Ejection Operation

During ejection, the PIRD retracts the harness straps, pulling the pilot back against the seat and locking the pilot in the desired ejection posture.
Harness Control Lever

The seat has a shoulder harness control lever on the left side. It has a locked and unlocked position.

When the lever is moved aft to the locked position, the reel will retract any slack in the harness straps as you lean back. The reel will then not allow any forward movement. The same is true when the inertial reel locks.

When the lever is moved forward, the shoulder harness is unlocked, allowing the pilot to move forward and backward freely.

Lock Positions

Normally, you will fly with the control lever in the unlocked position. The locked position is used during ejection or emergency landing situations.

Figure SY210-14 – Shoulder Harness Lever
Head Box

The parachute and risers are packed into the seat’s headbox.

The parachute’s risers emerge from the container and are connected to the seat-mounted restraint system.

In front of the headbox is a fixed contoured head pad.

Box Deployment

The container holding the parachute is ejected from the seat during the ejection sequence. As the container is ejected, a lid on the bottom opens to deploy the parachute.
Canopy Breaker

Also at the top of the seat is the canopy breaker. It penetrates the canopy as the seat moves up the catapult rails during ejection. This is a backup in the event the Canopy Fracturing System (CFS) fails.

Emergency Oxygen

The seat contains an emergency oxygen system that is activated automatically during ejection. During ejection, oxygen will flow continuously for either 10 minutes, or until seat/pilot separation, whichever comes first.

The oxygen supply can be manually activated in response to various emergency situations where OBOGS cannot be used. To activate the emergency oxygen system manually, pull up on the green looped emergency oxygen handle. Once activated, emergency oxygen cannot be shut off and will provide oxygen flow until the cylinder is depleted (10 minutes).
ISS Modifications

The aircraft ejection system is fitted with a gas-operated Interseat Sequencing System (ISS). The ISS mode selector is located on the left side console panel in the rear cockpit. The ISS selector controls whether either the activating seat or both seats will eject.

ISS Mode Selection

The ISS mode is set by lifting the spring-loaded lever up and moving it to the desired position. The lever is then locked in place by releasing it into the detent.
ISS BOTH

The ISS mode selector panel has a placarded BOTH position, a placarded SOLO position, and a placarded CMD FWD (command forward) position. Each position must be manually set by the operator.

Figure SY210-21 – ISS BOTH

ISS SOLO

You should set the ISS selector to SOLO prior to flying solo. Normally, you should also select SOLO prior to entering, exiting, or egressing the aircraft on the ground.

When flying dual, the ISS mode selector should normally be set to BOTH to allow either crewmember to initiate ejection of both seats.

The CMD FWD is normally used only if non-rated personnel occupy the rear seat.

Detailed procedures for mode selection and seat pin usage will be covered in subsequent instruction units.

Figure SY210-22 – ISS SOLO

Figure SY210-23 – ISS DUAL

Figure SY210-24 – ISS CMD FWD
ISS Functions

When set to BOTH, both seats will eject regardless of which pilot pulls the ejection handle, with the rear seat ejecting first, even if the non-initiating seat has the ejection handle safety pin installed. The ISS delays the front seat ejection for 0.37 seconds.

When the ISS mode selector is set to SOLO, each seat ejects independently of the other. Sequencing is dependent upon when and in what order the pilots pull the handles.

When the selector is set to the CMD FWD position, the crewmember in the rear seat initiates ejection of the rear seat only, and the crewmember in the forward seat initiates ejection of both seats with the rear seat ejecting first.

SSK

The Seat Survival Kit (SSK) is fitted in the seat pan. It is secured in position by a fiberglass upper lid which is part of the sitting platform.

The SSK’s pilot-selectable deployment unit allows it to be suspended on a twelve foot nylon lowering line, either automatically or manually during parachute descent.
Auto vs Manual

The SSK deployment unit is normally set to AUTO. Prior to strapping in, the pilot can select either AUTO or MANUAL resulting in the following:

When set to AUTO, the SSK is lowered automatically on a line four seconds after seat/pilot separation.

When set to MANUAL, the pilot must pull the manual release handle to lower the SSK.

The manual KIT RELEASE handle is part of the SSK, and is located on the left side of the seat next to the seat cushion.
Seat Height Adjust

Adjusting the height of your ejection seat is more than a matter of comfort. The seat should be adjusted so that the canopy breaker, and not the pilot’s head, hits the canopy. Failure to properly adjust the seat can have lethal results.

A recommended method to ensure proper clearance is while keeping your eyes level with the instrument panel, have at least one fist width between the top of your helmet and the canopy. This ensures the canopy breaker will hit the canopy first.

Seat Height Switch

To adjust your seat height up or down, use the electrical seat height actuator switch located on the left side console in each cockpit. It is spring-loaded to the OFF position and must be moved aft to raise the seat, and forward to lower it. The ejection sequence is not affected by the seat height.
**Circuit Breaker**

Electrical power for the seat adjustment system is provided through a circuit breaker placarded SEAT ADJ, located on the generator bus circuit breaker panel in each cockpit.

