310REDUX
USER GUIDE

MILVIZ

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Hello there!

Welcome to the ranks of 310R pilots.

This User Guide has been prepared to help you get started with your new 310R.

It contains useful information about your 310R's equipment, operating procedures, and performance. It also contains instructions for installation and updating. We recommend that you take some time to read through this guide from cover to cover, and to refer to it as needed.

Our interest in your flying pleasure has not ceased with your purchase of the MilViz 310R Redux. Worldwide, the Military Visualizations staff stands ready to assist and serve. For technical support, please post a request on our 310R Redux support forum. Our dedicated and talented staff is ready to help you.

For forum access please email oisin@milviz.com with your proof of purchase and your preferred or existing forum username.

This aircraft has a history.

This isn't the first version of the venerable 310R to wear the MilViz label. The original version of the MilViz 310R was released way back in 2010 to widespread acclaim, lauded not only for it's accurate portrayal of the iconic twin but also for the carefully tuned and highly realistic flight model.

This new version is a complete overhaul of the original, with enhanced and updated systems programming, an updated virtual cockpit, new external textures, and a brand new soundset. In other words, pretty much everything required in order to bring this aircraft up to current standards.

But we haven't forgotten what made the original great, either. Expect the same attention to detail, the same quality workmanship, and the same carefully replicated handling characteristics that made the original release so lively and lifelike.

Get the most from this guide.

This User Guide is split into several sections. The first section deals with installation and configuration of the 310R, while the second section provides an overview of the operation of the aircraft within the simulator.

The third section covers aircraft specifications and limitations. The fourth section details emergency procedures, the fifth normal operating procedures, and the sixth and final section provides a wealth of performance charts.

To navigate this manual, helpful features have been included. In the index, all section titles are live bookmarks that will jump to the appropriate page with a single click. In your PDF viewer, you are also able to browse the sections by use of the bookmarks panel.

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Section 1
Installation & Configuration

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Introduction

Section 1 of this user guide covers the information needed for successful installation. It also covers operation of our included MVAMS utlility, as well as recommended realism settings, mouse operation, and instructions for accessing support.

System Requirements

The following requirements apply as a minimum to successfully install, configure and operate the MilViz 310R.

(Please note that your choice of scenery, location, simulator settings and 3rd party utilities may place additional demands on your simulation platform and may affect your simulator experience.)

Supported Platforms:

- Microsoft Flight Simulator X, Service Pack 2(SP2)

(Note: Service Pack 2 is required, aircraft may not function correctly with Service Pack 1 or earlier. The Acceleration expansion pack is fully supported but not required.)

- Microsoft Flight Simulator X, Steam Edition
- Lockheed Martin Prepar3D, version 2
- Lockheed Martin Prepar3D, version 3
- Lockheed Martin Prepar3D, version 4

(Note: Our product is tested with and designed to operate in the most recent updates to Prepar3D; this includes all hotfixes available at date of release. For compatibility with any future updates and hotfixes, please register for and visit our product forums. Compatibility with future versions of Prepar3D is not implied nor included.)

Supported Operating Systems:

- Windows Vista
- Windows 7
- Windows 10

Processor (CPU):

- 2.4 GHz single core processor required (3.0 GHz, multiple core processor or better recommended).

Video Card (GPU):

- DirectX 11 compliant video card with a minimum of 1024 MB video ram.

System Memory (RAM):

- 4 GB RAM (minimum).

Hard Drive:

- 2.5 GB or greater free hard drive space.

Gaming Controller:

- Joystick, yoke, or other gaming controller (a means of controlling the aircraft rudder, either with twist joystick function or dedicated pedals, is additionally recommended).

(Note: All MilViz products require a minimum of one functioning gaming device such as a joystick for proper operation and control.)

Installation Instructions

Important Information

As with other flight simulator add-ons, pre-installation precautions should involve closing any open applications, as well as temporarily disabling any active antivirus software.

Failure to temporarily disable antivirus software when installing may result in a non-functioning product and/or simulator!!!

Note: *Version numbers shown in any following images may differ from the downloaded product.*

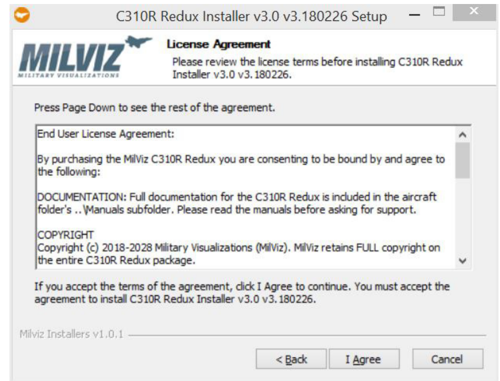
After purchase, you will have been given a link or an option to download a compressed (.zip) file. This compressed file contains an executable (.exe) file, which is the installer for the MilViz 310R Redux.

Using the Windows File Explorer or file compression utility of your choice, unzip this file to a location of your choosing.

Once unzipped, you may begin installation by right clicking on the executable (.exe) file, then selecting "Run as administrator". The installer will run, showing an initial welcome screen. Left click on the "Next" button to continue.

Licence Agreement

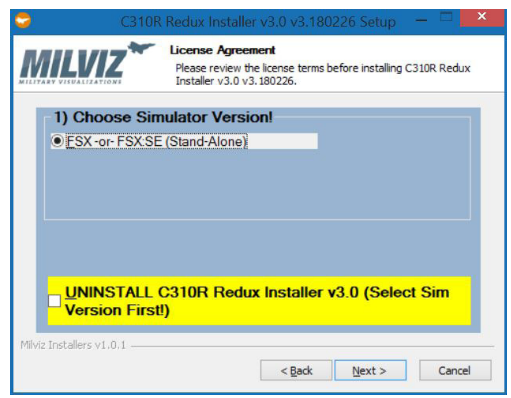
1



This screen will allow you to view the end user license agreement. Please take the time to review the included details. Clicking "I Agree" at this screen will confirm your acceptance of the license agreement, and will allow you to proceed to the next step of the installation.

Choose Simulator Version

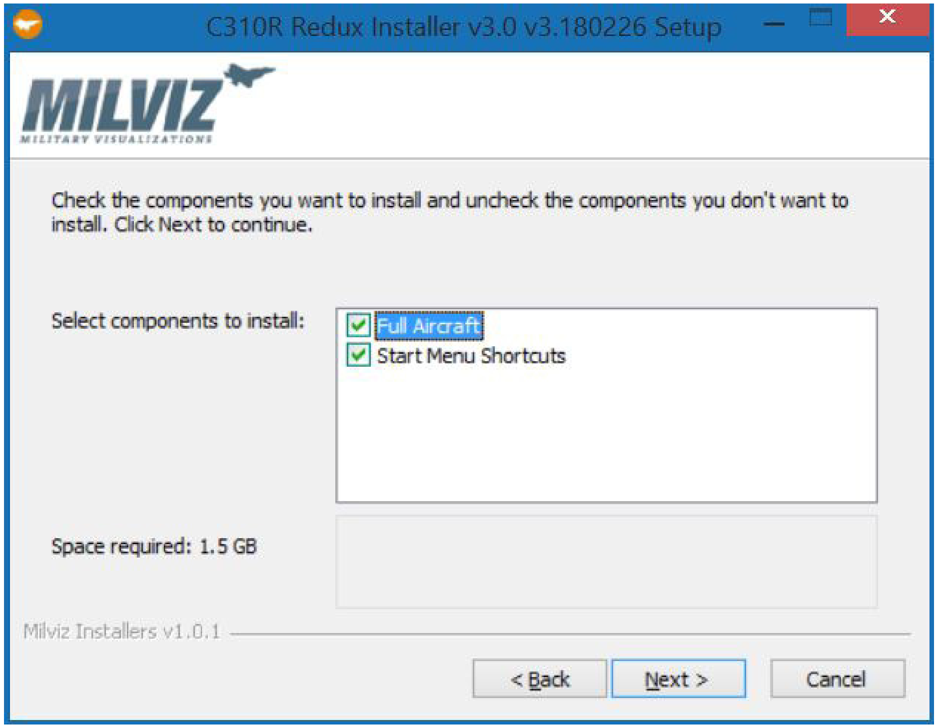
2



The installer will automatically find all compatible simulator platforms on your system. Only compatible simulators will be displayed as options. (For example, the system in the screenshot only has FSX installed.) Please note that you will be unable to select multiple simulators at once; to install into multiple simulators, re-run the installer for each platform you wish to install to.

Component Selection

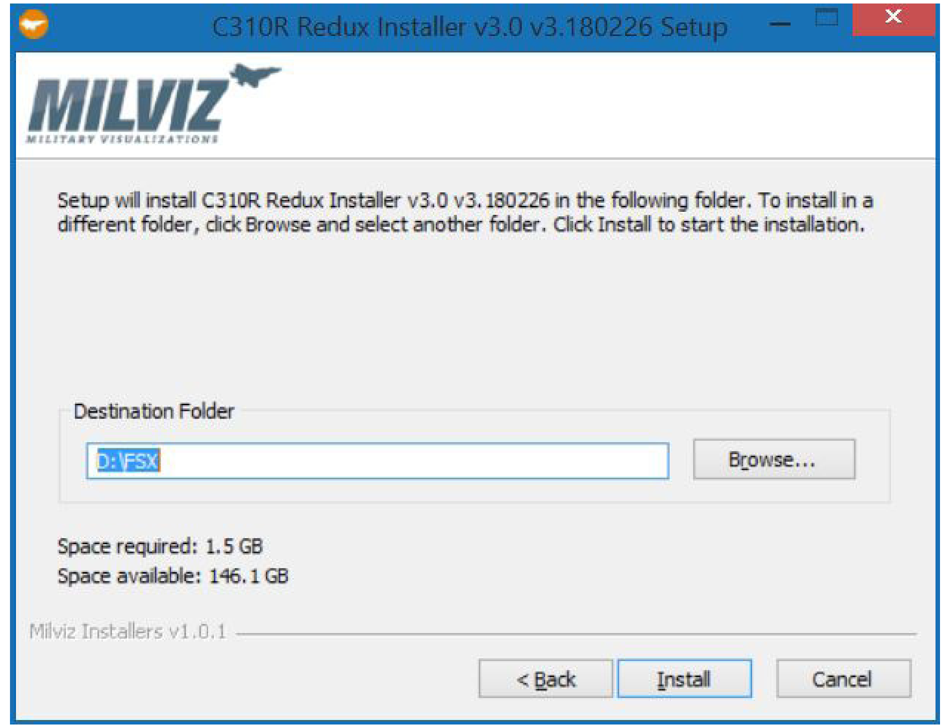
3



The various components that make up the installation may selected or deselected at this screen, though we really don't recommend deselecting any preselected components.

Install Location

4



The next screen shown will display the location where the MilViz 310R Redux will be installed.

This will be pre-filled out with the location of the simulator chosen in Step 2. If you wish to change the location where the 310R is to be installed, you may do so by left clicking the "Browse" button and selecting a different folder.

Post Installation Tasks

- Be sure to turn your antivirus program back to it's previous state. Also ensure to make sure that your FSX or P3D directory is off-limits to any automatic antivirus scanning. Failure to do this may result in a non-functioning simulator!
- It may be worthwhile to back-up or save a copy of your downloaded installer. It's worth noting that as new updates are released, we do not continue to offer older versions for download.

Updating your 310R

The MilViz 310R Redux is updated by one of two methods, with minor update notifications delivered through the MVAMS application, and major update notification being provided by your vendor.

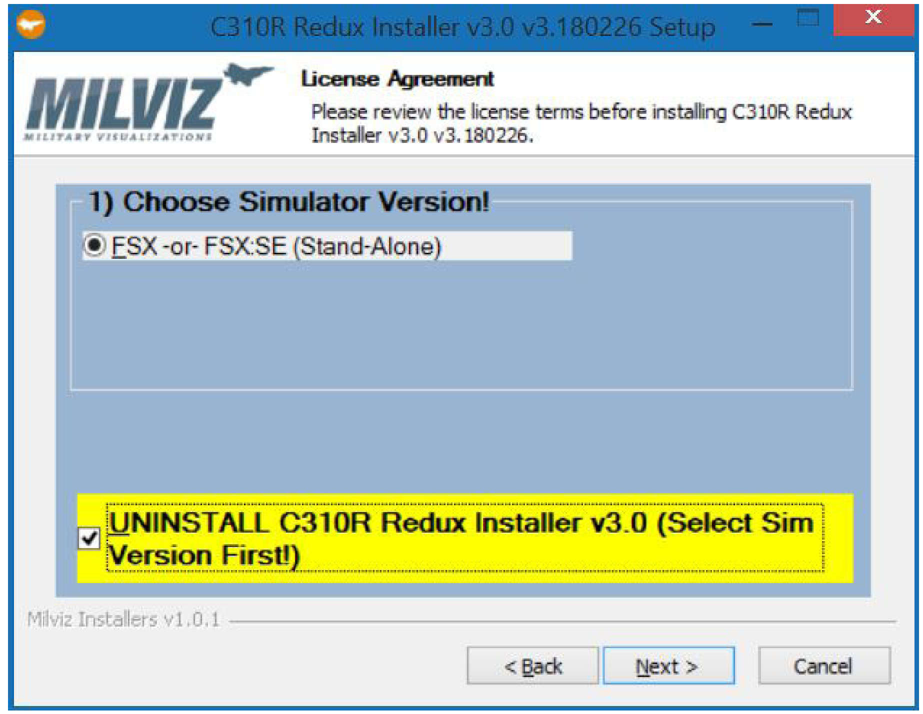
To check for a minor update, open the MVAMS application via the MVAMS icon which has been placed on your desktop. If you do not see it, the MVAMS application is installed to 'C:\Users\(username)\AppData\Local\MVAMS'.

If a minor update for the 310R is available, a notification will appear here. Click yes to begin the update process, which largely mirrors the install process.

Major updates are beyond the scope of the MVAMS application, however, and require a new version of the aircraft to be downloaded and installed. Be sure to uninstall the previous version first, backing up any custom files or liveries prior to doing so.

Uninstalling

5



The MilViz 310R Redux may be uninstalled from a single simulator at a time by re-running the installer.

Once the installer opens, you may select the simulator you wish to uninstall from, then select the checkbox which is highlighted in a nice subdued yellow color and reads "UNINSTALL". Left click on the "Next" button to proceed with uninstalling the aircraft.

Note: Prior to uninstalling the aircraft, please be sure to back up any customized files or custom liveries you have installed.

MVAMS Overview & Operation

MVAMS stands for MilViz Addon Management System. It is a standalone application used by many of our product releases which represents our user-friendly solution to the growing complexity of options and choices available within our aircraft. It provides a central location to manage your aircraft, as well as providing incremental update capabilities.

The MilViz 310R Redux installs (if not already present) and fully integrates with the MVAMS application, allowing the user to choose between differing avionics options and start-up state.

Starting MVAMS

If this is your first MilViz product that includes the MVAMS application, running the aircraft installer will place a shortcut icon on your desktop. If this is not your first MVAMS equipped MilViz product, the shortcut icon may already exist on your desktop.

You may use this icon to open the MVAMS application to configure your MilViz 310R Redux to your liking. Immediately after your installation is complete, the MVAMS application will also open automatically.

Selecting Your Aircraft

When you open the MVAMS application, you are presented with the instruction to select an addon from the Quick Access menu. Clicking on the top left icon will bring up visual icons of any your installed MilViz addons which are integrated with the MVAMS application. Your newly installed 310R Redux will now be one of the available selections.

Configuring Avionics

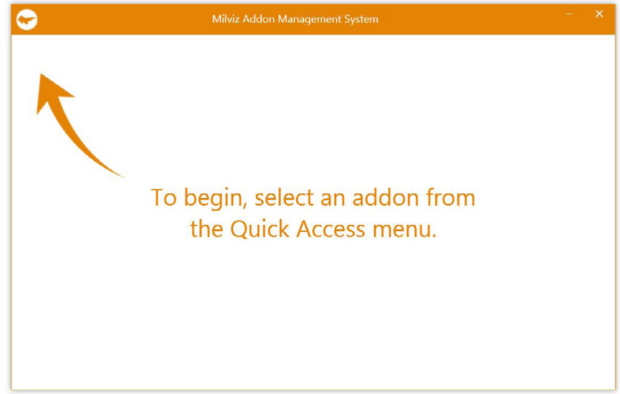
The MilViz 310R Redux has some of the most comprehensive support for third party avionics in the 3D virtual cockpit that we've ever featured. At the time of release, we support configurations that include the Flight1 GNS 430 & 530, the Flight1 GTN 750 and 650, the RXP 430 & 530, the NavStax Bendix Radio Stack, and the REX/MilViz WX Advantage Weather Radar.

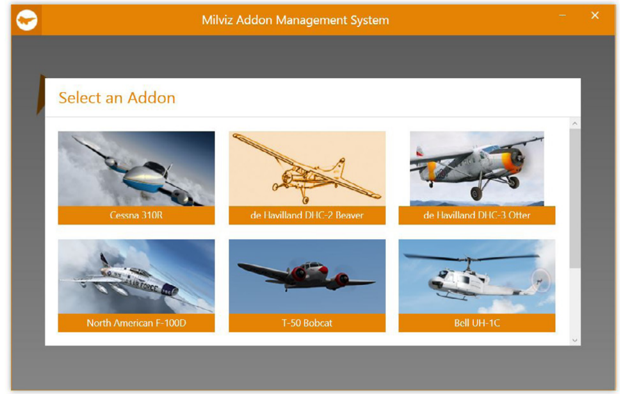
To change between panel configurations, simply select the desired choice from the dropdown selection box and click the button 'Save Defaults'. (Note: If your simulator with this aircraft is active while you access this menu, you will need to reload your aircraft before you will see any change.)

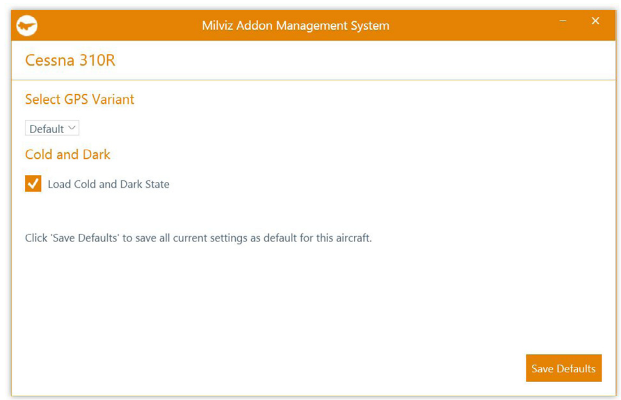
It's important to note that while the REX/MilViz WX Advantage Weather Radar is included with the 310R Redux, it is a product-locked version that will only function with the 310R. All other third party gauges referenced are not included with the 310R Redux and must be purchased separately from their respective publishers.

Loading Cold and Dark

To have the 310R Redux load in the simulator forced to a 'cold n' dark' state, select the checkbox titled with this option. Click the button click the button 'Save Defaults' to see this option reflected in the simulator when the aircraft is first loaded.







Realism Settings

The MilViz 310R Redux has been designed with the goal of replicating a high level of accuracy in regards to operation and flight response. To this end, development and testing have both been carried out using the highest realism settings available within the simulator.

The realism settings within both Flight Simulator X and Prepar3D exist in order to make simulated flying less of a chore, to remove some of the tasks which are necessary in real life to ensure a safe and proper flight. We fully encourage the use of many of these settings, if they help provide anyone with greater enjoyment of flight simulation.

In consideration of the above, our recommended settings exist not as a strict guideline, but as a means to ensure that the full level of accuracy available within our 310R Redux may be experienced if desired. Without these recommended settings in place, particularly in regards to the section which controls the flight model, the aircraft may not perform as intended.