**Figure SY210-29 – Seat Adjust Circuit Breakers**

**Ejection System Propellant Components**

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<tr>
<td>1.23.9.0.3</td>
<td>Match ejection seat/seat structure and catapult system components to functions</td>
</tr>
</tbody>
</table>
Propellant Intro

During ejection, the seat is actually propelled using a sequence of two separate and distinct systems.

Initially, the seat moves up a set of rails on a catapult assembly propelled by detonated gas pressure once the main catapult cartridge has ignited.

As the seat reaches the top of the catapult rails, it is propelled farther by ignition of the rocket motor.
CFS Initiator

As the seat rises, the Canopy Fracturing System (CFS) initiator activates the CFS which fractures the canopy.

When the seat reaches the top of the rails, the rocket motor fires, starting the second step in the propellant sequence.

Rocket Motor

Each seat contains a rocket motor on the underside of the seat bucket attached to the catapult assembly. The rocket motor is a steel cylinder with integral rocket nozzles designed to impart asymmetric thrust.

The front and rear seat rockets are configured with opposite nozzle configurations to ensure the seats are separated from one another during ejection.
General Ejection Operations

Ejection Procedures

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<tr>
<td>1.23.8.0.8</td>
<td>Identify ejection seat/general system operating limits</td>
</tr>
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</table>

Envelope Intro

As a general rule, ejecting at low altitudes presents significant risks.

Additionally, ejecting while the aircraft is in an unusual attitude reduces the chances for successful ejection.

Consequently, you should try to climb to exchange airspeed for altitude, and if possible, initiate ejection in level or climbing, unaccelerated flight.

Envelope 2

How well the ejection system performs depends upon three specific factors which create an operating envelope. Those factors are dive angle, bank angle, and sink rate, and are discussed in Section III of the Flight Manual under emergency procedures.
Dive Angle

This chart illustrates that at a given indicated airspeed, as dive angle increases, the minimum altitude for safe ejection also increases.

For instance, at 250 KIAS the minimum safe altitude for a dive angle of 20° is about 225 feet AGL, while it’s about 700 feet AGL at 60°.

Bank Angle

Similarly, as your bank angle increases, for each of the airspeeds shown, you require greater altitude to ensure a safe ejection.

Again, using 250 KIAS, you can see the difference between 40° and 100° bank angles. This assumes a level flight attitude.

Sink Rate

Another reason to eject in level flight or a climb configuration is to ensure you have little or no sink rate. Here you can see that as your sink rate increases, your minimum altitude for safe ejection also increases.
Again at 250 KIAS, you can see that a sink rate of 2000 feet per minute requires significantly less altitude for safe ejection than a sink rate of 7000 feet per minute.

Safe Terrain Clearance

A conservative safe ejection clearance can be obtained by combining the minimum clearances for each condition.

\[700 + 100 + 170 = 970 \text{ feet}\]

Ejection Prep

There are two conditions under which you eject:

Controlled Ejection: This is the situation where you have time to assess and respond to an emergency situation, and prepare for ejection by following the prescribed checklist.

Uncontrolled Ejection: This is a situation where the need to eject is immediate and you have little or no time to respond to an emergency situation.

Figure SY210-37 – T-6B Ejection
Controlled Situation

In a controlled ejection situation, complete the CONTROLLED EJECTION checklist.

Be sure to assume the proper posture before pulling the handle, keeping elbows against the body and with legs extended but not rigid.

The Flight Manual recommends minimum altitudes for controlled and uncontrolled ejection of 2000 and 6000 feet AGL respectively.

Process Intro

Below 14,000 feet, the entire ejection process takes 4.37 seconds (front)/4.00 seconds (rear) from the time you pull the ejection control handle to the point that the chute is fully deployed.

Because ejection occurs so quickly, it is important that you prepare as best you can in case you eventually need to eject from the aircraft.

Figure SY210-38 – Dual Ejection
Uncontrolled 1

When the situation demands an immediate ejection with little or no preparation, the response is pretty straightforward. Initiate the ejection sequence as quickly as possible.

If the aircraft is not controllable, ejection must be accomplished regardless of speed, altitude or attitude since immediate ejection offers the best opportunity for survival.

Normally, you will hear a command to BAIL OUT from the instructor. You will be briefed on ejection criteria prior to each flight. Regardless, follow the checklist’s warning for pulling the ejection handle. Remember, recommended minimum altitude for uncontrolled ejection is 6000 feet AGL.

Uncontrolled 2

The possibility of safe ejection is greatly improved by making the decision to eject early, and with sufficient airspeed and altitude. Although the ejection seat is capable of ejection at zero altitude and zero airspeed with sink rates to 10,000 feet per minute, do not postpone the decision to eject.
Grip Techniques

There are two prescribed methods for grasping the ejection handle.

One method involves gripping the handle with the thumb and at least two fingers of each hand, with the palms towards the body and elbows in.

Strong Hand

The second method involves gripping the handle with your stronger hand, with palms toward the body. Grip the wrist of your strong hand with the other hand as shown, keeping your elbows in. Also, pull the handle the full travel.

Ejection Sequence

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<td>1.23.11.0.1</td>
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<tr>
<td>1.23.11.0.3</td>
<td>Match ejection seat/interseat sequence system components to functions</td>
</tr>
</tbody>
</table>
Steps Intro

When the interseat sequencing selector is set to BOTH, the rear seat will always eject first, even if one ejection handle safety pin is installed. This helps to avoid injury to the rear seat occupant caused by flying debris and rocket blast from the front seat during ejection.