Realism Settings Overview

Flight Model

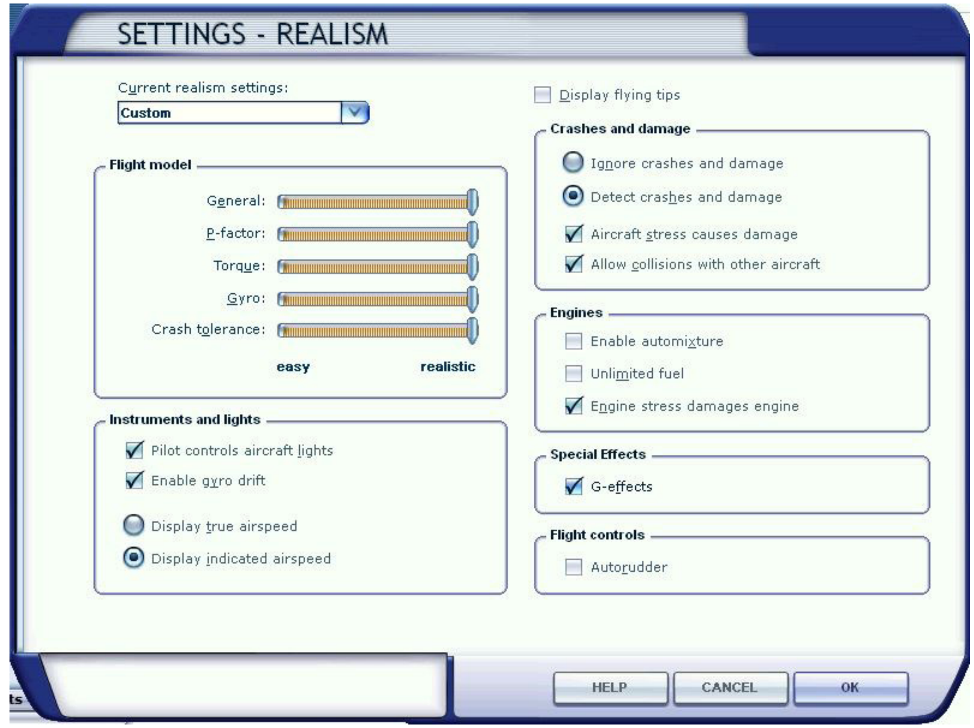
For the highest degree of realism, all sliders in the flight model section should be set fully to the right. Any movement to the left might cause the aircraft to become easier to fly at the expense of accuracy in regards to the intended flight model.

Instruments and Lights

The MilViz 310R Redux has a sophisticated lighting system in place, so the "Pilot controls aircraft lights" should be checked. "Enable gyro drift" and "Display indicated airspeed" add to the realistic operation of any aircraft within the simulator, but may be left to user preference.

Crashes and Damage

The choices in this section may be left to user preference.



Suggested Realism Settings - FSX

Engines

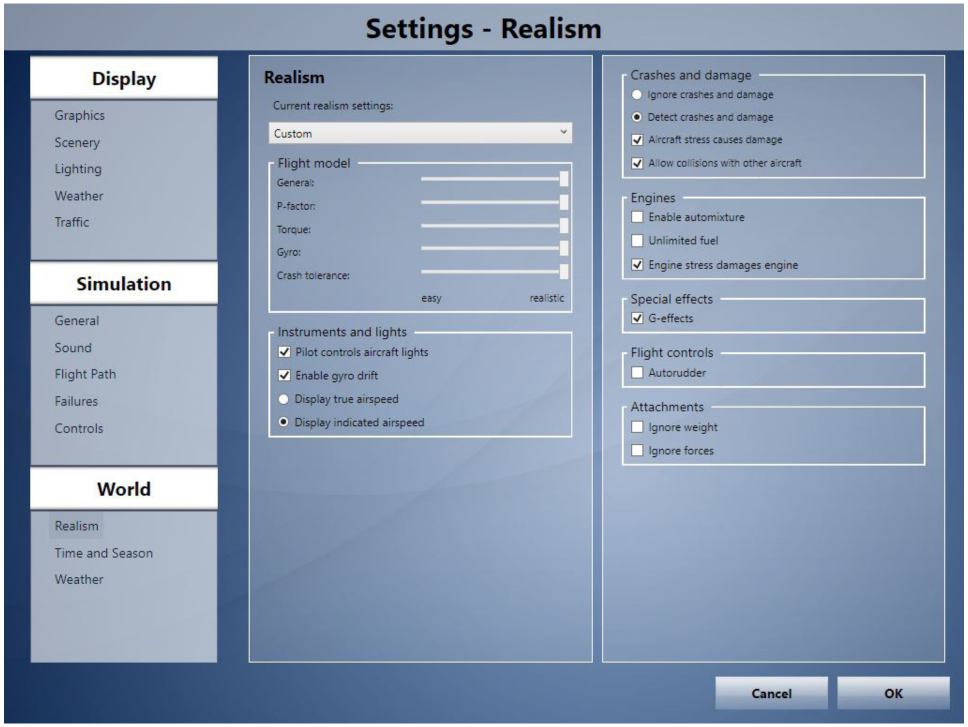
"Enable automixture" should not be selected in order to allow for functionality of the mixture lever. "Unlimited fuel" may be left to user preference, but disabling does allow for simulating fuel management. "Engine stress damages engine" may be left to user preference as well, but being present does introduce a certain amount of risk for engine mismanagement (simulator default, FSX Acceleration & Prepar3D only).

Special Effects

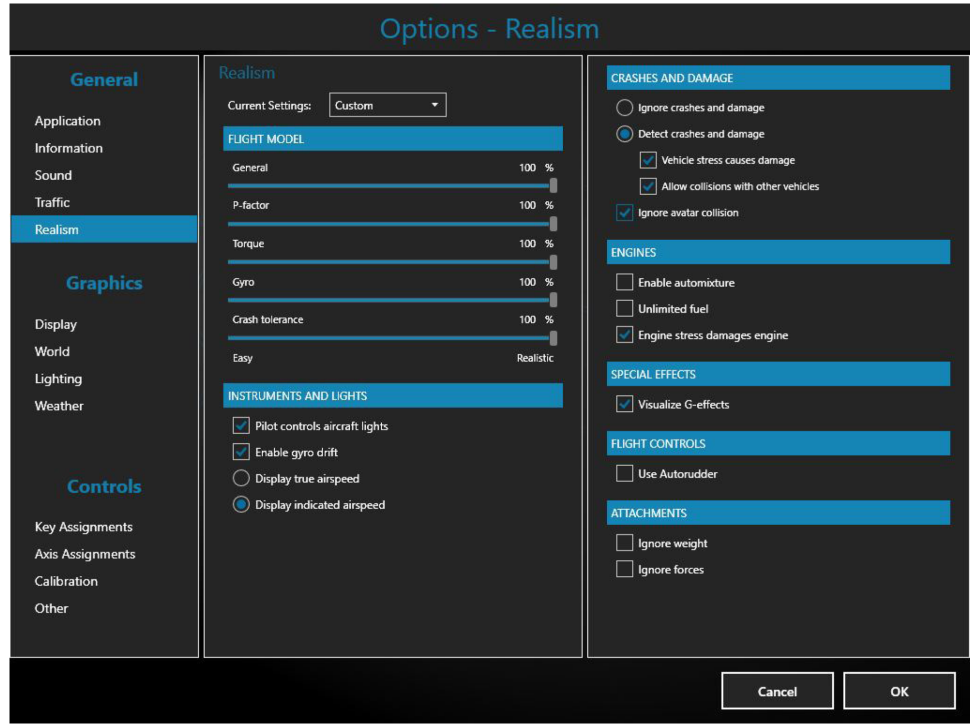
This may be left to user preference.

Flight Controls

"Autorudder" should be off so long as you have means to operate the aircraft rudder via rudder pedals or a twist axis on your joystick.



Suggested Realism Settings - Prepar3D Version 3.x



Suggested Realism Settings - Prepar3D Version 4.x

In-Game Configuration

There are no aircraft-specific configuration settings that directly affect the aircraft while loaded in the simulator for the 310R Redux, but there may be menu items for the third party avionics installed in the 310R, if such are installed and that particular panel is loaded through the MVAMS application.

Mouse Operation

As per typical convention, all controls in the MilViz 310R Redux can generally be operated by using the right or left mouse buttons, or in the case of levers, by holding a mouse button and dragging the control. In some cases, the mouse wheel may also be used for operating switches or controls.

Product Support

We are deeply committed to the satisfaction of our customers. If you encounter any issues with any of our products, require installation assistance, or just have a general question, we encourage you to visit our forums at http://milviz.com/forum/.

Support forums for our individual products are restricted to owners of that product. To register for a specific support forum, please contact oisin@milviz.com for registration information and details. Please note that proof of purchase will be required.

Section 2
Operating the MilViz 310R

Table of Contents

Introduction

Section 2 of this user guide covers the basics of operating the systems and controls of the MilViz 310R Redux within the simulator environment.

This section will make frequent reference to the use of the left and right mouse buttons and wheel as a means of interacting with the various controls in the 310R. In all cases, for the function to work as described, the pilot must first hover the mouse pointer over the associated system or switch.

Cabin Overview

The 310R cabin is a rather easy place in which to find your way around. For a twin, the controls are well laid out and not overly complex. This makes the 310R an ideal airplane both for those who desire a relaxing flight in an elegant aircraft, or for those learning the ins and outs of flying a twin.

The MilViz 310R is equipped with dual flight controls and is flyable from either the pilot's or the co-pilot's position. However, the left hand yoke does feature additional controls for the autopilot which the right hand yoke does not have. In addition, the majority of the traditional flight instruments are located on the left hand panel in front of the pilot.

Sweeping from left to right through the 310R cabin:

The electrical and circuit panel is located on the left side of the cabin, beside the pilot's seat. This contains the avionics master switch, exterior and interior lighting controls, as well as the deicing switches. (The circuit breakers are non-operable).

Next is the flight instrument panel, located in the upper left panel, above the yoke. It contains the following instruments: Airspeed Indicator, Artificial Horizon, Altimeter, Turn and Bank Indicator, Horizontal Situation Indicator (HSI), and the Vertical Speed Indicator. Located below the Vertical Speed Indicator to the right of the yoke shaft is an ADF Indicator, while on the left of the yoke shaft is a pair of EDM-700 engine temperature gauges. Above the EDM-700 gauges is a DME Indicator.

At the bottom of the left side front panel, directly under the yoke, is the lower electrical switch panel.

MILVIZ 310R CABIN LAYOUT

This panel contains, from left to right, the Auxiliary Fuel Pump Switches, the Left Engine Start Button, the Engine Primer Switch, the Right Engine Start Button, the Left Alternator Switch, the Master Battery Switch, the Right Alternator Switch, followed by the magneto switches for both engines.

The upper center panel area contains the communication and navigation equipment, as determined by the options the user has set in their configuration.

The lower center panel, immediately above the pedestal, contains the Landing Gear Switch and Landing Gear Indication Lights, the ammeter, and the Flap Switch and Indicator.

The center pedestal is topped by the Throttle Quadrant, with dual Throttle, Propeller, and Mixture levers to control the left and right engines independently. Bottom aft on the pedestal are the trim wheels for roll and yaw control, while the Elevator Trim Wheel and Indicator is located on the left side. At the bottom center of the pedestal are the Cowl Flap Controls.

At the base of the pedestal is the dual fuel selectors that allow detailed control of the fuel flow in the 310R.

The front right hand panel holds the primary engine instruments, including the Manifold Pressure Gauge, the dual gauges that display Oil Pressure, Oil Temperature, and Cylinder Head Temperature, the Tachometer, the EGT Gauge, the Suction Gauge, and the OAT Gauge. Also included on this panel are the Fuel Flow and Fuel Quantity Gauges, as well as a backup Altimeter and a clock.

The Cabin Air Controls are located to the right of the pedestal, underneath the front right hand panel.

Pilot's Side Switch Panel

1 The Avionics Master Switch is a two position switch for ON (up)/OFF (down) operation, providing power to the avionics bus. It is normally only turned on once one alternator is online and providing full electrical output. The switch is toggled with the LEFT MOUSE BUTTON.

2 The Surface and Propeller De-Icing Switches should be used when there exists the risk of flight into icing conditions within the simulator. Although the simulator does not provide visible ice accumulation, it will negatively effect flight characteristics. A two position switch for ON (up)/OFF (down) operation, the switch is toggled with the LEFT MOUSE BUTTON.

3 There are five exterior light switches: Anti-Collision, Strobe, Navigation, Taxi, and Landing Lights. With the exception of the Landing Lights, these are all two position switches for ON (up)/OFF (down) operation, toggled with the LEFT MOUSE BUTTON. The Landing Lights switch is a three position switch, toggled upwards with the LEFT MOUSE BUTTON and downwards with the RIGHT MOUSE BUTTON, through down (retracted), middle (extended) and up (lights on).

4 Interior lighting is controlled by the rheostat knobs located to the right of the exterior light switches. The right-most knob, labeled SW PNL, activates the instrument panel backlight illumination and is continuously adjustable from OFF to fully bright. The RADIO knob controls the avionics backlighting.

Pilot's Lower Switch Panel

1 Located in the center of this panel, the Master Battery Switch, flanked by the Left and Right Alternator Switches, supplies essential power to all aircraft systems and must be engaged before successful operation of any of the other lower panel operations.

The Left and Right Alternator Switches allow for the alternators to be connected into the power bus. These are turned on once the engine is sucessfully running.

All three switches are two position switches for ON (up)/OFF (down) operation, toggled with the LEFT MOUSE BUTTON.

2 The four Magneto Switches, located on the right side of this panel and protected from unintended operation by a steel guard bar, allow for power to be fed to the spark plugs. The left and right engines each feature a Left and Right Magneto Switch.

All four switches are two position switches for ON (up)/OFF (down) operation, toggled with the LEFT MOUSE BUTTON.

3 The two Auxiliary Fuel Pump Switches on the left side of this panel are both three position switches, toggled upwards with the LEFT MOUSE BUTTON and downwards with the RIGHT MOUSE BUTTON, through down (LOW), middle (OFF) and up (HIGH).

Lower pump power is normally used for engine starts, taxi, takeoffs and landings, and flight operations above 12,000 feet to prevent vapor lock. The high power pumps are used for hot starting to purge fuel vapors and during any fuel-related emergency situations to ensure positive flow to the engines.

4 The Left and Right Starter Buttons are found in the middle-left of the panel, as is the Engine Primer Switch, located in-between the two buttons.

Starting the engine normally requires the use of fuel priming. The primer switch is a three position momentary switch that is spring loaded to the center (OFF) position. To prime the left engine, click and hold the switch with the LEFT MOUSE BUTTON. To prime the right engine, click and hold the switch with the RIGHT MOUSE BUTTON.

The starter buttons are momentary switches that are activated by clicking and holding the LEFT MOUSE BUTTON.

Amperage / Voltage Indicator

The 310R features a comprehensive electrical indicator and test system. The rotary switch to the left of the indicator allows the pilot to isolate and test the power draw for either alternator system as well as for the battery. The pilot can also measure the total voltage draw from all engaged power sources.

To rotate the switch clockwise, click the RIGHT MOUSE BUTTON. To rotate the switch counter-clockwise, click the LEFT MOUSE BUTTON.

When rating the amperage draws for the alternators and battery, reference the top white section of the meter. When measuring the voltage draw, reference the bottom blue section of the meter.

In addition to the rotary switch and indicator, the system also has two warning lamps which illuminate when the aircraft detects alternator failure or inadequate alternator power generation. These lights can sometimes illuminate when the engine is idling at an RPM insufficient to provide optimal alternator power output.

With the left alternator switch disengaged, you can reference the left alternator failure light to confirm it is not supplying system power. The same relationship exists for the right alternator switch and light. If during flight operations with the alternator switches engaged, and an alternator light illuminates, you should assume that alternator has failed and troubleshoot with the wafer switch to isolate and measure that alternator's power output.

Artificial Horizon / Attitude Indicator

Featured in the 310R on the center top of the flight instrument panel is the Artificial Horizon, or Attitude Indicator.

This instrument informs the pilot of the orientation of the aircraft relative to Earth's horizon. Indicating both pitch (fore and aft tilt) and bank (side to side tilt), it is a primary instrument for flight in instrument meteorological conditions (IMC).

The Artificial Horizon in the 310R is gyroscopically stabilized by a vacuum system driven by either engine.

The instrument features a fixed yellow waterline which can be adjusted up or down manually by the pilot using the knob located at the bottom of the instrument. The "card" behind the waterline pivots and rotates in concert with the aircraft's pitch and roll movements.

The card features pitch indicators marked in five degree increments with the ten and twenty degree marks being wider and labeled.

Indications of bank are shown by the yellow arrow at the top of the instrument. The semicircular scale at the top of the instrument is graduated in ten degree marks to the thirty degree bank indication, and then marked by single marks for 45 and 60 degrees.

When the Artificial Horizon detects insufficient vacuum pressure to operate the gyroscope, it displays a red flag to alert the pilot that the instrument is unreliable.

To set the waterline on the Artificial Horizon, the pilot should use the rotate the knob to manually adjust the waterline so as to lie flush with the white horizon line that separates the blue and the brown sections of the card.

This should be done in stable level flight, under visual meteorological conditions (VMC), with reference to the actual horizon.

Horizontal Situation Indicator (HSI)

The Horizontal Situation Indicator (HSI) in the 310R, located in the flight instrument panel directly below the Artificial Horizon, provides a comprehensive display including course, localizer, and glideslope information referenced from either the number one (NAV 1) or number two (NAV 2) navigational systems.

The toggle switch located immediately below the HSI allows the pilot to select which navigation system is supplying input to the HSI. This two position switch is toggled with the LEFT MOUSE BUTTON.

On the HSI, the current aircraft heading is shown on the rotating compass card underneath the upper lubber line, which is stationary. The course indicating arrowhead can be set to the desired course using the course input knob located on the lower left side of the HSI, using either the LEFT or RIGHT MOUSE BUTTON or the MOUSE WHEEL to rotate the course indicating arrowhead clockwise or counter-clockwise. The tail of the course indicating arrow shows the reciprocal of the currently set course.

The course deviation bar operates with a VOR/LOC navigation receiver to indicate either left or right deviations from the selected course. On an instrument approach, the course bar will also indicate deviation left and right, but will switch to a more sensitive mode of operation, showing twice the amount of deflection for a given course distance error.

The TO/FROM indicator is a triangular-shaped pointer. When this indicator points to the head of the course arrow, it indicates that the course selected, if properly intercepted and flown, will take the aircraft TO the selected facility, and vice versa.

When flying a precision approach with operating glideslope information, the glide slope deviation pointer indicates the relationship of the aircraft to the glide slope. When the pointer is below the center position, the aircraft is above the glide slope, and an increased rate of descent is required.

The heading indicator on the HSI is slaved to the standby magnetic compass and is interconnected with the autopilot which is capable of following the heading select bug when engaged in Heading Mode. Please refer to the included standalone documentation for operation of the autopilot included in the 310R.

To adjust the heading bug, use the heading input knob located on the lower right of the HSI, using either the LEFT or RIGHT MOUSE BUTTON or the MOUSE WHEEL to rotate the heading bug clockwise or counter-clockwise. To sync the heading bug with the current aircraft heading, click the heading input knob with the MOUSE WHEEL BUTTON.

When the Heading Mode is engaged on the autopilot and the heading bug does not match the aircraft heading, or if Heading Mode is already engaged on the autopilot and the heading bug is rotated away from the current heading, the aircraft will steer in the direction of the heading bug, selecting a left or right turn depending on which is the shortest turn to the heading indicated by the bug.

The HSI in the 310R includes two red warning flags which alert the pilot when an unreliable navigational or heading input signal is encountered, or when aircraft power is not sufficient to operate the HSI.

Important: When the 310R is outfitted with GPS navigational equipment, only NAV 1 is capable of receiving a GPS navigational input. This is due to a limitation within the simulator. NAV 2 may be used in conjunction with a GPS as well, but the device must be set to VLOC in order for the HSI to properly display the navigational information.

Autopilot

New to the Redux version, the MilViz 310R features an in-depth, custom coded autopilot that over-comes much of the limitations involved with the default unit.

Inspired by a very common real world unit, func-tionality is nearly a perfect match, allowing us to present an even higher fidelity experience then what was previously possible.

It is beyond the scope of this user guide to go into full detail regarding use; as such, a separate man-ual for the autopilot has been included with your 310R.

We encourage our pilots to read that document completely in order to gain understanding about the proper use of this equipment.

CWS, Pitch Trim & A/P Disconnect

The autopilot installed in the 310R integrates a few extra features that are specific to this particular implementation.

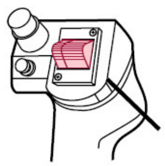
Control Wheel Steering (CWS) is installed into the 310R and controlled via a button toggle located on the left grip of the left hand yoke. The button is a momentary switch that toggles CWS on or off via clicking the LEFT MOUSE BUTTON.

The Control Wheel Steering function is also linked to the Tail Hook (up/down) command in the simu-lator, allowing it to be assigned to a joystick / yoke button or a key command.

With CWS engaged, the pilot is able to change the airplane heading directly though rotation of the yoke while the autopilot is engaged, with the air-plane holding the new heading when the yoke is released.

A Pitch Trim switch is also located on the same side of the left hand yoke; this is a three position mo-mentary switch that is spring loaded to the middle position. To apply negative (nose down) pitch, click the switch with the RIGHT MOUSE BUTTON; to ap-ply positive (nose up) pitch, click the switch with the LEFT MOUSE BUTTON.