The timeline for rear seat ejection is presented in the next section. Remember that the front seat will be .37 seconds behind the rear seat at each step. The sequence discussed in the following screens illustrates a lower altitude ejection (taking place below 14,000 - 16,000 feet MSL).

During higher altitude ejections, the head box deployment, drogue chute release, seat separation, and parachute deployment are all delayed until below 14,000 - 16,000 feet MSL.

Step 1

(00 -.23 Seconds)

Within .23 seconds, the PIRD retracts the shoulder straps, and the sequencing system is initiated.
SY0210
EJECTION SYSTEM

Step 2

(.23 - .35 Seconds)

The underseat manifold canister has ignited moving the seat and catapult system up the rails. The canopy fracturing system has initiated and all aircraft services are disconnected. The drogue chute deployment unit has fired. Remember the canopy breaker is not used during a normal ejection.

Figure SY210-43 – Step 2

Step 3

(.35 - .38 Seconds)

The legs are restrained as the leg restraints are pulled taut. The rocket motor ignites as the seat reaches the top of the rails, and emergency oxygen is activated. The drogue chute is deployed from its container. The drogue chute stabilizes the seat and aids deceleration.

Figure SY210-44 – Step 3
Step 4

(.38 - .69 Seconds)

The pilot is fully restrained and the drogue chute is completely deployed to stabilize and decelerate the seat.

Step 5

(.69 - 1.24 Seconds)

The drogue chute is released and the headbox fired. The main parachute begins deploying.

Remember, during higher altitude ejections, this step is delayed until below 14,000 – 16,000 feet.

Step 6

(1.24 - 1.45 Seconds)

The seat has separated and fallen clear. The parachute is inflating, and the Seat Survival Kit has been prepared for deployment.

The emergency locator transmitter begins transmitting automatically when the survival kit separates from the seat.
Step 7

(1.45 - 4.0 Seconds)

As the pilot descends on the fully inflated parachute, the Seat Survival Kit is deployed 4.0 seconds after seat/pilot separation if the SSK Selector was set to AUTO, or immediately if the KIT RELEASE handle was pulled (SSK Selector set to MANUAL).

Demo

Lesson Review Quiz
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. The pilot would use the MOR handle to separate from the seat ______. (B/1/1)
   a. over water
   b. while on the ground
   c. while the seat is in the aircraft
   d. over mountainous terrain above 8000 feet MSL

2. When properly secured, you will be restrained with the torso harness connected to the risers and SSK while also ensuring the ______ and ______ are securely fastened. (B/1/2)
   a. shoulder harness belts; lap belt
   b. lap belt; oxygen connectors
   c. shoulder belts; lap belt
   d. lap belt; leg restraints

3. What is the purpose of the leg restraint system? (B/1/3)
   a. Prevent movement about the cockpit during flight
   b. Prevent the feet from flailing during ejection
   c. Ensure freedom of movement during ejection
   d. Avoid constriction during ejection

4. During ejection, emergency oxygen is provided ______. (B/1/4)
   a. for about 10 minutes or until turned off
   b. for about 10 minutes and after seat-pilot separation
   c. for about 10 minutes or until seat-pilot separation
   d. until seat-pilot separation or until it is turned off

5. During ejection, what happens in the event the canopy fracturing system (CFS) fails? (B/1/5)
   a. The ejection sequence is aborted.
   b. The canopy breaker will penetrate the canopy transparency as the seat moves up the rails.
   c. The breaker head box will shatter the canopy as the seat moves up the catapult rails.
   d. The CFS must be reset.
6. What happens when the ISS is set to BOTH? (B/1/6)
   a. The seat that pulls the ejection handle first will eject first.
   b. The rear seat will always eject first.
   c. The front seat will eject first if the front handle is pulled first.
   d. No matter who pulls the handle first, the front seat will eject before the back seat.

7. During the ejection process, movement of the seat is first initiated by _____. (B/2/1)
   a. explosive hydraulic pressure
   b. mechanical catapult thrust
   c. detonated gas pressure
   d. detonation of the rocket motor propellant

8. What are the three factors affecting the effectiveness of the ejection system? (C/1/1)
   a. Dive speed, bank angle, and climb rate
   b. Dive angle, bank angle, and climb rate
   c. Dive speed, rate of bank, and sink rate
   d. Dive angle, bank angle, and sink rate

9. Why is it a good practice to eject from the aircraft in a level flight attitude? (C/1/2)
   a. Avoid a collision of the front and rear ejection seats
   b. Ensure a clear path away from the airframe
   c. Avoid flying debris and rocket motor blast
   d. Ensure little or no sink rate

10. What happens during simultaneous ejections (ISS mode selector is set to BOTH)? (C/2/1)
    a. The front seat will be delayed until the rear seat is clear.
    b. The rear seat will eject second.
    c. Both seats eject simultaneously with the rear rocket motor firing first.
    d. The rear seat will eject first.