Also located on the same side on the left hand yoke as the previous two controls is the Autopilot Disconnect button. This button is a momentary switch that disconnects the autopilot, and may be used by clicking it with the LEFT MOUSE BUTTON.



Engine Instrumentation

The Manifold Pressure (MP) gauge features independently operating needles for the left and right engines and displays the amount of air pressure that each engine is sucking through the throttle manifold aft of the venturi. When the engines are shut down, the MP displayed is equal to the outside air pressure. When the engines are running, then the MP value displayed is affected by the movement of the throttles which open and close the throttle wastegates.

When the throttles are fully closed, the wastegate is rotated to its maximum closed position, which reduces the amount of air that the engine can suck. When the throttle is fully opened, the wastegate is likewise fully opened, and the engine can suck air equal to the outside air pressure. Since this 310R is not turbocharged, the manifold pressure will reduce as the airplane climbs even if the throttles are fully opened. Manifold pressures over the normal range (25.5 inches) should only be demanded during takeoff and reduced to the normal range as soon as practical.

The Tachometer (RPM) gauge also features independently operating needles for each engine. The MilViz 310R features constant speed propellers. Therefore, the RPM can be adjusted by the pilot using the associated propeller condition levers located on the throttle quadrant. Full RPM is reached by the pilot moving the prop condition levers fully forward. The propeller hub contains a governor which should not allow the RPM to exceed 2700.

RPM's above the top of the normal range (2500) should only be allowed during takeoff and landing operations. Also, the pilot must be careful not to allow a combination of high manifold pressure and low RPM's as this combination could potentially lead to catastrophic failures.

During cruise operations, the pilot should ensure that the RPM is kept in the normal operating range (the green arc) by moving the associated prop condition levers.

Each engine has its associated Cylinder Head Temperature (CHT) and Oil Temperature / Pressure Instruments. During all phases of engine operation, these instruments should be referenced to ensure no abnormal engine conditions are allowed.

During engine start, the pilot should immediately reference the oil pressure gauge to ensure proper flow of oil through the engine. If no increase to the normal range is seen immediately after start, the engine should be shut down as soon as possible to avoid possible seizure.

In addition, during the propeller feather checks on the ground, the pilot should observe a drop in oil pressure and temperature when he moves the associated prop condition lever aft. This ensures that the oil is flowing through the propeller governor.

The Exhaust Gas Temperature (EGT) gauge measures the temperature of the exhaust gases immediately after fuel burn in the ignition phase of engine operations. The gauge features independent indications for each engine. As EGT increases, the associated needle will rise to indicate that engine's exhaust gas temperature.

During cruise operations, the pilot should lean out the fuel mixture to maintain an optimal ratio of fuel to air. EGT can be referenced to ensure this optimal mixture setting is maintained.

During climbs, the pilot will need to lean the fuel mixture by moving the associated fuel mixture lever on the throttle quadrant aft. During descents, as the air pressure increases, fuel will need to be enriched by moving the mixture lever forward. The asterisks located on the EGT gauge can be referenced to help determine optimal fuel mixture.

The Fuel Flow gauge uses independently operating needles for each engine to allow the pilot to easily match the fuel flows to each engine. The outer scale is calibrated from a minimum value of 2.5 PSI to a maximum value of 21.7 PSi. In between these two PSI limits, the outer scale is calibrated in fuel flow in pounds per hour.

The inner scale is calibrated to assist the pilot in setting fuel flows consistent with certain phases of flight. For example, during normal takeoff at airports below 3,000 feet field elevation, the pilot should set a fully rich mixture as indicated by the small white section of the inner scale. The bottom half of the inner scale is in blue and used for takeoffs and climbs as a reference to keep fuel flows high enough to help keep the cylinder head temperatures in normal range (unburned fuel acts as a coolant). During cruise, the pilot can set the fuel mixture levers to obtain a flow reading in the green upper section of the inner scale.

The Vacuum Pressure or Suction gauge allows the pilot to measure the amount of air pressure that the engine vacuum pumps are sucking. This vacuum pressure rotates the vanes of all the air driven gyroscopes that stabilize such instruments as the artificial horizon and HSI.

During the engine ground run, and periodically during flight, the pilot should reference this gauge to determine is he is experiencing possible vacuum failure on these critical flight instruments.

The vacuum pump on either engine is capable of supplying enough vacuum pressure to supply the demands of all air driven instruments.

EDM 700 Digital Engine Temperature Gauge

The MilViz 310R is equipped with a pair of Digital Engine Temperature gauges. These gauges, located on the left front panel to the bottom left of the flight instrument panel, are an advanced gauge which display a bar graph of Exhaust Gas Temperature (EGT) for each of the six cylinders, the "T" average Exhaust Gas Temperature and a bar graph of the Oil Pressure. At the bottom of the gauge, there is a digital readout of EGT (left) and CHT (right).

The left button (Step) will display the EGT temperature for each cylinder in the left digital readout, as well as the "T" average EGT. The right button (LeanFind) is used to engage automatic search for peak EGT. Both buttons are operated with the LEFT MOUSE BUTTON.

In addition, the Cylinder Head Temperature (CHT) for each of the six cylinders is displayed in the bar graph as a red bar that corresponds to the scale on the left side of the gauge.

The major function of the Digital Engine Temperature gauge is to allow the pilot to lean or enrich the mixture so that fuel/burn ratio is maximized, while at the same time allowing the cooling effect of rich mixture settings.

The instructions for usage of the EDM 700 Digital Engine Temperature Gauge is as follows:

1. When starting the engine, advance the mixture levers to FULL RICH.
2. During climb, slowly pull back the mixture levers until the fuel flow gauge indicates approximately 18 GPH.
   a. If operating from a high altitude airfield or climbing above 8000 feet, you may need to lean further.
3. Upon attaining cruise altitude, slowly pull back the throttle levers to cruise manifold pressure.
4. Click the LeanFind button with the LEFT MOUSE BUTTON to start the automatic process.
5. Slowly lean mixture, while watching the EDM 700's EGT display. When peak EGT is reached, the display will 'lock' on the peak EGT for the hottest cylinder, and will display a bar above the cylinder number.
6. Click the LeanFind Button with the LEFT MOUSE BUTTON to turn the function off. The display will automatically lock to the "T" column, which displays the average EGT for all cylinders in the left digital display.
7. By advancing the mixture levers, slowly enrich the mixture to a temperature 20 degrees lower than that of the peak EGT point. For example, if peak EGT is 1640 degrees, enrich the mixture until EGT reads 1620 degrees.

For greatest ECONOMY, the best EGT setting will be 20 degrees Rich of Peak (ROP). This should result in an indicated fuel flow in the range of approximately 12 to 13 GPH between 6500' and 8500' for the engines in the 310R.

For greatest PERFORMANCE, the best EGT setting will be found at 60 degrees Rich of Peak. This should result in a fuel flow in the range of 15 to 18 GPH.

Important Notes:

1. For any leaning operations to work within the simulator, it is critical that the setting labelled 'Automixture' is turned OFF. If this setting is left on, the simulator will adjust the mixture on it's own and the aircraft engines will not respond to user adjustment of the mixture levers.
2. Due to simulator limitations, cylinder #5 will always have the 'hottest' EGT. This means that in step 5, the display will always 'lock' on the same cylinder, #5.

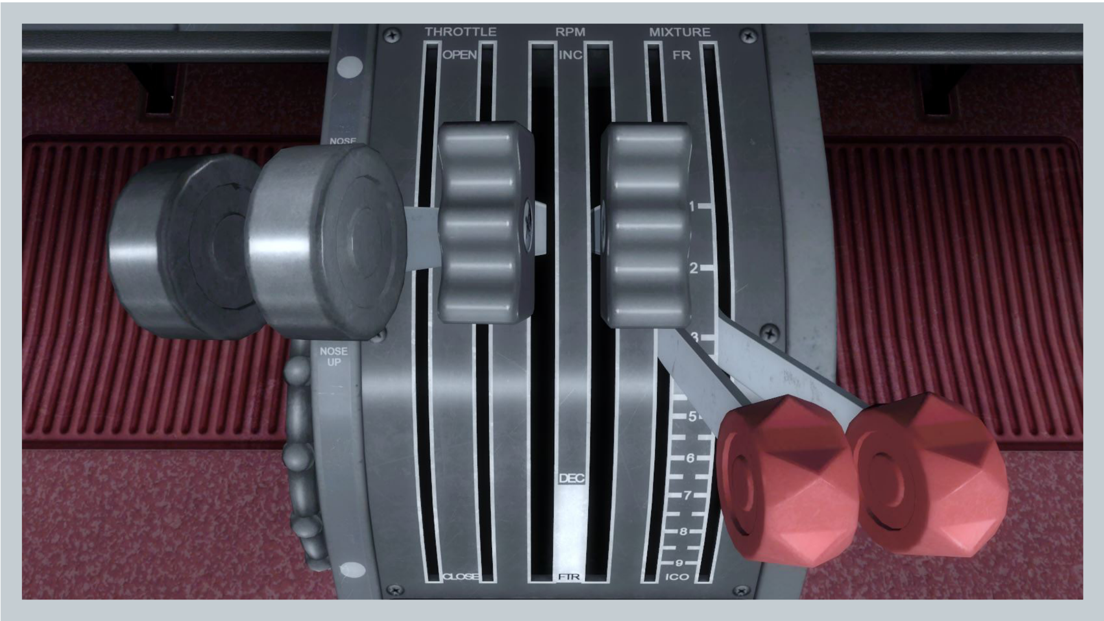
Throttle Quadrant

The top of the pedestal houses the throttle quadrant, with twin levers for the throttle (left, black round knobs), propeller (center, black rectangular knobs), and mixture (right, red ridged circular knobs). This arrangement in the allows for both visual and tactile recognition of the levers to help avoid undesired engine settings.

The throttles control amount of opening in the throttle wastegate. With the throttle fully forward (full open) the wastegate is 100% opened, allowing maximum manifold air pressure to be sucked by the engine. When the throttle is moved aft, the throttle wastegate is closed until at minimum setting (closed throttle) the wastegate is shut as tight as possible, which restricts the airflow to the engines, resulting is the lowest possible manifold pressure. The throttle wastegate cannot be physically closed entirely, and should normally be advanced about "one inch" past the fully closed position when starting the engines.

The propeller condition levers control the amount of blade angle commanded to the propeller governors. Using oil pressure, the governor responds to movements in the prop condition levers and set that blade angle to achieve a fixed RPM setting. Then, the governor makes automatic small corrections to blade angle to maintain that constant RPM setting during ever changing conditions of flight.

The mixture levers control how much fuel is sent to the fuel injectors and is used by the pilot to adjust the fuel quantity so that as the aircraft climbs or descends, the optimal ratio of fuel to air is maintained. Only at the optimal ratio is best possible quality of fuel ignition in the pistons maintained. As the plane climbs, the air gets thinner, which requires reducing fuel flow to the injectors (called leaning the mixture). As the plane descends, the air gets thicker, which requires increasing the fuel flow (called enriching the mixture). To lean the mixture, rotate the mixture lever aft. To enrich the mixture, rotate the lever forward.



Trim Controls

The trim wheels are located on the pedestal, with the elevator trim wheel located to the left of the throttle quadrant, and the rudder (yaw) and aileron (roll) trim wheels located below the throttle quadrant.

There is a template for the elevator trim that allows the pilot to accurately set the takeoff trim by referencing the location of a small indicator needle in relation to the trim template.

For the yaw and roll trim, there are white dots that move as the trim wheels are rotated left or right. These two trim values should be set and maintained for takeoff and cruise operations with both engines operating in symmetry. They will need to be adjusted for any single engine operations.

Propeller Feathering

The Concept

Feathering (rotating the blades parallel to the airflow) the propeller on a dead engine is absolutely vital. If this is not done, the airflow will cause the propeller to continue to rotate.

A propeller blade is similar in airfoil section to a low-drag wing. When rotated by the engine, it produces lift in a horizontal direction (otherwise known as thrust), as well as a small amount of induced drag as the propeller slices through the air. If the engine loses power, no thrust is produced, but all of the induced drag from the now windmilling propeller remains.

This is undesirable when operating with reduced, asymmetrical power (one engine inoperative) or under no power at all (both engines inoperative), as it can rob the aircraft of overall power required to maintain altitude, exacerbate negative control effects resulting from asymmetrical thrust, and shorten glide distances in total power loss situations.

The solution is to eliminate as much induced drag as possible by stopping the propeller rotation. To accomplish this, the propeller is feathered by pulling the propeller condition levers full aft, causing the propeller blades to rotate to a fully coarse setting parallel to the airflow. This reduces the aerodynamic force of the passing air so that the propeller no longer windmills.

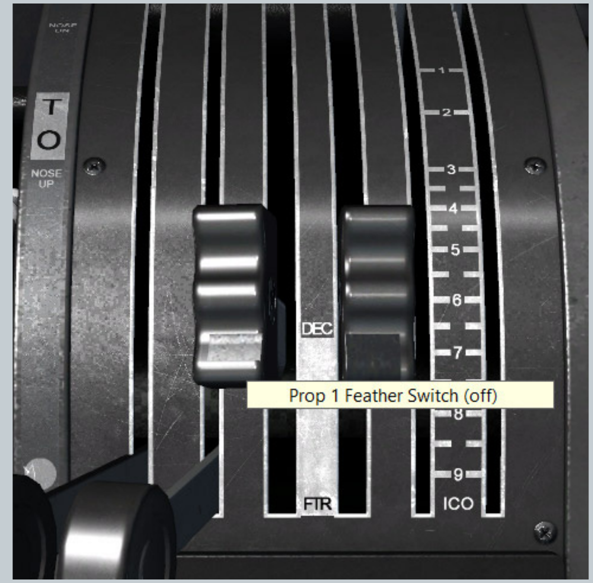
Simulator Implementation

Unfortunately, due to limitations within the simulator, there is no way to directly model propeller feathering merely using the propeller condition levers in the virtual cockpit. By default, the levers stop at the minimum (non-feathered) propeller pitch position in order to prevent unintentional feathering by the pilot. This 'feature' exists when accessing prop levers within the virtual cockpit with the mouse, or when using an external throttle quadrant.

The MilViz 310R has implemented a different method that strives for a more complete and realistic response.

When using a controller and moving the propeller lever fully aft, the corresponding propeller lever in the virtual cockpit will only move to the DEC position, which represents the minimum non-feathered propeller pitch. To move the propeller levers further aft to the FTR or feathered position, you may proceed as follows:

1. HOVER the mouse pointer over the aft third of the prop condition lever knob for the propeller you wish to feather.
2. While hovered over the aft third of the knob, click the RIGHT MOUSE BUTTON. This will immediately cause the prop condition lever to move fully aft into the feathered position on the virtual throttle quadrant and more importantly, the propeller blades for that engine will go to the fully feathered pitch position.
3. To quickly un-feather the propeller, click the same aft third location on the knob with the RIGHT MOUSE BUTTON while the propeller lever is in the feathered position.



Fuel Systems

The fuel system in the MilViz 310R is intended to provide a very high fidelity experience, modeled after real world usage, in conjunction with the limitations present within the simulator.

The airplane has a two main fuel tanks, often referred to as 'wingtip' or 'tip' tanks. Each tank has a usable capacity of 50 gallons. In addition, there are also two auxiliary fuel tanks, each with a usable capacity of 31.5 gallons. The total amount of usable fuel available to the pilot is 163 gal.

Each engine is typically fed by the tank on the respective side, but the airplane features the capability to crossfeed the fuel from the main tank on the opposite side from the engine.

Fuel Controls

The MilViz 310R features a pair of fully realistic fuel switches and placards located immediately aft of the pedestal. The left fuel switch controls the fuel flow for the left engine, and the right fuel switch controls the fuel for the right engine.

The handles of the switches are rotated by the pilot in order to select a desired position as outlined on the placard below the switch and indicated by the tapered end of the switch handle.

To rotate the LEFT fuel switch CLOCKWISE, click on the switch with the RIGHT MOUSE BUTTON. To rotate the LEFT fuel switch COUNTER-CLOCKWISE, click on the switch with the LEFT MOUSE BUTTON.

To rotate the RIGHT fuel switch CLOCKWISE, click on the switch with the LEFT MOUSE BUTTON. To rotate the RIGHT fuel switch COUNTER-CLOCKWISE, click on the switch with the RIGHT MOUSE BUTTON.

The placard below the switches is color coded, illuminated for night operations, and displays the four positions available for each switch:

a. Fuel Cutoff (Solid Red Outline)
b. Main Tank (Solid Blue Outline)
c. Auxiliary Tank (Blue and Yellow Stripes)
d. Crossfeed (Solid Yellow Outline)

When the switch is rotated to a new position, an audible sound effect should be heard.

Fuel Gauge

The fuel gauge featured on the 310R is of a dual needle type, with the left needle corresponding to the left tanks and the right needle corresponding to the right tanks. The gauge is graduated in gallons of fuel remaining on the blue arc, and pounds of fuel remaining on the white arc.

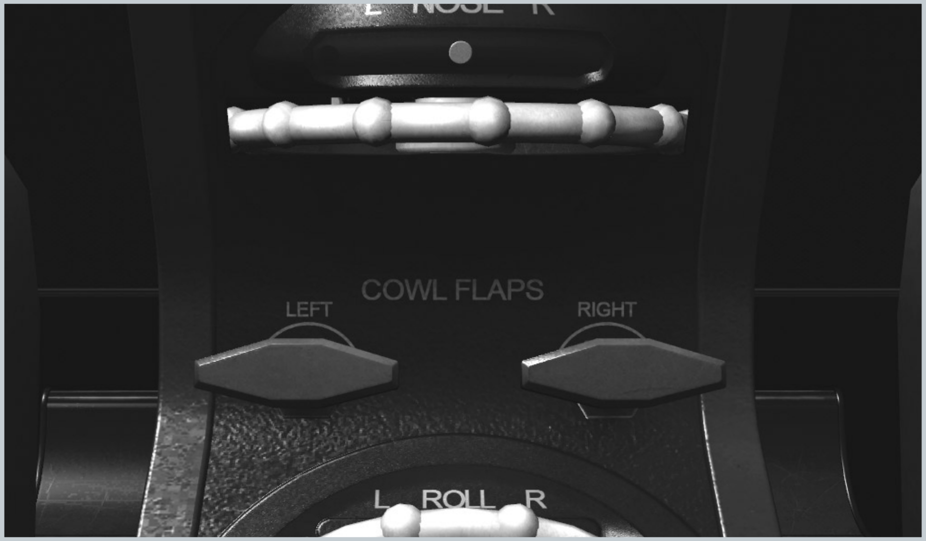
The fuel gauge automatically shows the usable fuel remaining on the tank selected by the fuel control for that engine. If the main fuel tank is selected by the fuel control switch, the gauge will display the remaining usable fuel for the main fuel tank. If the auxiliary fuel tank is selected by the fuel control switch, the gauge will display the remaining usable fuel for the auxiliary tank.

The switch immediately below the fuel gauge is a three position momentary switch that is spring loaded to the center position. To temporarily display the fuel quantity in the main tanks, click and hold the switch with the LEFT MOUSE BUTTON. To temporarily display the fuel quantity in the auxiliary tanks, click and hold the switch with the RIGHT MOUSE BUTTON. Upon releasing the button, the quantity gauge will revert to displaying the quantity in the tank selected by the fuel switch.

The indicator lamps to either side of the switch will illuminate when the pilot has selected the auxiliary fuel tank for the associated engine.

Warning lamps will illuminate to notify the pilot of low fuel quantity in the selected tank. All lamps are of the push-to-test type.

Cowl Flaps



The dual cowl flap controls on the 310R are located on the lower portion of the pedestal. They control the cowl flaps which are internally located in the rear section of each engine nacelle, underneath the prominent grill.

The cowl flaps on the 310R are designed to minimize drag when in the open position and as such, normal operation is for the cowl flaps to be left in the fully open position.

The only times when the cowl flaps require attention is to prevent shock cooling of the engine during rapid descents, during simulated single engine training, or when conduction engine shutdowns for emergencies or training purposes.

To close the cowl flaps, place the mouse cursor over the cowl flap handle for the cowl flap you wish to adjust, then rotate the MOUSE WHEEL DOWN or aft.

To open the cowl flaps, place the mouse cursor over the cowl flap handle for the cowl flap you wish to adjust, then rotate the MOUSE WHEEL UP or forward.

This action visibly pulls the respective cowl flap handle outwards in the virtual cockpit.

Doors & Windows

The MilViz 310R features an operable main cabin door, as well as an animated baggage door and left and right wing locker doors. The nose baggage door is not animated.

To operate the main cabin door from within the virtual cockpit, click the LEFT MOUSE BUTTON on the door lever located on the right side of the cockpit.

To operate the main cabin door from the outside, or to open or close the baggage or wing locker doors, use the keyboard combination SHIFT+E, followed in quick succession by the numbers 1, 2, 3 or 4.

Door Seal Operation

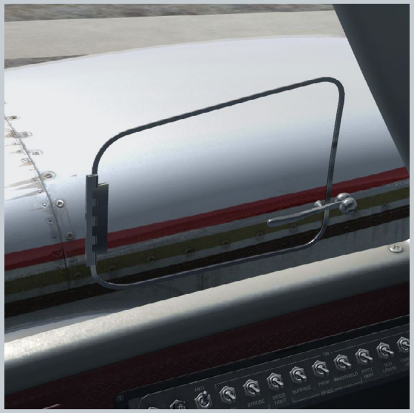
The 310R features an operating inflatable door seal with an authentic sound effect for inflation and deflation.

The Door Seal Switch is located on the right side front panel and is a two position toggle switch for ACTIVATE (up) / OFF (down) operation, toggled with the LEFT MOUSE BUTTON.

Storm Window

The 310R features a pilot side storm window which is fully animated.

To operate the window, click the LEFT MOUSE BUTTON on the aluminum window latch. This will swing the window open inwards, or closed, depending on the previous position of the window.



Hiding the Yokes

A common issue within the simulator is that it's possible for the yoke to obscure switches and controls, such as those on the 310R's lower switch panel.

To alleviate that issue, both the left and right yokes in the 310R may be toggled on or off.

To hide the yoke, click the LEFT MOUSE BUTTON where the yoke shaft meets the panel. To show the yoke again, simply click in the same location.

2D Popup Throttle Quadrant

For flexibility or ease of use, the 2D popup Throttle Quadrant panel that existed in the original version of the 310R has been retained for the 310R Redux.

This panel can be shown with the key combination SHIFT+2, or through the simulator's menu system.

It allows mouse access to the throttle, propeller and mixture levers, as well as the elevator trim wheel and fuel tank controls.

Avoinics / GPS

As mentioned in the MVAMS overview in this manual, the MilViz 310R contains the widest array of choice for panel layouts and 3rd party avionics support that we've ever offered in one of our products.

We provide panel layouts, selectable through our MVAMS utility, for the following configurations:

- Default-based GNS 530 + GNS 430
- Flight1 GNS 430 (x2)
- Flight1 GNS 530 + GNS 430
- Flight1 GTN 650 (x2)
- Flight1 GTN 750 + GTN 650
- Flight1 GTN 750 + default-based GNS 430
- RealityXP GNS 430 (x2)
- RealityXP GNS 530 + GNS 430
- NavStax Radio Navigation Stack
- Free Radio (blank panel for implementing your own 2D gauges)

In addition, each one of the above is also selectable as a separate choice outfitted with the REX/MilViz WX Advantage Weather Radar.

Important: All options except for the first (Default-based GNS 530 + GNS 430) and the last (Free Radio) require ownership of the corresponding 3rd party gauges, which are not included in the MilViz 310R Redux.

Special Features

(**Important:** These features are compatible with **Prepar3D 4.x** only.)

We are pleased to offer the brand new **TrueGlass** and **RealLight** technologies in the MilViz 310R Redux.

Licensed from TFDi Design, these stunning technologies allow for a more immersive experience in Prepar3D 4.x.

TrueGlass allows advanced rain, ice, and condensation effects to appear on the cockpit windows, while RealLight provides beautiful and adjustable night lighting to the aircraft.

Section 3
Specifications & Limitations

Table of Contents

INTRODUCTION

Section 3 of this user guide covers both the basic specifications of the airplane, as well as an abbreviated list of limitations. The full scope of the specifications and limitations are not reproduced here as some areas are simply not applicable within the simulator, nor are they of great interest for general reading.

Also included in this section is a very useful list of the symbols, abbreviations and terminology used throughout the rest of this user guide.

ENGINES

Number of Engines:	2
Engine Type:	Fuel injected, direct drive, air-cooled, horizontally opposed, six cylinder, 520 cubic-inch displacement.
Horsepower:	285 rated horsepower at 2700 RPM.

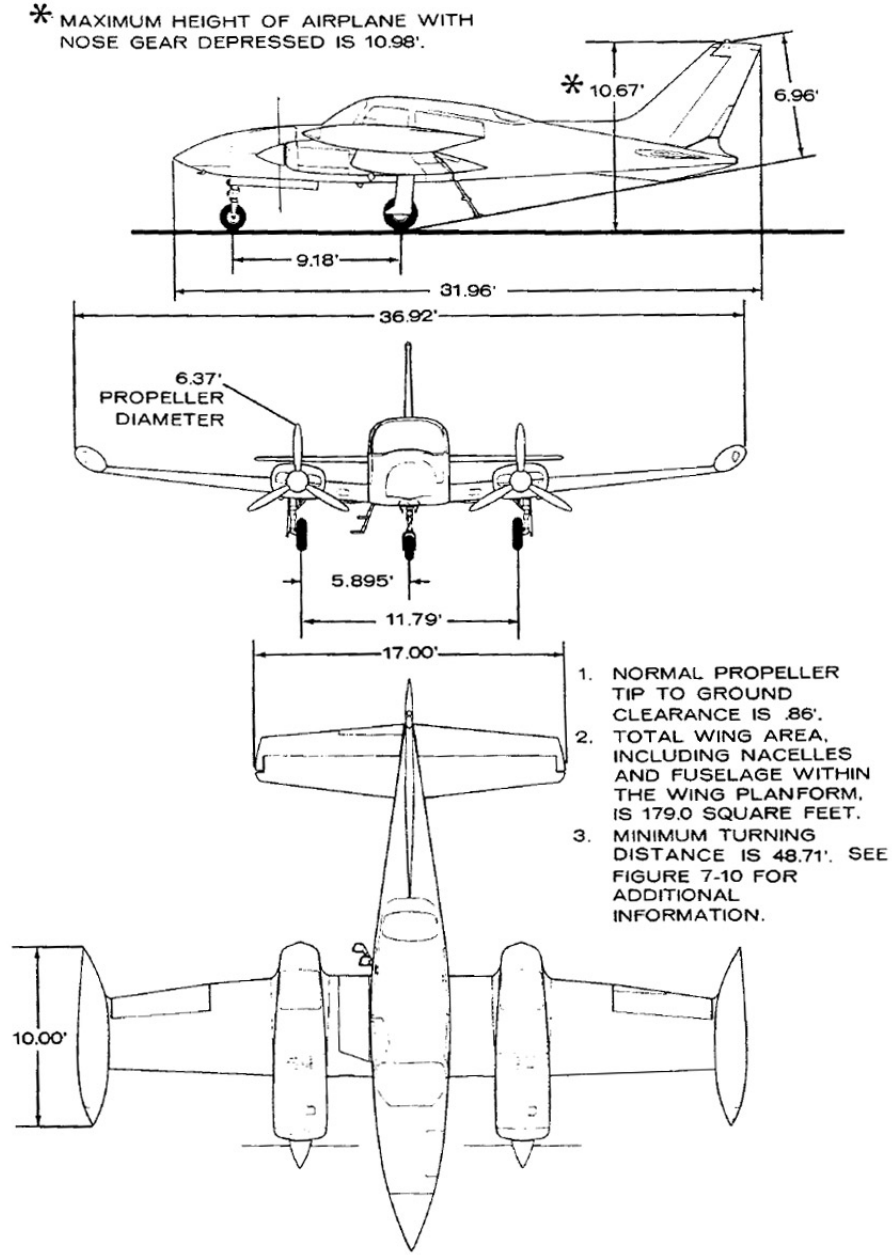
PROPELLERS

Number of Propellers:	2	
Number of Blades:	3	
Propeller Diameter:	6’ 4.5”	
Propeller Type:	Constant speed, full feathering, nonreversible hydraulically actuated.	
Blade Range:	a. Low Pitch	13.9° +/- 0.2°
	b. Feather	81.7° +/- 0.3°

MAXIMUM CERTIFIED WEIGHTS

Maximum Ramp Weight:	5535 pounds
Maximum Takeoff Weight:	5500 pounds
Maximum Landing Weight:	5400 pounds
Maximum Zero Fuel Weight:	4900 pounds

(FIGURE 3-1) THREE-VIEW DRAWING



STANDARD AIRPLANE WEIGHTS

Standard Empty Weight: 3358 pounds
Maximum Useful Load: 2177 pounds

SPECIFIC LOADINGS

Wing Loading: 30.73 pounds per square foot
Power Loading: 9.65 pounds per horsepower

SYMBOLS, ABBREVIATIONS AND TERMINOLOGY

GENERAL AIRSPEED TERMINOLOGY AND SYMBOLS

CAS — Calibrated Airspeed is the indicated speed corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.

G — G is acceleration due to gravity.

IAS — Indicated Airspeed is the speed shown on the airspeed indicator. IAS values shown in this user guide assume zero instrument error.

KCAS — Calibrated Airspeed expressed in knots.

KIAS — Indicated Airspeed expressed in knots.

KTAS — True Airspeed expressed in knots.

TAS — True Airspeed is the airspeed relative to undisturbed air which is the CAS corrected for altitude, temperature and compressibility.

V_A — Maneuvering Speed is the maximum speed at which application of full available aerodynamic control will not overstress the airplane.

V_{FE} — Maximum Flap Extended Speed is the highest speed permissible with wing flaps a prescribed extended position.

V_{LE} — Maximum Landing Gear Extended Speed is the maximum speed at which an airplane can be safely flown with the landing gear extended.

V_{LO} — Maximum Landing Gear Operating Speed is the maximum speed at which the landing gear can be safely extended or retracted.

V_{MC_A} — Air Minimum Control Speed is the minimum flight speed at which the airplane is controllable with a bank of not more than 5° when one engine suddenly becomes inoperative and the remaining engine is operating at takeoff power.

V_{NE} — Never Exceed Speed is the speed limit that may not be exceeded at any time.

V_{NO} — Maximum Structural Cruising Speed is the speed that should not be exceeded except in smooth air and then only with caution.

V_{SSE} — Intentional One Engine Inoperative Speed is a minimum speed selected by the manufacturer for intentionally rendering one engine inoperative in flight for pilot training.

V_X — Best Angle-of-Climb Speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance.

V_Y — Best Rate-of-Climb Speed is the airspeed which delivers the greatest gain in altitude in the shortest possible time.

METEOROLOGICAL TERMINOLOGY

°C — Temperature in degrees Celsius.

°F — Temperature in degrees Fahrenheit.

ISA — International Standard Atmosphere in which:

4. The air is a dry perfect gas;
5. The temperature at sea level is 15° Celsius (59° Fahrenheit);

6. The pressure at sea level is 29.92 inches Hg. (1013.2 mb);
7. The temperature gradient from sea level to the altitude at which the temperature is -56.5°C (—69.7°F) is -1.98°C (-3.5°F) per 1000 feet.

OAT	Outside Air Temperature is the free air static temperature, obtained either from inflight temperature indications adjusted for instrument error and compressibility effects or ground meteorological sources.
Pressure Altitude	Altitude measured from standard sea-level pressure (29.92 inches Hg.) by a pressure or barometric altimeter. It is the indicated pressure altitude corrected for position and instrument error. In this user guide, altimeter instrument errors are assumed to be zero.
Wind	The wind velocities recorded as variables on the charts of this handbook are to be understood as the headwind or tailwind components of the reported winds.

POWER TERMINOLOGY

BHP	Brake horsepower means the power delivered at the propeller shaft of an airplane engine.
Critical Altitude	The maximum altitude at which in standard temperature it is possible to maintain a specified power.
Maximum Continuous Power	The power developed in a standard atmosphere from sea level to the critical altitude at the maximum RPM and manifold pressure approved for use during periods of unrestricted duration.
RPM	The revolutions per minute (RPM) of an engine refers to the rotational speed of the propeller shaft, as shown on a tachometer.

AIRPLANE PERFORMANCE AND FLIGHT PLANNING TERMINOLOGY

Accelerate-Go Distance	The distance required to accelerate an airplane to a specified speed and, assuming failure of an engine at the instant that speed is attained, continue takeoff on the remaining engine to a height of 50 feet.
Accelerate-Stop Distance	The distance required to accelerate an airplane to a specified speed and, assuming failure of an engine at the instant that speed is attained, to bring the airplane to a stop.
Acrobatic Maneuver	An intentional maneuver involving an abrupt change of an airplane's attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight.
Balked Landing	A balked landing is an aborted landing (i.e., all engines go—around).
Balked Landing Transition Speed	The minimum speed at which transition to a balked landing climb should be attempted.
Demonstrated Crosswind Velocity	The demonstrated crosswind velocity is the velocity of the crosswind component for which adequate control of the airplane during takeoff and landing was actually demonstrated during certification tests. The value shown is not considered to be limiting. This value is not an aerodynamic limit for the airplane.
Maximum Effective Braking	The maximum amount of braking pressure that can be applied to the toe brakes without locking the wheels.

Limitations

AIRSPEED LIMITATIONS

(See figure 3.2).

(FIGURE 3-2) AIRSPEED LIMITATIONS TABLE

SPEED	KIAS	KCAS	REMARKS
Maneuvering Speed V_A (Knots)	148	150	Do not make abrupt control movements above this speed.
Maximum Flap Extended Speed V_{FE} (Knots) 15° 35°	158 139	160 140	Do not exceed this speed with the given flap setting.
Maximum Gear Operating Speed V_{LO} (Knots)	138	140	Do not extend or retract landing gear above this speed.
Maximum Gear Extended Speed V_{LE} (Knots)	138	140	Do not exceed this speed with landing gear extended.
Air Minimum Control Speed V_{MC_A} (Knots)	80	81	This is the minimum flight speed at which the airplane is controllable with one engine inoperative and a 5° bank towards the operative engine.
One Engine Inoperative Best Rate-of-Climb Speed V_Y (Knots)	106	107	This speed delivers the greatest gain in altitude in the shortest possible time with one engine inoperative at sea level, standard day conditions and 5500 pounds weight.
Never Exceed Speed V_{NE} (Knots)	223	227	Do not exceed this speed in any operation.
Maximum Structural Cruising Speed V_{NO} (Knots)	181	183	Do not exceed this speed except in smooth air and then only with caution.

(FIGURE 3-3) AIRSPEED INDICATOR TABLE

MARKING	KIAS VALUE OR RANGE	SIGNIFICANCE
Red Radial	80	Air minimum control speed.
White Arc	72 to 139	Operating speed range with 35° wing flaps. Lower limit is maximum weight stalling speed in landing configuration. Upper limit is maximum speed permissible with wing flaps extended 35°.
Green Arc	79 to 181	Normal operating range. Lower limit is maximum weight stalling speed with flaps and landing gear retracted. Upper limit is maximum structural cruising speed.
Blue Radial	106	One engine inoperative best rate-of-climb speed at sea level standard day conditions and 5500 pounds weight.
Yellow Arc	181 to 223	Caution range. Operations must be conducted with caution and only in smooth air.
Red Line	223	Maximum speed for all operations.

ENGINE LIMITATIONS

Number of Engines: 2

Engine Operating Limits for Takeoff and Continuous Operation:

e. Maximum power for all operations (All Altitudes)

Engine RPM	Manifold Pressure	Time	Max. Head Temp. (°F)	Max. Oil Temp. (°F)
2700	Full Throttle	Continuous	460	240

Powerplant Instrument Markings:

a. Tachometer:
 (1) Normal Operating 2100 to 250 RPM (Green Arc)
 (2) Maximum 2700 RPM (Red Radial)

b. Manifold Pressure:
   (1) Normal Operating 15.0 to 24.5 Inches Hg. Manifold Pressure (Green Arc)

c. Oil Temperature:
   (1) Normal Operating 75 to 240°F (Green Arc)
   (2) Maximum 240°F (Red Radial)

d. Oil Pressure:
   (1) Minimum Operating 10 PSI (Red Radial)
   (2) Normal Operating 30 to 60 PSI (Green Arc)
   (3) Maximum 100 PSI (Red Radial)

e. Cylinder Head Temperature:
   (1) Normal Operating 200 to 460°F (Green Arc)
   (2) Maximum 460°F (Red Radial)

f. Fuel Flow:
   (1) Minimum Operating 2.5 PSI (Red Radial)
   (2) Normal Operating 0.0 Pounds per hour (3.4 PSI) to 155.0 Pounds per hour (21.7 PSI (Green Arc)
   (3) Maximum Operating 155.0 Pounds per hour (21.7 PSI) (Red Radial)

WEIGHT LIMITS

Maximum Takeoff Weight: 5500 Pounds

Maximum Landing Weight: 5400 Pounds

Maximum Zero Fuel Weight: 4900 Pounds

Maximum Weights in Baggage Compartments:

a. Left and Right Wing Lockers - 120 pounds each.
   (1) If optional wing locker tanks are installed, change item 'a' to 40 pounds each.

b. Nose Bay - 350 pounds less installed optional equipment.

c. Aft Cabin (Station 89 to Station 109) - 200 pounds.

d. Aft Cabin (Station 109 to Station 132) - 160 pounds.

MANEUVER LIMITS

This is a normal category airplane. Acrobatic maneuvers, including spins, are prohibited.

FLIGHT LOAD FACTOR LIMITS

The design load factors are 150% of the following and in all cases, the structure exceeds design loads.

At Design Takeoff Weight of 5500 Pounds:

a. Landing gear up, wing flaps 0° +3.8G to -1.52G

b. Landing gear down, wing flaps 35° +2.0G

FLIGHT CREW LIMITS

Minimum flight crew is one pilots.

OPERATION LIMITS

The standard airplane is approved for day and night operation under VFR conditions. With the proper optional equipment installed, the airplane is approved for day and night IFR conditions.

Section 4
Emergency Procedures

Table of Contents

INTRODUCTION

Section 4 of this user guide describes the recommended procedures for emergency situations in an abbreviated checklist form, as well as partially including the amplified procedures.

Listed emergency procedures are for education only and do not imply additional failure capabilities within the aircraft above that provided by the default simulator.

Emergency Procedures

Abbreviated Checklist

NOTE

This Abbreviated Emergency Procedures Checklist is included in this User Guide as a replacement for the Amplified Emergency Procedures Checklist.

Normally, use of the Abbreviated Emergency Procedures Checklist would not be used until the flight crew has become familiar with the airplane and systems. However, the Amplified Procedures in this User Guide is limited to discussion of emergency situations only.

Procedures in the Abbreviated Checklist portion of this section outlined in black are immediate-action items and should be committed to memory.

ENGINE INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE

1. Throttle - CLOSE.
2. Mixture – IDLE CUT-OFF.
3. Propeller – FEATHER.
4. Fuel Selector – OFF (Feel For Detent).
5. Auxiliary Fuel Pump – OFF.
6. Magneto Switches – OFF.
7. Propeller Synchrophaser – OFF (If Installed).
8. Alternator – OFF.
9. Cowl Flap - CLOSE.

ENGINE FAILURE DURING TAKEOFF SPEED BELOW 92 KIAS

1. Throttles – CLOSE IMMEDIATELY.
2. Brakes – AS REQUIRED.

ENGINE FAILURE AFTER TAKEOFF SPEED ABOVE 92 KIAS WITH GEAR UP OR IN TRANSIT

1. Mixtures – AS REQUIRED for flight altitude.
2. Propellers – FULL FORWARD.
3. Throttles – FULL FORWARD.
4. Landing Gear – CHECK UP.
5. Inoperative Engine – DETERMINE:
   a. Throttle - CLOSE.
   b. Mixture - IDLE CUT-OFF.
   c. Propeller - FEATHER.
6. Establish Bank - 5° toward operative engine.
7. Wing Flaps - UP, if extended, in small increments.
8. Climb To Clear 50 Foot Obstacle — 92 KIAS.
9. Climb At One Engine Inoperative Best Rate-of-Climb Speed - 106 KIAS at sea level; 94 KIAS at 10 ,000 feet.
10. Trim Tabs – ADJUST 5° bank toward operative engine with approximately ½ ball slip indicated on the turn and bank indicator.
11. Cowl Flap – CLOSE (Inoperative Engine).
12. Inoperative Engine – SECURE as follows:
    a. Fuel Selector – OFF.
    b. Auxiliary Fuel Pump – OFF.
    c. Magneto Switches – OFF.
    d. Alternator – OFF.
13. As Soon As Practical – LAND.

ENGINE FAILURE DURING FLIGHT SPEED ABOVE $^{V}MC_{A}$

1. Inoperative Engine – DETERMINE.
2. Operative Engine – ADJUST as required.

Before Securing Inoperative Engine:

3. Fuel Flow - CHECK. If deficient, position auxiliary fuel pump to ON.
4. Fuel Selectors – MAIN TANKS (Feel For Detent).
5. Fuel Quantity – CHECK.