11. What happens if the SSK Selector is set to AUTO? (C/2/2)
    a. The SSK will deploy 4.0 seconds after seat-pilot separation.
    b. The pilot must use the manual release handle marked KIT RELEASE and wait 4 seconds.
    c. The pilot must wait 4.5 seconds until the SSK is lowered.
    d. The pilot must pull the manual release handle marked KIT RELEASE to release the SSK.
LESSON REVIEW QUIZ QUESTIONS

1. The T-6B ejection seat is designed to provide rapid ejection capability at zero altitude and zero speed up to _____feet and _____KIAS.
   a. 30,000; 300
   b. 31,000; 350
   c. 35,000; 370
   d. 37,000; 370

2. The ejection seat leg restraint garters are attached _____.
   a. just above the thigh
   b. just above the boots
   c. just below the knees
   d. just below the ankles

3. You will attach the SSK by connecting _____.
   a. the torso harness to the Frost fittings
   b. the lap belt to the torso harness Frost fittings
   c. the SSK V-rings on the torso harness to the seat buckles
   d. the SSK Frost fittings to the torso harness V-rings

4. The PIRD performs which of the following functions?
   a. Retracts the shoulder harness straps during deceleration
   b. Retracts the lap belt during ejection
   c. Retracts the leg restraints during ejection
   d. Retracts the shoulder harness straps during ejection

5. Where are the parachute and chute harness assembly located?
   a. Beneath the seat bucket
   b. In the headbox
   c. In the seat box
   d. Behind and below the seat bucket
6. What happens if the SSK selector is set to AUTO?
   a. The SSK is lowered 10 seconds after ejection
   b. The SSK is lowered 4.0 seconds after seat-pilot separation
   c. The SSK is lowered 4.0 seconds after ejection
   d. The SSK is lowered 10 seconds after seat-pilot separation

7. The ejection seat emergency oxygen system provides which of the following?
   a. 10 seconds of oxygen
   b. 1.0 minute of oxygen
   c. 5-7 minutes of oxygen
   d. 10 minutes of oxygen

8. In order to prevent inadvertent activation of the ejection system while on the ground, each seat _______.
   a. has a seat release locking handle on the right side
   b. should be secured with a safety pin that has a red streamer
   c. should be lowered to the minimum height
   d. should have the safety pin with the red streamer removed

9. How is the T-6B ejection seat propelled?
   a. Detonated gas pressure, rocket motor, and hydraulic power
   b. Explosive motor and hydraulic power
   c. Detonated gas pressure and rocket motor
   d. Detonated gas pressure, hydraulic catapult, and rocket motor

10. Prior to ejection, it is desirable to do which of the following?
    a. Descend to trade altitude for airspeed
    b. Climb to trade airspeed for altitude
    c. Maintain altitude and increase airspeed
    d. Alter altitude to gain adequate airspeed

11. What is the purpose of the drogue chute?
    a. Assists the catapult in transporting the seat during ejection
    b. It opens the main parachute
    c. Increases drag so the seats do not collide during ejection
    d. Helps to stabilize and decelerate the seat
12. Recommended minimum altitudes for controlled and uncontrolled ejection, according to the Flight Manual, are _____ and _____ feet AGL respectively.
   a. 2000; 6000
   b. 3000; 6000
   c. 6000; 2000
   d. 15,000; 35,000

13. Proper seat adjustment during ejection is a safety issue because ______.
   a. adjusting the seat so your helmet is higher than the canopy breaker can have lethal results
   b. the leg restraint garters will not properly attach
   c. the ejection system only operates with the seat full down
   d. adjusting the seat so your helmet is lower than the canopy line can have serious results
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OVERVIEW
The Systems Review 3 lesson provides a review of the normal operation of the T-6B environmental and canopy/ejection systems, and then covers characteristics of abnormal operation and failure indications for environmental systems.

REFERENCES
Personnel: None
Media Facilities: Student CAI Workstation
Support Resources: T-6B Flight Manual
SY207, SY208, SY209, and SY210 student guides

STUDENT ASSIGNMENTS
Review SY207, SY208, SY209, and SY210 student guides.
Read T-6B Flight Manual, Section I.
Complete lesson review questions for SY212.

LESSON OUTLINE
The Systems Review 3 lesson provides you with a review of the normal operation of T-6B environmental, canopy, and ejection systems. The lesson then covers abnormal operation and failure indications for the canopy and environmental systems.
Introduction

Systems Review 3

Environmental System

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<td>1.21.2.0.2</td>
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<td>Identify OBOGS operating limits</td>
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<td>1.21.11.0.2</td>
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<tr>
<td>1.21.11.0.6</td>
<td>Identify emergency oxygen system operating limits</td>
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Please refer to your student guides for the following lessons:

SY207 – Environmental System 1
SY208 – Environmental System 2
### Canopy/Ejection Systems

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<td>1.23.1.0.2</td>
<td>Describe canopy/assembly system operating principles</td>
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<td>Identify canopy/assembly system operating limits</td>
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<td>Describe canopy/latching system operating principles</td>
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<td>Describe canopy fracturing system operating principles</td>
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<td>Identify canopy fracturing system operating limits</td>
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<td>1.23.6.0.6</td>
<td>Identify parachute/container and harness system operating limits</td>
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<td>Describe ejection seat/general system normal operating principles</td>
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<td>1.23.8.0.8</td>
<td>Identify ejection seat/general system normal operating limits</td>
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<td>1.23.18.0.2</td>
<td>Describe seat adjustment system operating principles</td>
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<td>Identify seat adjustment system operating limits</td>
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Please refer to your student guides for the following lessons:

SY209 – Canopy System

SY210 – Ejection System
## Abnormal Operations

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<td>Identify indications of OBOGS heat exchanger overtemp</td>
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<td>Identify indications of environmental system duct overtemp</td>
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<td>Identify indications of loss of cockpit pressure</td>
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<td>6.4.40.0.1</td>
<td>Identify indications of defog valve failing to close in flight</td>
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**OBOGS System Failure**

**OBOGS SYSTEM FAILURE**

- Reduced gas pressure or quantity

**OBOGS FAIL** warning message

---

**Figure SY212-1 – OBOGS System**

**Figure SY212-2 – OBOGS FAIL Warning Message**
OBOGS Heat Exchanger
Overtemp

**OBOGS HEAT EXCHANGER OVERTEMP**

Heat Exchanger Failure

**OBOGS TEMP caution message**

Environmental System Duct
Overtemp

**ENVIRONMENTAL SYSTEM DUCT OVERTEMP**

Duct temperature exceeds 300° F at temperature switch near firewall shutoff valve or 300° F at the temperature switch at the rear air distribution valve aft of the front ejection seat

**Figure SY212-3 – OBOGS Heat Exchanger**

**Figure SY212-4 – OBOGS TEMP Caution Message**

**Figure SY212-5 – Duct Temperature Sensors**
Defog Valve Fails to Close in Flight

**DEFOG VALVE FAILS TO CLOSE**

Defog valve (bi-level flow control bypass valve) fails to close in flight and the cockpit heat becomes very uncomfortable

Verify appropriate time has elapsed

-- within 40 seconds

Use TEMP CONTROL switch set at MANUAL (held toward COLD) to help control temperature.

---

**Figure SY212-6 – DUCT TEMP Caution Message**

**Figure SY212-7 – Defog Valve Failure Diagram**
Canopy Unlocked

**CANOPY UNLOCKED**

*Figure SY212-8 – Canopy Latch Indicator*

**CANOPY warning message**

Cockpit Overpressure

**COCKPIT OVERPRESSURE**

*Figure SY212-9 – CANOPY Warning Message*

*Figure SY212-10 – Cockpit Overpressure Indication*
CKPT PX warning message

Cockpit differential pressure has exceeded 3.9 to 4.0 psi

Figure SY212-11 – CKPT PX Warning Message

Loss of Cockpit Pressure

LOSS OF COCKPIT PRESSURE

Rapid decompression/cockpit pressure altitude above 19,000 feet.

Figure SY212-12 – Cockpit Altitude Indication

CKPT ALT caution message

Figure SY212-13 – CKPT ALT Caution Message

Lesson Review Questions
LESSON QUESTIONS

EMBEDDED QUESTIONS (Ref: Segment/Topic/Question)

1. Which switch controls the flow of fresh air to the cockpit during ground operations and unpressurized flight? (B/1/1)

2. True or false? The AIR COND switch is available in both cockpits and is used to activate the air conditioner compressor. (B/1/2)

3. True or false? Placing the vent control lever in the CANOPY position opens the defog (bi-level flow control bypass) valve. (B/1/3)

4. Which cockpit control and duct component controls whether warm bleed air is routed to the footwarmers or defog outlets? (B/1/4)

5. True or false? The Temperature Control Switch Knob on the Environmental Control Panel controls the temperature of both heating and defogging air. (B/1/5)

6. If cockpit pressure differential exceeds 4.0 psi, the ΔP regulator sends a signal to the safety valve. What does the safety valve do? (B/1/6)

7. A cockpit pressure differential of 3.6 psi is normally reached at what altitude? (B/1/7)

8. True or false? Pressure for the anti-G system is supplied from an electrically driven pump. (B/1/8)

9. Which oxygen pressure regulator concentration lever position supplies the highest possible oxygen concentration? (B/1/9)

10. When activated, the emergency oxygen bottle will supply oxygen for how long? (B/1/10)

11. When is the canopy pressure seal inflated? (B/2/1)

12. True or false? Aircraft electrical power must be available for the canopy fracturing system to function. (B/2/2)

13. The T-6B Martin-Baker ejection seat is a zero-zero seat usable up to what altitude and airspeed? (B/2/3)

14. How would you deploy the parachute if the automatic system fails? (B/2/4)

15. Illumination of the CKPT PX warning message indicates what? (B/3/1)

16. The CKPT ALT caution message is illuminated, indicating the cockpit altitude has exceeded 19,000 feet. What ΔP reading should you expect to see? (B/3/2)

17. An OBOGS FAIL warning message should be accompanied by what other panel indication? (B/3/3)
LESSON REVIEW QUESTIONS

1. Where does bleed air for T-6B heating, defogging, pressurization, anti-G and OBOGS come from?

2. True or false? The entire T-6B canopy is protected for birdstrikes.

3. If the ejection seat SSK switch is set to AUTO, when will the SSK deploy?

4. True or false? The T-6B air conditioning system is electrically operated and is available when electrical power is applied to the aircraft.