(FIGURE 4-1) SINGLE-ENGINE AIRSPEEDS FOR SAFE OPERATION

Conditions:
1. Takeoff Weight 5500 Pounds
2. Landing Weight 5400 Pounds
3. Standard Day, Sea Level

(1) Air Minimum Control Speed . . . . 80 KIAS
(2) Intentional One Engine Inoperative Speed . . . . . . 92 KIAS
(3) One Engine Inoperative Best Angle-of-Climb Speed (Wing Flaps UP) . . . . 95 KIAS
(4) One Engine Inoperative Best Rate-of-Climb Speed (Wing Flaps UP) . . . . 106 KIAS

6. Oil Pressure and Oil Temperature – CHECK.
7. Magneto Switches – CHECK ON.
8. Mixture – ADJUST until evidence of engine firing. Continue to adjust for smooth operation.
9. Inoperative Engine – SECURE.
    a. Throttle - CLOSE.
    b. Mixture - IDLE CUT-OFF.
    c. Propeller - FEATHER.
    d. Fuel Selector - OFF (Feel For Detent).
    e. Auxiliary Fuel Pump - OFF.
    f. Magneto Switches - OFF.
    g. Propeller Synchrophaser - OFF (If Installed).
    h. Alternator – OFF.
    i. Cowl Flap - CLOSE.
10. Operative Engine - ADJUST.
    a. Power - AS REQUIRED.
    b. Mixture - AS REQUIRED for flight altitude.
    c. Fuel Selector - AS REQUIRED (Feel For Detent).
    d. Auxiliary Fuel Pump - ON.
    e. Cowl Flap - AS REQUIRED.
    f. Trim Tabs – ADJUST 5° bank toward operative engine with approximately ½ ball slip indicated on the turn and bank indicator.
    g. Electrical Load — DECREASE to minimum required.
    h. As Soon As Practical - LAND.

ENGINE FAILURE DURING FLIGHT SPEED BELOW $^{V}MC_{A}$

1. Rudder - APPLY towards operative engine.
2. Power - REDUCE to stop turn.
3. Pitch Attitude - LOWER NOSE to accelerate above $^{V}MC_{A}$.
4. Inoperative Engine Propeller - FEATHER.
5. Operative Engine - INCREASE POWER as airspeed increases above $^{V}MC_{A}$.
6. Inoperative Engine - SECURE.
7. Trim Tabs – ADJUST 5° bank toward operative engine with approximately ½ ball slip indicated on the turn and bank indicator.
8. Operative Engine Cowl Flap - AS REQUIRED.

ENGINE INOPERATIVE LANDING

1. Fuel Selector - MAIN TANK (Feel For Detent).
2. Auxiliary Fuel Pump - ON (Operative Engine).
3. Alternate Air Control - IN.
4. Mixture - AS REQUIRED for flight altitude.
5. Propeller Synchrophaser - OFF (If Installed).
6. Propeller - FULL FORWARD.
7. Approach - 106 KIAS with excessive altitude.
8. Landing Gear - DOWN within gliding distance of field.
9. Wing Flaps - DOWN when landing is assured.
10. Speed - DECREASE below 93 KIAS only if landing is assured.
11. Air Minimum Control Speed - 80 KIAS.

ENGINE INOPERATIVE GO-AROUND SPEED ABOVE 92 KIAS

1. Throttle - FULL FORWARD.
2. Mixture - AS REQUIRED for flight altitude.
3. Positive Rate-of-Climb - ESTABLISH.
4. Landing Gear - UP.
5. Wing Flaps — UP, if extended.
6. Cowl Flap - OPEN.
7. Climb at One Engine Inoperative Best Rate-of-Climb Speed - 106 KIAS at sea level; 94 KIAS at 10,000 feet.
8. Trim Tabs – ADJUST 5° bank toward operative engine with approximately ½ ball slip indicated on the turn and bank indicator.

AIRSTART

Airplanes Without Optional Propeller Unfeathering System:

1. Auxiliary Fuel Pump – CHECK OFF. If ON or LOW, purge engine by turning OFF auxiliary fuel pump, mixture to IDLE CUT-OFF, throttle full open, magneto switches OFF, and rotating engine 15 revolutions with starter.
2. Magneto Switches – ON.
3. Fuel Selector - MAIN TANK (Feel For Detent).
4. Throttle - FORWARD approximately one inch.
5. Mixture - AS REQUIRED for flight altitude.
6. Propeller - FULL FORWARD.
7. Propeller - RETARD to detent when propeller reaches 1000 RPM.
8. Auxiliary Fuel Pump – LOW.
9. Mixture – AS REQUIRED.
10. Power – INCREASE after cylinder head temperature reaches 200°F with gradual mixture enrichment as power increases.
11. Cowl Flap – AS REQUIRED.
12. Alternator – ON.

BOTH ENGINES FAILURE DURING CRUISE FLIGHT

1. Wing Flaps - UP.
2. Landing Gear - UP.
3. Propellers - FEATHER.
4. Cowl Flaps - CLOSE.
5. Airspeed - 111 KIAS.
6. Landing - Refer to FORCED LANDING (Complete Power Loss) in this section.

FIRE PROCEDURES

FIRE ON THE GROUND (ENGINE START, TAXI AND TAKEOFF WITH SUFFICIENT DISTANCE REMAINING TO STOP)

1. Throttles – CLOSE.
2. Brakes – AS REQUIRED.
3. Mixtures – IDLE CUT-OFF.
4. Battery – OFF (Use Gang Bar).
5. Magnetos – OFF (Use Gang Bar).
6. Evacuate airplane as soon as practical.

INFLIGHT WING OR ENGINE FIRE

1. Both Auxiliary Fuel Pumps – OFF.
2. Appropriate Engine – SECURE.
    a. Throttle – CLOSE.
    b. Mixture – IDLE CUT-OFF.
    c. Propeller – FEATHER.
    d. Fuel Selector – OFF (Feel For Detent).
    e. Magnetos – OFF.
    f. Propeller Synchrophaser – OFF (If Installed).
    g. Alternator – OFF.
    h. Cowl Flap – CLOSE.

3. Cabin Heater - OFF.
4. Land and evacuate airplane as soon as practical.

INFLIGHT CABIN ELECTRICAL FIRE OR SMOKE

1. Electrical Load - REDUCE to minimum required.
2. Attempt to isolate the source of fire or smoke.
3. Wemacs - OPEN.
4. Cabin Air Controls - OPEN all vents including windshield defrost. CLOSE if intensity of smoke increases.
5. Land and evacuate airplane as soon as practical.

EMERGENCY DESCENT PROCEDURES

PREFERRED PROCEDURE

1. Throttles - IDLE.
2. Propellers – FULL FORWARD.
3. Mixtures – ADJUST for smooth operation with gradual enrichment as altitude is lost.
4. Wing Flaps – UP.
5. Landing Gear – UP.
6. Moderate Bank – INITIATE.
7. Airspeed – 220 KIAS.

IN TURBULENT ATMOSPHERIC CONDITIONS

1. Throttles - IDLE.
2. Propellers – FULL FORWARD.
3. Mixtures – ADJUST for smooth operation with gradual enrichment as altitude is lost.
4. Wing Flaps – DOWN 35°.
5. Landing Gear – DOWN.
6. Moderate Bank – INITIATE.
7. Airspeed – 138 KIAS.

EMERGENCY LANDING PROCEDURES

FORCED LANDING (WITH POWER)

1. Landing Site – CHECK. Overfly site at 100 KIAS and 15° wing flaps.
2. Landing Gear – DOWN if surface is smooth and hard.
   a. Normal Landing – INITIATE. Keep nosewheel off ground as long as practical.
3. Landing Gear – UP if surface is rough or soft.
   a. Approach – 100 KIAS with 15° wing flaps.
   b. All Switches Except Magnetos – OFF.
   c. Cabin Door – UNLATCH prior to flare-out.
   d. Mixtures – IDLE CUT-OFF.
   e. Magneto Switches – OFF.
   f. Fuel Selectors – OFF (Feel For Detent).
   g. Landing Attitude – NOSE HIGH.

FORCED LANDING (COMPLETE POWER LOSS)

1. Mixtures - IDLE CUT-OFF.
2. Propellers – FEATHER.
3. Fuel Selectors – OFF (Feel For Detent).
4. All Switches Except Battery – OFF.
5. Approach – 111 KIAS.
6. If Smooth and Hard Surface:
   a. Landing Gear – DOWN within gliding distance of field.
   b. Wing Flaps – AS REQUIRED.
   c. Battery Switch – OFF.
   d. Cabin Door – UNLATCH prior to flare-out.
   e. Normal Landing – INITIATE. Keep nosewheel off ground as long as practical.
7. If Rough or Soft Surface:
   a. Landing Gear – UP.
   b. Wing Flaps – DOWN 15°.
   c. Approach – 97 KIAS.
   d. Battery Switch – OFF.
   e. Cabin Door – UNLATCH prior to flare-out.
   f. Landing Attitude – NOSE HIGH.

LANDING WITH FLAT MAIN GEAR TIRE

1. Landing Gear – Leave DOWN.
2. Fuel Selectors – SELECT main tank on same side as defective tire; feel for detent.
3. Fuel Selectors – MAIN TANKS (Feel For Detent) before landing.
4. Wind should be headwind or crosswind opposite the defective tire.
5. Wing Flaps – DOWN 35°.
6. In approach, align airplane with edge of runway opposite the defective tire, allowing room for a mild turn in the landing roll.
7. Land slightly wing low on the side of the inflated tire and lower the nosewheel to the ground immediately for a positive steering.
8. Use full aileron in landing roll to lighten the load on the defective tire.
9. Apply brakes only on the inflated tire to minimize landing roll and maintain directional control.
10. Stop airplane to avoid further damage unless active runway must be cleared for other traffic.

LANDING WITH DEFECTIVE MAIN GEAR

1. Fuel Selectors – SELECT main tank on same side as defective tire; feel for detent.
2. Fuel Selectors – MAIN TANKS (Feel For Detent) before landing.
3. Wind – HEADWIND or crosswind opposite defective gear.
4. Landing Gear – DOWN.
5. Wing Flaps – DOWN 35°.
6. Approach – ALIGN AIRPLANE with the edge of runway opposite the defective landing gear.
7. Battery Switch – OFF.
8. Land wing low toward operative landing gear. Lower nosewheel immediately for positive steering.
9. Ground Loop – INITIATE into defective landing gear.
10. Mixtures – IDLE CUT-OFF.
11. Use full aileron in landing roll to lighten the load on the defective gear.
12. Apply brakes only on the operative landing gear to hold desired rate of turn and shorten landing roll.
13. Fuel Selectors – OFF (Feel For Detent).
14. Airplane – EVACUATE.

LANDING WITH FLAT NOSE GEAR TIRE

1. Landing Gear – Leave DOWN.
2. Passengers and Baggage - MOVE AFT.
3. Approach – 100 KIAS with 15° Wing Flaps.
4. Landing Attitude – NOSE HIGH.

5. Nose – HOLD OFF during landing roll.
6. Brakes – MINIMUM in landing roll.
7. Throttles – RETARD in landing roll.
8. Control Wheel – FULL AFT until airplane stops.
9. Minimize additional taxiing to prevent further damage.

LANDING WITH DEFECTIVE NOSE GEAR

1. If Smooth and Hard Surface:
    a. Baggage and Passengers – MOVE AFT.
    b. Landing Gear – DOWN.
    c. Approach – 100 KIAS with 15° wing flaps.
    d. All Switches Except Magnetos - OFF.
    e. Landing Attitude – NOSE HIGH.
    f. Mixtures - IDLE CUT-OFF.
    g. Magneto Switches - OFF
    h. Nose - LOWER as speed dissipates.
2. If Rough or Sod Surface:
    a. Landing Gear – UP.
    b. Approach – 100 KIAS with 15° wing flaps.
    c. All Switches Except Magnetos - OFF.
    d. Cabin Door - UNLATCH prior to flare out.
    e. Landing Attitude – NOSE HIGH.
    f. Mixtures - IDLE CUT-OFF.
    g. Magneto Switches - OFF.
    h. Fuel Selectors – OFF (Feel For Detent).

LANDING WITHOUT FLAPS (0° EXTENSION)

1. Mixtures – AS REQUIRED for flight altitude.
2. Propellers – FULL FORWARD.
3. Fuel Selectors – MAIN TANKS (Feel For Detent).
4. Minimum Approach Speed – 105 KIAS.
5. Landing Gear – DOWN.

DITCHING

1. Landing Gear – UP.
2. Approach – HEADWIND if high winds. PARALLEL to SWELLS if light wind and heavy swells.
3. Wing Flaps – DOWN 35°.
4. Power – AS REQUIRED (300 Feet Per Minute Descent).
5. Airspeed – 93 KIAS minimum.
6. Attitude – DESCENT ATTITUDE through touch-down.

SPINS

1. 1. Throttles – CLOSE IMMEDIATELY.
2. Ailerons – NEUTRALIZE.
3. Rudder – HOLD FULL RUDDER opposite the direction of rotation.
4. Control Wheel – FORWARD BRISKLY, ½ turn of spin after applying full rudder.
5. Inboard Engine – INCREASE POWER to slow rotation. (If Necessary).
6. After rotation has stopped:
    a. Rudder – NEUTRALIZE.
    b. Inboard Engine (If Used) – DECREASE POWER to equalize engines.
    c. Control Wheel – PULL to recover from resultant dive. Apply smooth steady control pressure.

Amplified Procedures

NOTE

The Amplified Emergency Procedures in this User Guide exists for further education of various emergency situations that are covered in the Abbreviated Emergency Procedures Checklist.

For the sake of brevity, and not least of all because the majority of emergency situations are only encountered in the simulator by choice, a full listing of the Amplified Procedures as well as the inclusion of Amplified Procedure checklists will not be covered.

SINGLE ENGINE AIRSPEEDS FOR SAFE OPERATION

The most critical time for an engine failure condition in a multi-engine airplane is during a two or three second period late in the takeoff run while the airplane is accelerating to a safe engine failure speed. A detailed knowledge of recommended single-engine airspeeds is essential for safe operation of the airplane.

The airspeed indicator is marked with a red radial at the air minimum control speed and a blue radial at the best single-engine rate-of-climb speed to facilitate instant recognition. The following paragraphs present a detailed discussion of the problems associated with engine failures during takeoff.

AIR MINIMUM CONTROL SPEED

The multi-engine airplane must reach the air minimum control speed (80 KIAS) before full control deflections can counteract the adverse rolling and yawing tendencies associated with one engine inoperative and full power operation on the other engine. This speed is indicated by a red radial on the airspeed indicator.

RECOMMENDED SAFE SINGLE-ENGINE SPEED

Although the airplane is controllable at the air minimum control speed, the airplane performance is so far below optimum that continued flight near the ground is improbable. A more suitable recommended safe single-engine speed is 92 KIAS. At this speed, altitude can be maintained more easily while the landing gear is being retracted and the propeller is being feathered.

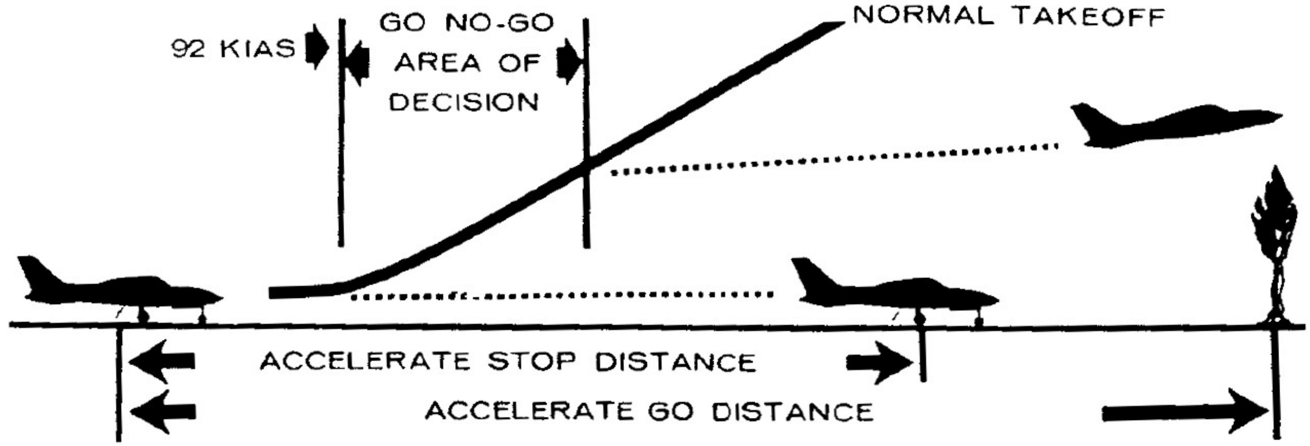
BEST SINGLE-ENGINE ANGLE-OF-CLIMB SPEED

The best single-engine angle-of-climb speed becomes important when there are obstacles ahead on takeoff. Once the best single-engine angle-of-climb speed is reached, altitude becomes more important than airspeed until the obstacle is cleared. The best single-engine angle-of-climb speed is approximately 95 KIAS with wing flaps and landing gear up.

BEST SINGLE-ENGINE RATE-OF-CLIMB SPEED

The best single-engine rate-of-climb speed becomes important when there are no obstacles ahead on takeoff, or when it is difficult to maintain or gain altitude in single-engine emergencies. The best single-engine rate-of-Climb speed is 106 KIAS with wing flaps and landing gear up. This speed is indicated by a blue radial on the airspeed indicator.

The variations of wing flaps up best single-engine rate-of-climb speed with altitude are shown in the performance section. For best single-engine climb performance, the wings should be banked 5° toward the operative engine.



(FIGURE 4-2) ENGINE FAILURE DURING TAKEOFF, GO NO-GO DECISION

ENGINE INOPERATIVE PROCEDURES

ENGINE FAILURE AFTER TAKEOFF

Upon engine failure after reaching 92 KIAS on takeoff, the multi-engine pilot has a significant advantage over a single-engine pilot, for he has a choice of stopping or continuing the takeoff. This would be similar to the choice facing a single-engine pilot who has suddenly lost slightly more than half of his takeoff power. In this situation, the single-engine pilot would be extremely reluctant to continue the takeoff if he had to climb over obstructions. However, if the failure occurred at an altitude as high or higher than surrounding obstructions, he would feel free to maneuver for a landing back at the airport.

Fortunately, the airplane accelerates through this "area of decision" in just a few seconds. However, to make an intelligent decision in this type of emergency, one must consider the field length, obstruction height, field elevation, air temperature, headwind, and takeoff weight. The flight paths illustrated in Figure 4—2 indicate that the "go no-go area of decision" is bounded by: (1) the point at which 92 KIAS is reached and (2) the point where the obstruction altitude is reached. An engine failure in this area requires an immediate decision. Beyond this area, the airplane, within the limitations of single-engine climb performance shown in the performance charts, may be maneuvered to a landing back at the airport.

At sea level standard day, with zero wind and 5500 pounds weight, the distance to accelerate to 92 KIAS and stop is 3645 feet, while the total unobstructed distance required to takeoff and climb over a 50 foot obstacle after an engine failure at 92 KIAS is 3645 feet. This total distance over an obstacle can be reduced slightly under more favorable conditions of weight, headwind, or obstruction height. However, it is recommended that in most cases it would be better to discontinue the takeoff, since any slight mismanagement of single-engine procedure would more than offset the small distance advantage offered by continuing the takeoff. Still higher field elevations will cause the engine failure takeoff distance to lengthen disproportionately until the altitude is reached where a successful takeoff is improbable unless the airspeed and height above the runway at engine failure are great enough to allow a slight deceleration and altitude loss while the airplane is being prepared for a single-engine climb.

During single-engine takeoff procedures over an obstacle, only one condition presents any appreciable advantage; this is headwind. A decrease of approximately 6% in ground distance required to clear a 50 foot obstacle can be gained for each 10 knots of headwind. Excessive speed above best single-engine rate-of-climb speed at engine failure is not nearly as advantageous as one might expect since deceleration is rapid and ground distance is used up quickly at higher speeds while the airplane is being cleaned up for climb. However, the extra speed is important for controllability.

The following facts should be used as a guide at the time of engine failure: (1) discontinuing a takeoff upon engine failure is advisable under most circumstances; (2) altitude is more valuable to safety after takeoff than is airspeed in excess of the best single-engine rate-of-climb speed since excess airspeed is lost much more rapidly than is altitude; (3) climb or continued level flight at moderate altitude is improbable with the landing gear extended and the propeller windmilling; (4) in no case should the airspeed be allowed to fall below the best single-engine angle-of-climb speed, even though altitude is lost, since this speed will always provide a better chance of climb, or a smaller altitude loss, than any lesser speed. The single-engine best rate-of-climb speed will provide the best chance for climb or the least altitude loss, and is preferable unless there are obstructions which make a steep climb necessary.