5. Which control opens the bi-level flow control bypass valve?

6. Which message will light if duct air temperature exceeds 300° F?

7. Emergency oxygen can be activated manually in the event of OBOGS failure. When does it automatically activate?

8. OBOGS will provide oxygen for how many hours of flight?

9. True or false? The CKPT ALT caution message indicates the cockpit is overpressurized.

10. In addition to the cold air vent on the center console in each cockpit, additional air conditioning outlets are located where?

11. When the ejection seat sequencer is set to SOLO, which seat will eject first?

12. True or false? The anti-G system will activate only during negative-G maneuvers.
## APPENDIX A
### ANSWER KEY

### SY0201 ELECTRICAL SYSTEM

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<td>2. C</td>
<td>11. B</td>
</tr>
<tr>
<td>3. C</td>
<td>12. D</td>
</tr>
<tr>
<td>5. D</td>
<td>14. FALSE</td>
</tr>
<tr>
<td>6. C</td>
<td>15. B</td>
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<tr>
<td>7. A (Question should read backup VHF control head)</td>
<td>16. D</td>
</tr>
<tr>
<td>8. C</td>
<td>17. B</td>
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<td>9. B</td>
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### Lesson Review Quiz Questions

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<td>1. C</td>
<td>6. C</td>
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<tr>
<td>2. B</td>
<td>7. D</td>
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<tr>
<td>3. click on graphic (Avionics Master Switch)</td>
<td>8. D</td>
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<td>5. A</td>
<td>10. B</td>
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### SY0202 FUEL SYSTEM

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<td>2. B</td>
<td>11. C</td>
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<tr>
<td>3. A</td>
<td>12. Click on graphic (fuel flow transmitter)</td>
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<tr>
<td>6. A</td>
<td>15. TRUE</td>
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<td>7. C</td>
<td></td>
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<tr>
<td>8. B</td>
<td>16.</td>
</tr>
<tr>
<td>9. C</td>
<td>17. FALSE</td>
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<td>10. B</td>
<td>18. A</td>
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### Lesson Review Quiz Questions

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<td>2. A</td>
<td>7. (MANUAL FUEL BAL switch)</td>
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<td>3. C</td>
<td>8. D</td>
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<tr>
<td>4. Click on graphic (FUEL PX annunciator)</td>
<td>9. B</td>
</tr>
<tr>
<td>5. D</td>
<td>10. C</td>
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<tr>
<td><strong>Embedded Questions</strong></td>
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<tr>
<td>1. Both generator and battery buses are powered by the generator.</td>
<td></td>
</tr>
<tr>
<td>2. The GCU is under a panel on the right side of the rear cockpit.</td>
<td></td>
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<tr>
<td>3. Bus tie switch</td>
<td></td>
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<tr>
<td>4. Both generator and battery buses supply power to avionics and radios.</td>
<td></td>
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<td>5. Battery bus circuit breakers are located on the left side of the cockpit.</td>
<td></td>
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<tr>
<td>6. Battery power control is transferable using the battery switch.</td>
<td></td>
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<tr>
<td>7. False. It must be activated by the auxiliary battery switch.</td>
<td></td>
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<tr>
<td>8. down and locked</td>
<td></td>
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<tr>
<td>9. Red at the left wingtip and green at the right wingtip</td>
<td></td>
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<td>10. 1100 pounds</td>
<td></td>
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<tr>
<td>11. Over-the-wing gravity refueling</td>
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<tr>
<td>12. The primary jet pump and transfer jet pumps are both operated by venturi flow generated by fuel flowing in the motive flow line.</td>
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<tr>
<td>13. The EICAS (Engine Indicating and Crew Alerting System)</td>
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<td>14. Seven</td>
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<tr>
<td>15. The fuel balance switch on the right forward switch panel has been set to MAN/RESET.</td>
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<td>16. True. Collector tank fuel is split between the left and right fuel quantity indications.</td>
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<td>17. Float valve</td>
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<td>18. Motive flow is halted to the light tank.</td>
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</tr>
<tr>
<td>19. 30 pounds</td>
<td></td>
</tr>
<tr>
<td>20. True.</td>
<td></td>
</tr>
<tr>
<td>21. Low fuel pressure</td>
<td></td>
</tr>
<tr>
<td><strong>Lesson Review Questions</strong></td>
<td></td>
</tr>
<tr>
<td>1. 28 volts DC</td>
<td></td>
</tr>
<tr>
<td>2. The strobe lights are located on each wingtip near the leading edge.</td>
<td></td>
</tr>
<tr>
<td>3. Battery bus</td>
<td></td>
</tr>
<tr>
<td>4. 100 pounds</td>
<td></td>
</tr>
<tr>
<td>5. Right side</td>
<td></td>
</tr>
<tr>
<td>6. Generator Bus</td>
<td></td>
</tr>
<tr>
<td>8. The firewall shutoff valve control is located on the left console of the front cockpit.</td>
<td></td>
</tr>
<tr>
<td>9. The FUEL BAL message will display in these instances.</td>
<td></td>
</tr>
<tr>
<td>10. The primary/main battery</td>
<td></td>
</tr>
<tr>
<td>Embedded Questions</td>
<td>Lesson Review Quiz Questions</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>1. D</td>
<td>6. D</td>
</tr>
<tr>
<td>2. C</td>
<td>7. C</td>
</tr>
<tr>
<td>3. FALSE</td>
<td>8. B</td>
</tr>
<tr>
<td>4. D</td>
<td>9. D</td>
</tr>
<tr>
<td>5. TRUE</td>
<td>10. B</td>
</tr>
<tr>
<td>6. FALSE</td>
<td></td>
</tr>
<tr>
<td>7. C</td>
<td></td>
</tr>
<tr>
<td>8. TRUE</td>
<td></td>
</tr>
<tr>
<td>9. C</td>
<td></td>
</tr>
<tr>
<td>10. A</td>
<td></td>
</tr>
<tr>
<td>11. D</td>
<td></td>
</tr>
<tr>
<td>12. C</td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX A  
#### STUDENT GUIDE

## SY0205 PROPULSION 2

### Embedded Questions

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>1.</td>
<td>FALSE</td>
</tr>
<tr>
<td>2.</td>
<td>D</td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>B</td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>D</td>
</tr>
<tr>
<td>7.</td>
<td>FALSE</td>
</tr>
<tr>
<td>8.</td>
<td>TRUE</td>
</tr>
<tr>
<td>9.</td>
<td></td>
</tr>
</tbody>
</table>

### Lesson Review Quiz Questions

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>D</td>
</tr>
<tr>
<td>2.</td>
<td>C</td>
</tr>
<tr>
<td>3.</td>
<td>C</td>
</tr>
<tr>
<td>4.</td>
<td>C</td>
</tr>
<tr>
<td>5.</td>
<td>B, C, and D are all correct for EICAS display</td>
</tr>
<tr>
<td>6.</td>
<td>B</td>
</tr>
<tr>
<td>7.</td>
<td>C</td>
</tr>
<tr>
<td>8.</td>
<td>FALSE</td>
</tr>
<tr>
<td>9.</td>
<td>D</td>
</tr>
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## SY0206 PROPULSION REVIEW

### Embedded Questions

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<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Air, fuel, and heat</td>
</tr>
<tr>
<td>2.</td>
<td>Execute the abort start procedure</td>
</tr>
<tr>
<td>3.</td>
<td>Hot, hung, no start</td>
</tr>
</tbody>
</table>

Version 0.3 January 15
4. High/rapidly rising ITT, lower N₁, lower N_p
5. Slow rising ITT, lower N₁, lower N_p
6. No ITT indication, lower N₁, no N_p indication, no torque indication
7. a. Initial indications: Loss of power and airspeed; rapid decay of N₁, torque, and ITT; MASTER WARN Lights and tone; propeller moves toward feather
   b. Accompanying indications: Rapidly decreasing ITT, N_p, lower than normal oil pressure; engine noise; GEN, FUEL PX, OIL PX, OBOGS FAIL messages; Possibly PMU FAIL and CKPT PX messages
8. Power step change, PMU FAIL messages, MASTER WARN light, aural tone
9. Rapid loss of power, high torque, lower N_p, possible PMU FAIL/PMU STATUS messages, engine vibration, engine noise
10. See smoke or flames, smell oil burning, hear unusual sounds, feel engine vibration or roughness

Lesson Review Questions

1. 550º C
2. Expanding gases
3. Fluctuating oil pressure, oil temperature or hydraulic pressure, Excessive turbine temperature, Visual indications (smoke), Erratic engine operation, Roughness or vibration
4. Accessory compartment, gas generation section, and power turbine section
5. Hot, hung, no start
6. Maintain operating limits, process power requests, control engine and propeller, provide near linear power response.
7. Regulate oil pressure to the pitch change mechanism
8. It is out of limits and in a warning range.
9. Fuel starvation, mechanical failure, compressor stall
10. 2950 psi
11. FEVER, FIRE message, MASTER WARNING light, aural tone
12. Feather dump, Loss of oil pressure, PIU failure, oil blockage
13. Air, Fuel, and Heat
14. High ITT; Fluctuating: oil temperature and pressure, hydraulic pressure

SY0207 ENVIRONMENTAL SYSTEMS 1

<table>
<thead>
<tr>
<th>Embedded Questions</th>
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<tbody>
<tr>
<td>1. C</td>
</tr>
<tr>
<td>2. Bleed Air Inflow Switch</td>
</tr>
<tr>
<td>3. Temperature Control Switch Knob</td>
</tr>
<tr>
<td>4. FALSE</td>
</tr>
<tr>
<td>5. A</td>
</tr>
<tr>
<td>6. B</td>
</tr>
<tr>
<td>7. A</td>
</tr>
<tr>
<td>8. B</td>
</tr>
<tr>
<td>9. false</td>
</tr>
</tbody>
</table>