WARNING

The propeller on the inoperative engine must be feathered, landing gear retracted and wing flaps up or continued flight may be impossible.

ENGINE OVERSPEED

Should an overspeed condition occur, the pilot should reduce airspeed as quickly as possible by closing both throttles. On reaching an airspeed below 120 KIAS and above the single-engine rate-of-climb speed (blue radial), set the RPM control on the overspeeding engine for feather. If propeller will not feather, the power on the normally operating engine should be advanced to maximum and the power on the overspeeding engine should be advanced to 50 RPM below the maximum allowable RPM (red line). Maintain the best single-engine rate-of-climb speed (blue radial) and land as soon as practical. This will provide more than zero thrust at altitudes up to approximately 10,000 feet. During landing, the application of partial throttle on the malfunctioning engine (within limits of the tachometer red line) will minimize asymmetrical thrust.

MAXIMUM GLIDE

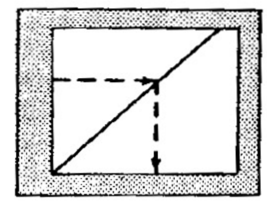
In the event of an all engines failure condition, maximum gliding distance can be obtained by feathering both propellers, and maintaining approximately 111 KIAS with landing gear and wing flaps up. The speed which provides the "absolute maximum" glide distance varies with weight as shown in Figure 4-3.

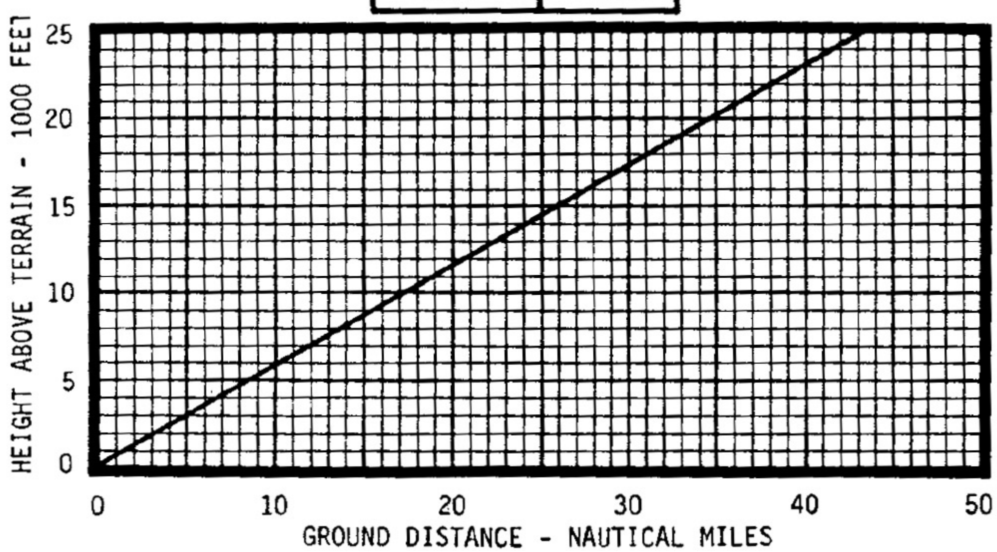
(FIGURE 4-3) MAXIMUM GLIDE

CONDITIONS:
1. Landing Gear - UP.
2. Wing Flaps - UP.
3. Propellers - FEATHERED.
4. Cowl Flaps - CLOSED.
5. Best Glide Speed.
6. Zero Wind.

BEST GLIDE SPEED

WEIGHT POUNDS	KIAS
4700	102
5100	107
5500	111





Section 5
Normal Procedures

Table of Contents

INTRODUCTION

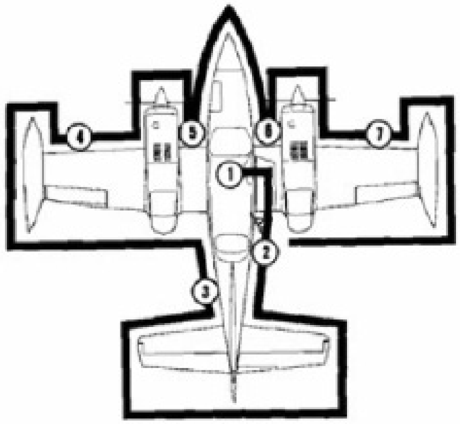
Section 5 of this user guide describes the recommended procedures for normal operations. The first part of this section provides normal procedural action in an abbreviated checklist form. Amplification of the abbreviated checklist is presented in the second part of this section.

Preflight Inspection

NOTE

Visually check inspection plates and general airplane condition during walkaround inspection. If night flight is planned, check operation of all lights and make sure a flashlight is available.

Ensure airplane has been serviced with the proper grade and type of fuel.



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(1)
a. Control Lock(s) - REMOVE and stow.
b. Parking Brake - SET.
c. Alternate Static Source - CLOSED.
d. All Switches - OFF.
e. All Circuit Breakers - IN.
f. Landing Gear Switch - DOWN.
g. Left Fuel Selector - LEFT MAIN (Feel For Detent).
h. Right Fuel Selector - RIGHT MAIN (Feel For Detent).
i. Trim Tab Controls (3) - NEUTRAL.
j.*Oxygen - ON; Quantity, Masks and Hoses - CHECK; Oxygen - OFF.
k. Battery Switch - ON.
l. Navigation and Anti-Collision Lights - ON.
m. Fuel Gages - CHECK quantity and operation.
n.*Fuel Totalizer - SET.
o. Wing Flaps - DOWN 35°.
p. Pitot, Stall and Vent Heat Switches - ON 20 seconds then OFF. Ensure pitot tube cover(s) are removed before actuating pitot heat switch.
q. Windshields and Windows - CHECK for cracks and general condition.
r.*Electric Windshield - CHECK operation by observing discharge on voltammeter if inflight use is anticipated. Insure system is turned off after operational check.
s.*Cabin Fire Extinguisher - CHECK security and pressure.

(2)
a. Baggage Door - SECURE and LOCKED (with key).
b. Air Conditioning Overboard Heat and Condensate Drain Lines - CLEAR.
c. Static Port(s) - CLEAR.
d.*Deice Boots - CHECK condition and security.
e. Control Surface Lock(s) - REMOVE, if installed.
f. Elevator and Tab - CHECK condition, freedom of movement, and tab position.
g. Tie Down - REMOVE.
h. Rudder and Tab - CHECK condition, freedom of movement and tab position.
i.*Deice Boots - CHECK condition and security.

(3)
a. Static Port(s) - CLEAR.
b. Wing Locker Baggage Door - SECURE.
c. Battery Compartment Cover - SECURE.
d. Wing Flap - CHECK security and attachment.
e. Bottom Outboard Wing - CHECK for fuel leaks or stains.
f. Control Surface Lock - REMOVE, if installed.
g. Aileron and Tab - CHECK condition, freedom of movement and tab position.
h. Tip Tank Transfer Pump - LISTEN for operation.
i. Main Tank Fuel Vent - CLEAR.
j. Navigation and Anti-Collision Lights - CHECK operation.
k. Landing Light Filament - CHECK condition.
l. Main Tank Fuel Sump - DRAIN; CHECK for water and contamination.
m. Fuel Vent and Sniffle Valve - CLEAR.
n. Main Tank Fuel Quantity - CHECK; Cap - SECURE.
o.*Deice Boot - CHECK condition and security.
p. Stall Warning Vane - CHECK freedom of movement and audible warning.
q. Wing Tie Down - REMOVE.

(4)
a. Auxiliary Tank Fuel Quantity - CHECK; Cap - SECURE.
b.*Wing Locker Tank Fuel Vent - CLEAR and WARM.
c.*Auxiliary Tank and Wing Locker Transfer Line Fuel Sump - DRAIN. CHECK for water and contamination
d. Fuel Strainer - DRAIN. CHECK for water and contamination.
e.*Wing Locker Tank Fuel Quantity - CHECK; Cap - SECURE.
f. Oil Level - CHECK, minimum 9 quarts.
g. Engine Compartment General Condition - CHECK for fuel, oil and exhaust leaks or stains.
h. Propeller and Spinner - EXAMINE for nicks, security and oil leaks.
i. Leading Edge Air Intake - CLEAR.
j. Main Gear Strut, Doors, Tire and Wheel Well - CHECK.
k.*Wing Locker Tank Fuel Sump - DRAIN. CHECK for water and contamination.
l.*Inboard Deice Boot - CHECK condition and security.

(5)
a. Nose Baggage Door - SECURE and LOCKED (with key).
b. Nose Gear, Strut, Doors, Tire and Wheel Well - CHECK.
c. Lower Fuselage, Nose and Center Section - CHECK for fuel and oil leaks or stains and antenna security.
d. Pitot Cover(s) - REMOVE; Pitot Tube(s) - CLEAR and WARM.
e. Tie Down - REMOVE.
f. Heater Inlet - CLEAR.

(6)
a.*Inboard Deice Boot - CHECK condition and security.
b. Leading Edge Air Intake - CLEAR.
c. Crossfeed Lines - DRAIN. CHECK for water and contamination.
d.*Wing Locker Tank Fuel Sump - DRAIN. CHECK for water and contamination.
e. Main Gear, Strut, Doors, Tire and Wheel Well - CHECK.
f.*Wing Locker Tank Fuel Quantity - CHECK; Cap - SECURE.
g. Oil Level - CHECK, minimum 9 quarts.
h. Engine Compartment General Condition - CHECK for fuel, oil and exhaust leaks or stains.
i. Propeller and Spinner - EXAMINE for nicks, security and oil leaks.
j.*Wing Locker Tank Fuel Vent - CLEAR and WARM.
k.*Auxiliary Tank and Wing Locker Transfer Line - DRAIN. CHECK for water and contamination.
l. Fuel Strainer - DRAIN. CHECK for water and contamination.
m.*Auxiliary Tank Fuel Quantity - CHECK; Cap - SECURE.

(7)
a. Wing Tie Down - REMOVE.
b.*Deice Boot - CHECK condition and security.
c. Main Tank Fuel Quantity - CHECK; Cap - SECURE.
d. Navigation and Anti-Collision Lights - CHECK operation.
e. Fuel Vent and Sniffle Valve - CLEAR.
f. Main Tank Fuel Sump - DRAIN. CHECK for water and contamination.
g. Tip Tank Transfer Pump - LISTEN for operation.
h. Main Tank Fuel Vent - CLEAR and WARM.
i.*Landing Light Filament - CHECK condition.
j. Control Surface Lock - REMOVE, if installed.
k. Aileron - CHECK condition and freedom of movement.
l. Bottom Outboard Wing - CHECK for fuel leaks or stains.
m. Wing Flap - CHECK security and attachment.
n. Wing Locker Baggage Door - SECURE.
o. Battery Switch - OFF.
p. Navigation and Anti-Collision Lights - OFF.
q.*Alcohol Deice Tank - CHECK quantity.

*Denotes items to be checked if the applicable optional equipment is installed on your airplane.

Normal Procedures

Abbreviated Checklist

NOTE

This Abbreviated Normal Procedures Checklist is included as a supplement to the Amplified Normal Procedures Checklist.

Use of the Abbreviated Normal Procedures Checklist should not be used until the flight crew has become familiar with the airplane and systems. All amplified normal procedure items must be accomplished regardless of which checklist is used.

BEFORE STARTING ENGINES

1. Preflight - COMPLETE.
2. Cabin Door - LATCHED and SECURE.
3. Control Locks - REMOVE.
4. Seats, Seat Belts and Shoulder Harness - ADJUST and SECURE.
5. Fuel Selectors - MAIN TANKS.
6. Landing Gear Switch - DOWN.
7. Mixtures, Propellers and Throttles - SET.
8. All Switches and Circuit Breakers - SET.
9. Battery and Alternators - ON.
10. Landing Gear Position Indicator Lights - Check green lights ON.
11. All Warning Lights - PRESS-TO-TEST.
12. Lights - AS REQUIRED.

STARTING ENGINES

1. Propellers - CLEAR.
2. Magneto Switches - ON.
3. Engines - START.
4. Auxiliary Fuel Pumps - LOW.
5. Engine Instruments - CHECK.

BEFORE TAXIING

1. Avionics - ON and SET.

TAXIING

1. Brakes - CHECK.
2. Flight Instruments - CHECK.

BEFORE TAKEOFF

1. Engine Runup - COMPLETE.
   a. Throttles - 1700 RPM.
   b. Alternators - CHECK.
   c. Vacuum System - CHECK.
   d. Magnetos - CHECK.
   e. Propellers - CHECK.
   f. Engine Instruments - CHECK.
   g. Throttles - 1000 RPM.
2. Fuel Quantity - CHECK.
3. Fuel Selectors - MAIN TANKS.
4. Cowl Flaps - LOCKED FULL OPEN.
5. Trim Tabs - SET.
6. Wing Flaps - UP.
7. Propeller Synchrophaser - OFF. (If installed)
8. Flight Instruments and Avionics - SET.
9. Lights - AS REQUIRED.
10. All Cabin Doors and Windows - CLOSED.
11. All Warning Lights - CLEAR.
12. Auxiliary Fuel Pumps - ON.
13. Flight Controls - CHECK.

AIRSPEEDS FOR SAFE OPERATION

Conditions:
1. Takeoff Weight 5500 Pounds
2. Landing Weight 5400 Pounds
3. Sea Level, Standard Day

(1) Air Minimum Control Speed	80 KIAS
(2) Takeoff and Climb to 50 Feet (0° Wing Flaps)	92 KIAS
(3) All Engines Best Angle-of-Climb Speed (0° Wing Flaps)	85 KIAS
(4) All Engines Best Rate-of-Climb Speed (0° Wing Flaps)	107 KIAS
(5) All Engines Landing Approach Speed (35° Wing Flaps)	93 KIAS
(6) Maneuvering Speed	148 KIAS
(7) Structural Cruise Speed	181 KIAS
(8) Never Exceed Speed	223 KIAS
(9) Speed for Transition to Balked Landing Conditions	85 KIAS
(10) Maximum Demonstrated Crosswind Velocity	19 KNOTS

Normal Procedures

Abbreviated Checklist (cont.)

14. Ice Protection - AS REQUIRED.
15. Seat Belts and Shoulder Harness - SECURE.

TAKEOFF

1. Power - SET FOR TAKEOFF (Lean As Required).
2. Engine Instruments - CHECK.
3. Air Minimum Control Speed - 80 KIAS.
4. Takeoff and Climb to 50 Feet - 92 KIAS at 5500 lbs.

AFTER TAKEOFF

1. Landing Gear - RETRACT.
2. Best Angle-of-Climb Speed - 85 KIAS at sea level to 89 KIAS at 15,000 feet with obstacle.
3. Best Rate-of-Climb Speed With Wing Flaps Up - 107 KIAS at sea level and 5500 lbs.

CLIMB

1. Power - SET.
2. Mixtures - ADJUST.
3. Cowl Flaps - AS REQUIRED.

CRUISE

1. Cruise Power - SET.
2. Mixture - LEAN.
3. Cowl Flaps - AS REQUIRED.
4. Propellers - SYNCHRONIZE manually.
5. Propeller Synchrophaser - ON.
6. Auxiliary Fuel Pumps - OFF or LOW if required.
7. Fuel Selectors - MAIN TANKS.

DESCENT

1. Fuel Selectors - MAIN TANKS.
2. Auxiliary Fuel Pumps - ON.
3. Power - AS REQUIRED.
4. Cowl Flaps - AS REQUIRED.
5. Mixtures - ADJUST.
6. Altimeter - SET.

BEFORE LANDING

1. Seat Belts and Shoulder Harness - SECURE.
2. Propeller Synchrophaser - OFF. (If installed)
3. Wing Flaps - AS REQUIRED.
4. Landing Gear - DOWN.
5. Mixtures - ADJUST.
6. Propellers - FULL FORWARD.
7. Approach Speed - 93 KIAS at 5400 lbs.

AFTER LANDING

1. Auxiliary Fuel Pumps - LOW.
2. Cowl Flaps - OPEN.
3. Wing Flaps - UP.

SHUTDOWN

1. Parking Brake - SET if brakes are cool.
2. Accessory Switches - OFF.
3. Auxiliary Fuel Pumps - OFF.
4. Engines - SHUT DOWN.
5. Battery, Alternator and Magneto Switches - OFF.

Amplified Normal Procedures

Preflight Inspection

The Preflight Inspection is recommended for the first flight of the day. Inspection procedures for subsequent flights are normally limited to brief checks of the tail surface hinges, fuel and oil quantity and security of fuel and oil filler caps. If the airplane has been in extended storage, has had recent major maintenance or has been operated from marginal airports, a more extensive exterior inspection is recommended.

After major maintenance has been performed, the flight and trim tab controls should be double-checked for free and correct movement and security. The security of all inspection plates on the airplane should be checked following periodic inspections. Since avionics and heater maintenance requires the mechanic to work in the nose compartment, the nose cap is removed and the nose compartment door is opened for access to equipment. Therefore it is important after such maintenance to double-check the security of the nose cap and this door. If the airplane has been waxed or polished, check the external static pressure source holes for stoppage.

If the airplane has been exposed to much ground handling in a crowded hangar, it should be checked for dents and scratches on wings, main tanks, fuselage and tail surfaces, as well as damage to navigation, anti-collision and landing lights, deice boots and avionics antennas. Outside storage for long periods may result in water and obstructions in airspeed system lines, condensation in fuel tanks, and dust and dirt on the intake air filters and engine cooling fins. Outside storage in windy or gusty areas, or adjacent to taxiing airplanes, calls for special attention to control surface stops, hinges and brackets to detect presence of wind damage.

If the airplane has been operated from muddy fields or in snow or slush, check the main gear and nose gear wells for obstruction and cleanliness. Operation from a gravel or cinder field will require extra attention to propeller tips and abrasion on leading edges of the horizontal tail. Stone damage to the propeller can seriously reduce the fatigue life of the blades.

Airplanes that are operated from rough fields, especially at high altitudes, are subject to abnormal landing gear abuse. Check frequently all components of the landing gear retracting mechanisms, shock struts, tires and brakes. Undue landing and taxi loads will be subjected on the airplane structure when the shock struts are insufficiently extended. A completely collapsed (zero extension) shock strut could cause a malfunction in the landing gear retraction system.

To prevent loss of fuel in flight, make sure the main and auxiliary fuel tank filler caps are tightly sealed. The main fuel tank vents on the lower surface of the main tanks should also be inspected for obstructions, ice, or water, especially after operation in cold, wet weather.

The interior inspection will vary according to the planned flight and the optional equipment installed. Prior to high-altitude flights, it is important to check the condition and quantity of oxygen face masks and hose assemblies. The oxygen supply system should be functionally checked to insure it is in working order. The oxygen pressure gage should indicate 300 to 1800 PSI (48.3 cubic foot system) or 30 to 1850 PSI (76.6 cubic foot system) depending on the anticipated requirements.

Satisfactory operation of the pitot tube(s) and stall warning transmitter and optional wing locker fuel tank vent heating elements is determined by observing a discharge on the voltammeter when the pitot heat switch is turned ON. The effectiveness of these heating elements may be verified by cautiously feeling the heat of these devices while the switch is ON.

Flights at night and in cold weather involve a careful check of other specific areas which will be discussed later in this section.

BEFORE STARTING ENGINES

1. Preflight – COMPLETE.
2. Cabin Door – LATCHED and SECURE.
3. Control Locks – REMOVE.
4. Seats, Seat Belts, and Shoulder Harness – ADJUST and SECURE.
5. Brakes - SET.
6. Fuel Selectors -
   a. Left Engine - LEFT MAIN.
   b. Right Engine - RIGHT MAIN.
7. Landing Gear Switch – DOWN.
8. Mixtures – FULL RICH.
9. Propellers – FULL FORWARD.
10. Throttles – OPEN ONE INCH.
11. All Switches - OFF.
12. Circuit Breakers – IN.
13. Emergency Alternator Field Switch – OFF.
14. Emergency Avionics Power Switch – OFF.
15. Avionics Master Switch – OFF.
16. Auxiliary Fuel Pump Switches – OFF.
17. Battery and Alternators – ON.
18. Lighting Rheostats – AS REQUIRED.
19. Landing Gear Position Indicator Lights – Check green lights ON.
20. All Warning Lights – PRESS-TO-TEST.
21. Altimeter and Clock – SET.
22. Cowl Flaps – LOCKED FULL OPEN.
23. Fuel Quantity – CHECK.
24. Fuel Totalizer – SET (Optional System).
25. Cabin Air Controls – SET AS REQUIRED.
26. Alternate Air Controls – IN.
27. External Lights - AS REQUIRED.

NOTE

Ground operation of the high intensity anti-collision lights can be of considerable annoyance to ground personnel and other pilots.

STARTING ENGINES
(Left Engine First Without External Power)

1. Propellers – CLEAR.
2. Magneto Switches – ON.
3. Engines – START.
   a. Starter Button - PRESS.
   b. Primer Switch - Left Engine – LEFT.
      Right Engine – RIGHT.

CAUTION

If the primer is activated for excessive periods of time with the engine inoperative on the ground or during flight, damage may be incurred to the engine and/or airplane due to fuel accumulation in the cylinder intake ports. Similar conditions may develop when the engine is shutdown with the auxiliary fuel pump ON.

Should fuel priming or auxiliary fuel pump operation periods in excess of 60 seconds occur, the cylinders must be purged by one of the following procedures:
With auxiliary fuel pump OFF, allow manifold to drain at least 5 minutes or until fuel ceases to flow out of the drains under the nacelle.

If circumstances do not allow natural draining periods recommended above, with the auxiliary fuel pump OFF, magnetos OFF, mixture IDLE CUT-OFF and throttle FULL OPEN, turn engine with starter or by hand a minimum of 15 revolutions.

4. Auxiliary Fuel Pumps - LOW to purge vapor from fuel system.
5. Throttle – 800 to 1000 RPM.
6. Oil Pressure – 10 PSI minimum in 30 seconds in normal weather, or 60 seconds in cold weather. If no indication appears, shutdown engine and investigate.
7. Right Engine - START. Repeat steps 1 through 6.
8. Alternators - CHECK.

The left engine is normally started first because the cable from the battery to this engine is much shorter, permitting more electrical power to be delivered to the starter. If battery is low, the left engine should start more readily.

NOTE

Release starter button as soon as engine fires or engine will not accelerate and flooding can result.

The continuous flow fuel injection system will start spraying fuel in the engine intake ports as soon as the primer switch is actuated and the throttle and mixture controls are opened. If the auxiliary pump is turned on accidentally while the engine is stopped with the throttle open and the mixture rich, liquid fuel will collect temporarily in the cylinder intake ports. The quantity of fuel deposited will depend upon the amount of throttle opening and the length of time the pump has been operating. If this happens, it is advisable to wait a few minutes until the fuel drains away, then turn the propeller through 15 complete revolutions. This is done to prevent the possibility of engine damage due to hydrostatic lock before starting the engine. To avoid flooding, begin cranking the engine prior to priming the engine.

Engine mis-starts, characterized by weak intermittent explosions followed by black puffs of smoke from the exhaust, are the result of flooding or overpriming. This situation is more apt to develop in hot weather, or when the engines are hot. If it occurs, repeat the starting procedure with the throttle approximately 1/2 open, the mixture in IDLE CUT-OFF and the primer switch OFF. As the engine fires, move the mixture control to FULL RICH and close the throttle to idle.

If an engine is underprimed, as may occur in cold weather with a cold engine, repeat the starting procedure while holding the primer switch ON for 5 to 10 seconds until the engine fires.

If cranking longer than 30 seconds is required, allow starter-motor to cool five minutes before cranking again since excessive heat may damage the armature windings.

After the engines are started, the auxiliary fuel pumps should be switched to LOW to provide for improved purging and vapor clearing in the fuel system.

BEFORE TAXIING

1. Avionics Master Switch – ON.
2. Avionics - SET.
3. Wing Flaps – UP.
4. Lights – AS REQUIRED.
5. Cabin Temperature – AS REQUIRED.
   a. If heating and defrosting is required:
      (1) Cabin Air Knobs – OPEN.
      (2) Defrost Knob – AS REQUIRED.
      (3) Temperature Control Knob – OPEN.
      (4) Cabin Heat Switch – HEAT.
      (5) Heat Registers – AS REQUIRED.
   b. If ventilation is required:
      (1) Cabin Air Knobs – OPEN.
      (2) Cabin Heat Switch – FAN.
      (3) Heat Registers and Directional Air Vents – AS REQUIRED.
6. Brakes – RELEASE. Pushing the parking brake knob in releases the trapped brake fluid, allowing the brakes to be released.

TAXIING

1. Throttles – AS REQUIRED.
2. Brakes – CHECK.
3. Flight Instruments – CHECK.

Normal steering may be aided through use of differential power and differential braking on the main wheels. These aids are listed in the preferred order of use. Do not use excessive brake on the inboard side to effect a turning radius as decreased tire life will result.

At some time early in the taxi run, the brakes should be checked for any unusual reaction, such as uneven braking. The operation of the turn-and-bank indicator and directional gyro should also be checked during taxiing. When turning right, the turn-and-bank needle should deflect right while the ball goes left and directional gyro heading increases in numerical value. In a left turn the converse is true. At this time the artificial horizon should be up to speed and indicating a level attitude.

Most of the engine warm-up should be done during taxiing, with just enough power to keep the airplane moving. Engine speed should not exceed 1000 RPM while the oil is cold.

Do not operate engines at high RPM when taxiing over gravel or loose material that may cause damage to the propeller blades.

BEFORE TAKEOFF

1. Brakes – SET.
2. Engine Runup:
   a. Throttles – 1700 RPM.
   b. Alternators – CHECK.
   c. Vacuum System – CHECK 4.75 to 5.25 inches Hg.
   d. Magnetos – CHECK 150 RPM maximum drop with a maximum differential of 50 RPM.
   e. Propellers – CHECK feathering to 1200 RPM; return to high RPM (Full Forward Position).

CAUTION

During propeller feathering checks, do not allow the propeller RPM to fall below 1000 RPM as this may damage the hub mechanism.

   f. Engine Instruments – CHECK green arc.
   g. Throttles – 2100 RPM.

NOTE

It is important that the engine oil temperature be within the normal operating range prior to applying takeoff power.

   h. Governor – CHECK (Retard propeller condition levers until noting slight drop in RPM, then advance throttle and check for no increase in RPM).
   i. Propellers – FULL FORWARD.
   j. Throttles – 1000 RPM.
3. Fuel Quantity – CHECK.
4. Fuel Selectors - RECHECK:
   a. Left Engine - LEFT MAIN.
   b. Right Engine - RIGHT MAIN.
5. Alternate Air Controls – IN.
6. Trim Tabs – SET elevator, aileron and rudder tabs in the TAKEOFF range.
7. Cowl Flaps – LOCKED FULL OPEN.
8. Wing Flaps – UP.
9. Propeller Synchrophaser - OFF. (If Installed)
10. Flight Instruments and Avionics – SET.
11. Lights – AS REQUIRED.
12. All Cabin Doors and Windows – CLOSED.
13. All Warning Lights – CLEAR.
14. Auxiliary Fuel Pumps – ON.
15. Flight Controls – CHECK, free and correct.
16. Ice Protection Equipment – AS REQUIRED.
17. Seat Belts and Shoulder Harness – SECURE.
18. Brakes – RELEASE.

Full throttle checks on the ground are not recommended unless there is good reason to suspect that the engines are not operating properly. Do not runup the engines over loose gravel or cinders because of possible stone damage or abrasion to the propeller tips.

If the ignition system produces an engine speed drop in excess of 150 RPM, or if the drop in RPM between the left and right magneto differs by more than 50 RPM, continue warm-up a minute or two longer before rechecking the system. If there is doubt concerning operation of the ignition system, checks at higher engine speed will usually confirm if a deficiency exists. In general, a drop in excess of 150 RPM is not considered acceptable.

A careful check should be made of the vacuum sys-

tem. The minimum and maximum allowable suctions are 4.75 and 5.25 inches Hg., respectively, on the instrument. Good alternator condition is also important for instrument flight since satisfactory operation of all avionics equipment and electrical instruments is essential. The alternators are checked during engine runup (1700 RPM) by positioning the selector switch in the L ALT and R ALT position and observing the charging rate on the voltammeter.

A simple last minute recheck of important items should include a quick glance to see if all switches are ON, the mixture and propeller controls are forward, all flight controls have free and correct movement and the fuel selectors are properly positioned.

> **NOTE**
>
> Make sure that weight does not exceed 5500 pounds before attempting takeoff.

A mental review of all engine inoperative speeds, procedures and field length requirements should be made prior to takeoff.

TAKEOFF

NORMAL TAKEOFF

1. Power – FULL THROTTLE and 2700 RPM.

> **NOTE**
>
> Apply full throttle smoothly to avoid propeller surging and excessive manifold pressure.

1. Mixtures – LEAN for field elevation.
2. Engine Instruments – CHECK.
3. Air Minimum Control Speed – 80 KIAS.
4. Elevator Control – Raise nosewheel at 83 KIAS.
5. Lift-Off – 92 KIAS at 5500 pounds.

MAXIMUM PERFORMANCE TAKEOFF

1. Wing Flaps – DOWN 15°
2. Brakes – SET.
3. Power – FULL THROTTLE

> **NOTE**
>
> Apply full throttle smoothly to avoid propeller surging.

4. Mixtures – LEAN for field elevation.
5. Brakes – RELEASE.
6. Power – CHECK 2700 RPM.

> **NOTE**
>
> Leaning during the takeoff roll at low altitudes is normally not necessary for smooth engine operation; however, fuel flows should be adjusted to match field elevation to obtain maximum airplane performance.

7. Elevator Control – Raise nosewheel at 70 KIAS.
8. Air Minimum Control Speed – 80 KIAS.
9. Lift-Off – 82 KIAS at 5500 pounds.

Before initiating the takeoff roll, a go, no-go decision should have been made in the event an engine failure should occur. Review the anticipated performance presented in the Accelerate-Stop Distance, Accelerate-Go Distance and Engine Inoperative Rate-of-Climb charts. In addition, review the applicable procedures and speeds associated with single-engine operation so that the transition (in the event of an engine failure) will be smooth, positive and safe. If the anticipated performance exceeds the runway length available or obstacle clearance requirements cannot be achieved, it is recommended to takeoff on a more favorable runway, off-load the airplane until the anticipated performance is consistent with existing conditions or delay the takeoff until more favorable atmospheric conditions exist.

Since the use of full throttle is not recommended in the static runup, closely observe full-power engine operation early in the takeoff run. Signs of rough engine operation, unequal power between engines, or sluggish engine acceleration are good cause for discontinuing the takeoff. If this occurs, make a thorough full throttle static runup before another takeoff is attempted.

For maximum performance takeoff, the engines should be run up to full power before brake release. For maximum engine power, the mixture should be adjusted during the initial acceleration to the recommended fuel flow for the field elevation. The engine acceleration is increased significantly with fuel leaning above 3000 feet. This procedure always should be employed for field elevations greater than 5000 feet above sea level.

Full throttle operation is recommended on takeoff since it is important that a speed well above air minimum control speed (80 KIAS) be obtained as rapidly as possible. It is desirable to accelerate the airplane to 92 KIAS (recommended safe single-engine speed) before lift-off for additional safety in case of an engine failure. This safety may have to be compromised slightly where short and rough fields prohibit such high speed before takeoff.

For crosswind takeoffs, additional power may be carried on the upwind engine until the rudder becomes effective. The airplane is accelerated to a slightly higher than normal takeoff speed, and then is pulled off abruptly to prevent possible settling back to the runway while drifting. When clear of the ground, a coordinated turn is made into the wind to correct for drift.

A takeoff with one main tank full and the opposite tank empty creates a lateral unbalance. This is not recommended since gusty air or premature lift-off could create a serious control problem.

After takeoff, it is important to maintain the recommended safe single-engine climb speed (92 KIAS) to 50 feet. As the airplane accelerates still further to all engines best rate- of-climb speed (107 KIAS), it is good

practice to climb rapidly to an altitude at which the airplane is capable of circling the field on one engine.

AFTER TAKEOFF

1. Brakes – APPLY momentarily.
2. Landing Gear – RETRACT. Check red light off.
3. Wing Flaps – UP after obstacles are cleared if maximum performance takeoff.
4. Best Angle-of-Climb Speed (Sea Level) - 85 KIAS after reaching 50 feet if immediate obstacle clearance is a consideration.
5. Best Rate-of-Climb Speed - 107 KIAS at sea level and 5500 pounds.
6. Auxiliary Fuel Pumps - OFF.

To establish climb configuration, retract the landing gear, adjust power for climb, turn off auxiliary fuel pumps and adjust the mixtures for the selected power setting.

Before retracting the landing gear, apply the brakes momentarily to stop the rotation of the main wheels. Centrifugal force caused by the rapidly rotating wheels expands the diameter of the tires, and if ice or mud has accumulated in the wheel wells, the rotating wheels may rub as they enter.

On long runways, the landing gear should be retracted at the point over the runway where a wheels-down forced landing on that runway would become impractical. However, on short runways it may be preferable to retract the landing gear after the airplane is safely airborne.

Power reduction will vary according to the requirements of the traffic pattern or surrounding terrain, weight, field elevation, temperature, environmental considerations and engine condition. However, a normal after takeoff power setting is 2500 RPM and 24.5 inches Hg. manifold pressure.

CLIMB

CRUISE CLIMB

1. Power – 2500 RPM and 24.5 inches Hg.
2. Airspeed – 115 KIAS to 130 KIAS.
3. Mixtures - ADJUST to climb fuel flow.
4. Cowl Flaps – OPEN or as required.
5. Auxiliary Fuel Pumps – ON above 12,000 feet altitude to minimize vapor formation.

NOTE

During very hot weather, if there is an indication of vapor in the fuel system (fluctuating fuel flow) or anytime when climbing above 12,000 feet, turn the auxiliary fuel pumps ON until cruising altitude has been obtained and the system is purged (usually 5 to 15 minutes after establishing cruising flight).

6. Propellers — SYNCHRONIZE manually.
7. Quadrant Friction Lock - TIGHTEN securely (With Synchrophaser Installed).
8. Propeller Synchrophaser - PHASING (Optional System). Light should illuminate continuously.
   a. Phasing Knob - ADJUST for desired phasing position.

MAXIMUM CLIMB

1. Power – FULL THROTTLE and 2700 RPM.
2. Airspeed - 107 KIAS at sea level; 99 KIAS at 10,000 feet.
3. Mixtures - ADJUST for altitude and power.
4. Cowl Flaps — OPEN as required.
5. Auxiliary Fuel Pumps - ON above 12,000 feet altitude to minimize vapor formation.

NOTE

During very hot weather, if there is an indication of vapor in the fuel system (fluctuating fuel flow) or anytime when climbing above 12,000 feet, turn the auxiliary fuel pumps ON until cruising altitude has been obtained and the system is purged (usually 5 to 15 minutes after establishing cruising flight).

NOTE (CONT.)

It is recommended that the mixture remain at the climb mixture setting for approximately 5 minutes after establishing cruising flight before leaning is initiated.

Normal cruising climb is recommended where practical and should be conducted at 115 to 130 KIAS, using approximately 75% power (2500 RPM and 24.5 inches Hg. manifold pressure).

If it is necessary to climb rapidly to clear mountains or reach favorable winds at high altitudes, the best rate-of~climb speed should be used with maximum power. This speed varies from 107 KIAS at sea level to 99 KIAS at 10,000 feet. During maximum performance climbs, the mixture should be leaned to the recommended fuel flow. It is recommended that the auxiliary fuel pumps be on at altitudes above 12,000 feet for the duration of the climb and approximately 5 to 15 minutes after establishing cruising flight. It is also recommended that the mixture remain at the climb mixture setting for approximately 5 minutes after establishing cruising flight before leaning is initiated. These procedures will eliminate fuel vaporization problems likely to occur from rapid altitude changes.

If an obstruction ahead requires a steep climb angle, the airplane should be flown at the all engines best angle-of-climb speed with flaps up and maximum power. This speed varies from 85 KIAS at sea level to 89 KIAS at 15,000 feet.

During cruise climbs, positioning the propeller synchrophaser to PHASING will eliminate the unpleasant audio beat accompanying unsynchronized operation. The propeller synchrophaser can also provide a significant reduction in cabin vibration.

With the propellers slightly out of synchronization so that an audio beat is obtained approximately once each 5 seconds, it should be noted that the vibration level of the cabin and instrument panel will increase and

decrease at a rate of approximately once each 20 seconds. Optimum operation will be obtained by manually synchronizing the propellers and positioning the synchrophaser to PHASING. Best propeller synchronizing is obtained by making the final adjustment of the propeller controls in a DECREASE RPM direction. For best operation, securely tighten the quadrant friction lock to prevent the slaved propeller control from creeping.

CRUISE

1. Cruise Power – 2100 to 2500 RPM and 15.0 to 24.5 inches Hg.
2. Mixtures – LEAN for desired cruise fuel flow as determined from your power computer. Recheck mixtures if power, altitude or OAT changes.
3. Cowl Flaps – OPEN or as required.
4. Propellers – SYNCHRONIZE manually.
5. Quadrant Friction Lock – Tighten securely (With Synchrophaser Installed)
6. Propeller Synchrophaser – PHASING (Optional System). Light should illuminate continuously.
   a. Phasing Knob – ADJUST for desired phasing position.
7. Auxiliary Fuel Pumps:
   a. Main Tanks – OFF or LOW if required.
   b. Switching Tanks – LOW.
   c. Auxiliary Tanks – OFF.
   d. Crossfeeding – LOW.
8. Fuel Selectors - Left Engine - LEFT MAIN.
   Right Engine - RIGHT MAIN.
   a. If optional 40 gallon auxiliary tanks are installed, fuel selectors – MAIN TANKS for 60 minutes.
   b. If optional 63 gallon auxiliary tanks are installed, fuel selectors – MAIN TANKS for 90 minutes.
   c. Usable auxiliary fuel quantity is based on level flight.
   d. If wing locker tanks are installed, fuel selectors – MAIN TANKS or, after wing locker tanks are transferred and main tank quantity is less than 180 pounds each – AUXILIARY TANKS.

NOTE

- Turn auxiliary fuel pumps to LOW and mixtures to FULL RICH when switching tanks.
- The auxiliary fuel tanks are to be used in cruise flight only.

   e. If wing locker tanks are installed, crossfeed – SELECT as required to maintain fuel balance after wing locker tank fuel transfer.
9. If oxygen use is desired, proceed as follows:
   a. Mask – Connect mask and hose assembly and put mask on.

WARNING

Permit no smoking when using oxygen. Oil, grease, soap, lipstick, lip balm, and other fatty materials constitute a serious fire hazard when in contact with oxygen. Be sure hands and clothing are oil-free before handling oxygen equipment.

   b. Hose Coupling – Plug into oxygen outlet inside access door in outboard armrest.
   c. Oxygen Flow Indicator – Check Flow (Indicator Toward Mask Indicates Proper Flow).
   d. Disconnect hose coupling when not in use.
10. Trim Tabs - ADJUST.

Normal cruising requires between 50% and 70% power. The manifold pressure and RPM settings required to obtain these powers at various altitudes and outside air temperatures can be determined with your power computer. A maximum cruising power of approximately 75% (24.5 inches Hg. manifold pressure and 2500 RPM) may be used if desired. Various percent powers can be obtained with a number of combinations of manifold pressures, engine speeds, altitudes and outside air temperatures. However, at full throttle and constant engine speed, a specific power can be obtained at only one altitude for each given air temperature. For a given throttle setting, select the lowest engine speed in the green arc range that will give smooth engine operation without-evidence of laboring.

The use of lower power settings and the selection of cruise altitude on the basis of the most favorable wind conditions are significant factors that should be considered on every trip to reduce fuel consumption. Additional range can be achieved when operating at select power combinations, by leaning to peak exhaust gas temperature (EST) for Best Economy mixture. This setting results in an airspeed loss of 4 KTAS and range increase of 8% compared to the Recommended Lean mixture. Do not lean to the extent that engine roughness or excessive speed loss occurs.

CAUTION

Operation at Best Economy mixture is not recommended until oil consumption stabilizes or during the first 50 hours of operation. The purpose of this interval of operation at higher power levels (65% to 75% power) is to insure proper seating of the rings and is applicable to new engines, and engines in service following cylinder replacement or top overhaul of one or more cylinders.

When leaning, accomplish the procedure as precisely as possible. A little extra effort in setting the mixtures will yield significant dividends.

The internal cowl flaps should normally be locked and left in the FULL OPEN position for all flight and ground operations, particularly on standard or above standard temperatures. During below standard temperatures, the cowl flaps should be adjusted to modulate the cylinder head temperatures within the normal operating range (green arc). Cowl flap position has no effect on cruise or climb performance.

Best propeller synchronizing is obtained by making the final adjustment of the propeller controls in a DECREASE RPM direction. Manually synchronize the pro-

pellers as closely as possible and tighten the quadrant friction lock securely. Position the synchrophaser to PHASING. The phasing knob should then be adjusted until the desired sound and vibration characteristics are obtained. This setting will vary from flight to flight. If non-synchronized operation occurs during long cruise flights, manually re-synchronize the propeller controls as closely as possible and synchronized operation should reoccur. Securely tighten the quadrant friction lock, then adjust the phasing knob as desired.