Version 0.3 January 15
## Lesson Review Quiz Questions

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>D</td>
</tr>
<tr>
<td>2.</td>
<td>B</td>
</tr>
<tr>
<td>3.</td>
<td>RAM AIR FLOW Switch</td>
</tr>
<tr>
<td>4.</td>
<td>C</td>
</tr>
<tr>
<td>5.</td>
<td>EVAP BLWR Switch</td>
</tr>
<tr>
<td>6.</td>
<td>B</td>
</tr>
<tr>
<td>7.</td>
<td>D</td>
</tr>
<tr>
<td>8.</td>
<td>DUCT TEMP Annunciator</td>
</tr>
<tr>
<td>9.</td>
<td>A</td>
</tr>
<tr>
<td>10.</td>
<td>B</td>
</tr>
<tr>
<td>11.</td>
<td>A</td>
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</tbody>
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## SY0208 ENVIRONMENTAL SYSTEMS 2

### Embedded Questions

<p>| | |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A (limit should be 3.6 +/- 0.2)</td>
</tr>
<tr>
<td>2.</td>
<td>Click on graphic (pressurization switch DUMP position)</td>
</tr>
<tr>
<td>3.</td>
<td>C</td>
</tr>
<tr>
<td>4.</td>
<td>C</td>
</tr>
<tr>
<td>5.</td>
<td>B</td>
</tr>
<tr>
<td>6.</td>
<td>Click on graphic (oxygen regulator supply lever)</td>
</tr>
<tr>
<td>7.</td>
<td>C</td>
</tr>
<tr>
<td>8.</td>
<td>C</td>
</tr>
<tr>
<td>9.</td>
<td>FALSE</td>
</tr>
</tbody>
</table>

### Lesson Review Quiz Questions

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>1.</td>
<td>B</td>
</tr>
<tr>
<td>2.</td>
<td>A</td>
</tr>
<tr>
<td>3.</td>
<td>D</td>
</tr>
<tr>
<td>4.</td>
<td>A</td>
</tr>
<tr>
<td>5.</td>
<td>Click on graphic (oxygen regulator concentration lever MAX position)</td>
</tr>
<tr>
<td>6.</td>
<td>A</td>
</tr>
<tr>
<td>7.</td>
<td>Click on graphic (oxygen regulator pressure lever NORMAL position)</td>
</tr>
<tr>
<td>8.</td>
<td>C</td>
</tr>
<tr>
<td>9.</td>
<td>Click on graphic (OBOGS FAIL annunciator)</td>
</tr>
<tr>
<td>10.</td>
<td>B</td>
</tr>
<tr>
<td>11.</td>
<td>Click on graphic (anti-G test button)</td>
</tr>
</tbody>
</table>
SY0209 CANOPY SYSTEMS

Embedded Questions

1. B
2. Locking/latching system; sealing system; canopy fracturing system; defog and ventilation system
3. D
4. A
5. C
6. C
7. D
8. A
9. C
10. FALSE
11. A
12. B

Lesson Review Quiz Questions

1. A
2. C
3. D
4. B
5. D
6. D
7. C
8. D

SY0210 EJECTION SYSTEM

Embedded Questions

1. D
2. D
3. B (Connect lap belts to the torso harness mini Koch fittings)
4. C
5. B
6. B
7. C
8. D
9. D
10. D
11. A

Lesson Review Quiz Questions

1. C
2. B
3. B
4. D
5. B
6. D
7. D
8. B
9. C
10. B
11. D
12. A
13. A

SY0212 SYSTEMS REVIEW 3

EMBEDDED QUESTIONS

1. The RAM AIR FLOW switch on the Environmental Control Panel controls the position of the fresh air valve and thus the amount of air flow.
2. False. The AIR COND switch is located only in the front cockpit on the environmental control panel.
3. False. The defog valve is opened by placing the DEFOG switch in the ON position.

4. The front cockpit vent control lever adjusts the position of the cockpit selector valves to route warm air to either the foot warmers or the defog outlets.

5. True. The switch knob controls the position of the heat exchanger bypass valve which determines the temperature of air for both heating and defogging.

6. The safety valve will open to relieve excess cockpit pressure, regulating the pressure at 4.0 psi.

7. 18,069 feet

8. False. System pressure is supplied by the engine right side bleed air port.

9. The MAX position

10. Approximately 10 minutes

11. The seal is automatically inflated when bleed air inflow is available and weight is off the right main landing gear.

12. False. The CFS requires no electricity to function.

13. 35,000 feet and 370 KIAS

14. Use the manual override (MOR) handle on the right side of the seat bucket.

15. Cockpit pressure exceeding 3.9 to 4.0 psi, indicating a problem in the pressurization outflow system

16. Delta P less than 3.9

17. A flashing MASTER WARN switch light on the instrument panel.

**LESSON REVIEW QUESTIONS**

1. Left and right engine compressor P₃ ports

2. False. Only the forward windscreen and front cockpit transparency are protected.

3. Approximately 4 seconds after seat/pilot separation

4. False. Air conditioning depends on an engine-driven compressor which only operates when the: Engine is running; generator is on-line; AIR COND or DEFOG switch is ON

5. The DEFOG switch opens the bi-level flow control bypass valve.

6. DUCT TEMP message

7. Emergency oxygen is automatically activated during ejection.

8. OBOGS is an on-board generating system and its duration is unlimited.

9. False. It indicates a cockpit pressure altitude of 19,000 feet or higher, usually due to loss of cockpit pressurization.

10. On the glareshield.

11. Only the activating seat will eject.

12. False. The anti-G system only activates during positive-G maneuvers.