On long cruise flights, where the slaved governor can eventually operate near either end of its operating range, it may be necessary to periodically select the OFF position, reset the propeller controls and re-engage the synchrophaser.

If auxiliary fuel tanks are to be used, select main fuel for 60 minutes of flight (with 40 gallon auxiliary tanks) or 90 minutes of flight (with 63 gallon auxiliary tanks). This is necessary to provide space in the main tanks for vapor and fuel returned from the engine-driven fuel pumps when operating on auxiliary fuel. If sufficient space is not available in the main tanks for this diverted fuel, the tanks can overflow through the overboard fuel vents. After this period of time (60 or 90 minutes), set mixtures to FULL RICH, auxiliary fuel boost pumps to LON, select the auxiliary fuel tank position on the fuel selectors and feel for detent. The engines will now operate on the auxiliary tank fuel; the fuel quantity indicator will automatically reference the auxiliary fuel tanks. Lean the mixtures as required.

Since part of the fuel from the auxiliary tanks is diverted back to the main tanks instead of being consumed by the engines, the auxiliary tanks will run dry sooner than may be anticipated; however, the main tank endurance will be increased by the returned fuel. The total usable fuel supply is available during cruising flight only. An engine failure or engine driven pump failure results in the auxiliary fuel on the side of the failure being unusable. Operation on the auxiliary fuel tanks near the ground (below 1000 feet AGL) is not recommended.

After consuming the auxiliary tank fuel, set mixtures to FULL RICH, auxiliary fuel boost pumps to LOW, select the main tank position on the fuel selectors and feel for detent. After transitioning back to the main tanks, lean the mixtures as required and position auxiliary fuel pump switches to OFF.

If wing locker fuel is to be used, use the main tank fuel until 180 pounds or less remains in the main tank(s) which will receive the wing locker fuel; this will prevent overflowing of the main tank(s) when transferring the wing locker fuel.

There are no separate fuel selector controls for the wing locker fuel tanks. The wing locker fuel is pumped directly into the main tanks with a fuel transfer pump. Indicator lights are illuminated by pressure switches to indicate fuel has been transferred. Fuel should be cross-fed as required to maintain fuel balance after wing locker fuel has been transferred.

NOTE

Wing locker transfer pump switches provided on the instrument panel, energize the wing locker fuel transfer pumps for transferring fuel. These switches should be turned ON only to transfer fuel and turned OFF when the indicator lights come on indicating fuel has been transferred.

For flight in an icing environment, refer to the Alternate Induction Air paragraphs in this section and other sections dealing with flight in an icing environment.

DESCENT

1. Fuel Selectors - Left Engine - LEFT MAIN.
Right Engine - RIGHT MAIN.
2. Auxiliary Fuel Pumps - ON.
3. Power – AS REQUIRED to maintain engine temperatures in the green.
4. Cowl Flaps – AS REQUIRED.
5. Mixtures – ADJUST for smooth operation with gradual enrichment as altitude is lost.
6. Altimeters – SET.

Descents should be initiated far enough in advance of estimated landing to allow a gradual rate of descent at cruising speed. It should be at approximately 500 fpm for passenger comfort, using enough power to keep the engines warm. This will prevent undesirable low cylinder head temperatures caused by low power settings at cruise speed. The optimum engine speed in a descent is usually the lowest one in the RPM green arc range that will allow cylinder head temperatures to remain in the recommended operating range.

When operating at high altitudes and/or high ambient temperatures, careful attention should be paid to proper leaning of the mixture for both fuel economy and engine performance. This is especially important during prolonged low-power or idle-power operation. Overly rich mixtures during a long idle-power descent from cruising altitude could result in loss of power. During low-power operations, mixtures should always be leaned for smooth operation.

During the descent, the mixtures should be gradually enrichened to maintain smooth engine operation. This procedure will provide sufficient fuel flow for the descent; however, if a higher power setting (i.e. balked landing) is required before landing, the mixtures must be readjusted to obtain the correct fuel flow.

To prevent confusion in interpreting which 10,000 foot segment of altitude is being displayed on the altimeter, a striped warning segment is exposed on the face of the altimeter at all altitudes below 10,000 feet.

If fuel has been consumed at uneven rates between the two main tanks because of prolonged one engine flight, it is desirable to balance the fuel load by operating both engines from the fullest tank. However, if there is

sufficient fuel in both tanks, even though they may have unequal quantities, it is important to switch the left and right fuel selectors to the left and right main tanks, respectively; feel for detent; and check the auxiliary fuel pumps ON for the landing. This will provide an adequate fuel flow to each engine if a balked landing is necessary.

NOTE

Make sure that weight does not exceed 5400 pounds before attempting landing.

BEFORE LANDING

1. Seat Belts and Shoulder Harness – SECURE.
2. Propeller Synchrophaser – OFF (Optional System).
3. Alternate Air Controls – CHECK IN.
4. Wing Flaps – DOWN 15° below 158 KIAS.
5. Landing Gear – DOWN below 138 KIAS.
6. Landing Gear Position Indicator Lights – Check down lights – ON; Unlocked Light – OFF.
7. Mixtures – FULL RICH or lean as required for smooth operation.
8. Propellers – FULL FORWARD.
9. Wing Flaps – DOWN 35° below 138 KIAS.
10. Minimum Multi-Engine Approach Speed – 93 KIAS at 5400 pounds.
11. Air Minimum Control Speed - 80 KIAS.

Landing gear extension before landing is easily detected by a slight change in airplane trim and a slight "bump" as the gear locks down. Illumination of the gear-down indicator lights (green) is further proof that the gear is down and locked. The gear unlocked indicator light (red) will illuminate when the gear uplocks are released and will remain illuminated while the gear is in transit. The unlocked light will extinguish when the gear has locked down. If it is reasonably certain that the gear is down and one of the gear-down indicator lights is still not illuminated, the malfunction could be caused by a burned out light bulb. This can be checked by pushing the applicable gear-down indicator light. If the bulb is burned out, it can be replaced with the bulb from any post light, or the landing gear unlocked indicator light.

A simple last—minute recheck on final approach should confirm that all applicable switches are on, the gear-down indicator lights (green) are illuminated, the gear unlocked indicator light (red) is extinguished and the propeller and mixture controls are full forward.

Landings are simple and conventional in every respect. If power is used in landing approaches, it should be eased off cautiously near touch-down, because the "power-on" stall speed is considerably less than the "power-off" stall speed. An abrupt power reduction at five feet altitude could result in a hard landing if the airplane is near stall speed.

Landings on hard-surface runways are performed with 35° flaps and 93 KIAS during the approach, using as little power as practicable. A normal flare-out is made. and power is reduced in the flare- out. The landing is made on the main wheels first, and remaining engine power is cut immediately after touchdown. The nosewheel is gently lowered to the ground and brakes applied as required. Short field landings on rough or soft runways are done in a similar manner except that the nosewheel is lowered to the runway at a lower speed to prevent excessive nose gear loads.

Crosswind landings are performed with the least effort by using the crab method. However, either the wing-low, crab or combination method may be used. Crab the airplane into the wind in a normal approach using a minimum flap setting for the field length. Immediately before touchdown, the airplane is aligned with the flight path by applying down-wind rudder. The landing is made in nearly three-point attitude, and the nosewheel is lowered to the runway immediately after touchdown. A straight course is maintained with the steerable nosewheel and occasional braking if necessary.

BALKED LANDING

1. Increase engine speed to 2700 RPM and apply full throttle if necessary.
2. Mixtures – AS REQUIRED for balked landing power setting.
3. Balked Landing Transition Speed – 85 KIAS.
4. Landing Gear – RETRACT during IFR go-around or simulated IFR go-around after establishing a positive rate of climb.

NOTE

- Experience indicates that retracting the landing gear during an operational VFR go-around, when an immediate landing is contemplated, has been conducive to gear up landings.
- Always follow the Before Landing Checklist.

5. Wing Flaps – 15°.
6. Trim airplane for climb.
7. Cowl Flaps – OPEN.
8. Wing Flaps – UP as soon as all obstacles are cleared and a safe altitude and airspeed are obtained.

AFTER LANDING

1. Auxiliary Fuel Pumps – LOW during landing roll.
2. Cowl Flaps – OPEN.
3. Wing Flaps – UP.

Maximum braking effectiveness is obtained by applying full even pressure to the toe brakes without locking the wheels and applying full back pressure to the control column. This procedure is recommended only for emergency stops as excessive brake pad and tire wear will occur. Maximum brake wear occurs at high speed. This brake wear can be reduced using aerodynamic braking supplemented with the use of wheel brakes. Maximum aerodynamic braking occurs with the wing flaps fully extended and the control wheel held aft to keep the nose off the runway as long as possible.

After leaving the active runway, the wing flaps should be retracted. Be sure the wing flaps switch is identified before placing it in the UP position. The auxiliary fuel pump switches are turned to LOW during the landing roll.

SHUTDOWN

1. Parking Brake – SET if brakes are cool.
2. Avionics Master Switch - OFF.
3. All Switches Except Battery, Alternator and Magneto Switches – OFF.
4. Auxiliary Fuel Pumps – OFF.

NOTE

The fuel pumps must be turned OFF prior to stopping engines.

5. Throttles – IDLE.
6. Mixtures – IDLE CUT-OFF.
7. Battery and Alternators – OFF.
8. Magneto Switches – OFF, after engines stop.
9. Control Locks – INSTALL.
10. Fuel Selectors – OFF if a long period of inactivity is anticipated.
11. Cabin Door – CLOSE.

NOTE

To securely latch the cabin door from the outside, the exterior door handle must be rotated clockwise to its stop.

With the mixture levers in IDLE CUT—OFF, the fuel flow is effectively blocked at the fuel metering unit. Thus, it is unnecessary to place the fuel selectors in the OFF position if the airplane is receiving normal usage. However, if a long period of inactivity is anticipated, the fuel selectors should be turned OFF to preclude any possible fuel seepage that might develop through the metering valve.

NOTE

Do not leave the fuel selectors in an intermediate position, as fuel from the main tanks will transfer into the auxiliary tanks.

STALL

The stall characteristics of the airplane are conventional. Aural warning is provided by the stall warning horn between 5 and 10 KIAS above the stall in all configurations. The stall is also preceded by a mild aerodynamic buffet which increases in intensity as the stall is approached. The power-on stall occurs at a very steep angle with or without flaps. It is difficult to inadvertently stall the airplane during normal maneuvering.

MANEUVERING FLIGHT

No aerobatic maneuvers, including spins, are approved in this airplane; however, the airplane is conventional in all respects through the maneuvering range encountered in normal flight.

PROCEDURES FOR PRACTICE DEMONSTRATION OF $^{V}MC_{A}$

Single-engine procedures should be practiced in anticipation of an emergency. This practice should be conducted at a safe altitude (5000 feet), with full power operation on both engines, and should be started at a safe speed of at least 105 KIAS. As recovery ability is gained with practice, the starting speed may be lowered in small increments until the feel of the airplane in emergency conditions is well known. It should be noted that as the speed is reduced, directional control becomes more difficult. Emphasis should be placed on stopping the initial large yaw angles by the IMMEDIATE application of rudder supplemented by banking slightly away from the yaw. Practice should be continued until: (1) an instinctive correction reaction is developed and the correction procedure is automatic and, (2) airspeed, altitude, and heading can be maintained easily while the airplane is being prepared for a climb. In order to simulate an engine failure, set both engines at full power operation; then at a chosen speed, pull the throttle control of one engine to idle, and proceed with single-engine emergency procedures. Simulated single-engine flight characteristics can be practiced by setting propeller RPM to simulate a critical engine inoperative condition as shown in Figure 5-3.

1. Wing Flaps - UP.
2. Landing Gear - UP.
3. Airspeed - ^{V}SSE (92 KIAS) or above.
4. Inoperative Engine - IDLE POWER.
5. Operative Engine - 2700 RPM and FULL THROTTLE.
6. Airspeed - DECREASE at approximately 1 knot per second until $^{V}MC_{A}$ (red radial) or stall warning, whichever occurs first is obtained.

^{V}SSE is used in training and is not a limitation. It is recommended, however, that except for training, demonstrations, takeoffs and landings, this airplane should not be not be flown at a speed slower than ^{V}SSE.

Under no circumstances should a $^{V}MC_{A}$ demonstration be attempted at a speed slower than the red radial on the airspeed indicator.

NIGHT FLYING

Before starting the engines for a night flight, the rheostats should be turned on and adjusted to provide enough illumination to check all switches, controls, etc.

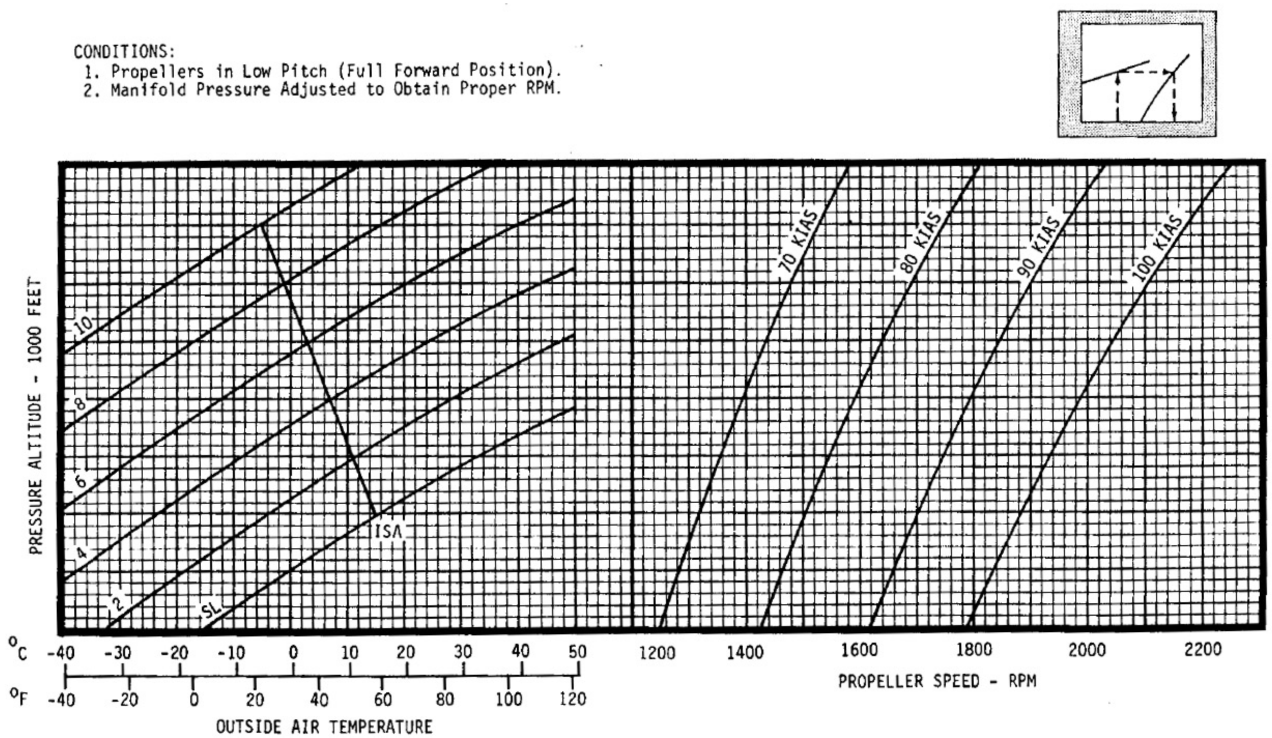
Navigation lights are then checked by observing illumination in the small peep holes in inboard leading edges of the wing tips and reflection from the pavement

or ground below the tail light. The operation of the anti-collision lights should be checked by observing the reflections on the ground and on the wing tips and wings. The retractable landing lights (the right landing light is optional equipment) may be extended and checked momentarily. Returning the landing light switches to OFF turns the lights off, but leaves them extended ready for instant use.

Before taxi, the interior lighting intensity is normally decreased to the minimum at which all the controls and switches are visible. The taxi light should be turned on prior to taxiing at night. The landing lights, if used during taxiing, should be used intermittently to avoid excessive drain on the battery. In the engine runups, special attention should be directed to alternator operation by individually turning the selector switch to L ALT and R ALT and noting response on the voltammeter.

Night takeoffs are conventional, although the gear retraction operation is usually delayed slightly to insure that the airplane is well clear of the runway.

In cruising flight, the interior lighting intensity should be decreased to the minimum which will provide adequate instrument legibility.



(FIGURE 5.3) RPM TO SIMULATE CRITICAL (LEFT) ENGINE INOPERATIVE AND FEATHERED

COLD WEATHER OPERATION

Whenever possible, external preheat should be utilized in cold weather. The use of preheat materially reduces the severity of conditions imposed on both engines and electrical systems. It is the preferred or best method of starting engines in extremely cold weather. Preheat will than the oil trapped in the oil coolers and oil filters, which will probably be congealed prior to starting in very cold weather. Refer to the Airplane Service Manual for additional information when operating in extremely cold weather.

When the oil pressure gage is extremely slow in indicating pressure, it may be advisable to fill the pressure line to the gage with kerosene or JP—4.

NOTE

During cold weather operation it is advisable to rotate propellers through four complete revolutions, by hand, before starting engines.

If preheat is not available, external power should be used for starting because of the higher cranking power required and the decreased battery output at low temperatures. The starting procedure is normal; however, if the engines do not start immediately, it may be necessary to position the primer switch to LEFT or RIGHT for 5 to 10 seconds.

After a suitable warm-up period (2 to 5 minutes at 1000 RPM, if preheat is not used) accelerate the engines several times to higher RPM. The propellers should be operated through several complete cycles to warm the governors and propeller hubs. If the engines accelerate smoothly and the oil pressure remains normal and steady, the airplane is ready for takeoff.

WARNING

The wings and tail surfaces must be clear of ice, snow and frost prior to takeoff as flight characteristics can be adversely affected.

During operation in cold wet weather, the possibility of brake freezing exists; therefore, special precautions should be taken. If ice is found on the brakes during pre-

flight inspection, heat the brakes with a ground heater until the ice melts and all traces of moisture are removed. If a ground heater is not available, spray or pour isopropyl alcohol (MIL-F-5566) on the brakes to remove the ice.

CAUTION

If brakes are deiced using alcohol, insure alcohol has evaporated from the ramp prior to starting engines as a fire could result.

If neither heat nor alcohol are available, frozen brakes can sometimes be freed by cycling the brakes asymmetrically while applying engine power. Caution should be exercised if the airplane is setting on ice or in close proximity to other parked airplanes.

After takeoff from slush-covered runways or taxiways, leave landing gear down for a short period, allowing wheels to spin. This will allow centrifugal force to throw off any accumulated slush which should preclude frozen brakes on landing. Insure wheels are stopped before retracting wheels to prevent buildup of ice or slush in the wheel wells.

During cruise, the propellers should be exercised at half-hour intervals to flush the cold oil from the governors and propeller hubs. Electrical equipment should be managed to assure adequate alternator charging throughout the flight, since cold weather adversely affects battery capacity.

During letdown, watch engine temperatures closely and carry sufficient power to maintain them above operating minimums.

The pitot heat switch should be turned ON at least 5 minutes before entering potential icing conditions (2 minutes if on ground) so that these units will be warm enough to prevent formation of ice. Preventing ice is preferable to attempting its removal once it has formed.

ALTERNATE INDUCTION AIR

The induction system employed on these engines is considered to be nonicing. However, manually operated alternate induction air is provided to assure satisfactory operation should the induction air filter become obstructed. Should a decrease in manifold pressure he experienced when flying in icing conditions, the alternate air doors should be manually opened. This will provide continued satisfactory engine operation.

Since the higher intake air temperature when using the alternate intake air results in a decrease in engine power, it is recommended that the alternate intake air not be utilized until indications of intake filter icing, (decreased manifold pressure) are actually observed.

Should additional power be required, the following procedures may be employed:

1. Increase RPM as desired.
2. Move throttles forward until maximum manifold pressure is reached.
3. Readjust mixture controls for smooth operation.

During ground operation, the alternate air doors should be closed to prevent engine damage caused by ingesting debris through unfiltered air ducts.

NOISE ABATEMENT

Increased emphasis on improving the quality of our environment requires renewed effort on the part of all pilots to minimize the effect of airplane noise on the public.

We, as pilots, can demonstrate our concern for environmental improvement by application of the following suggested procedures, and thereby tend to build public support for aviation:

1. Pilots operating airplanes under VFR over outdoor assemblies of persons, recreational and park areas, and other noise-sensitive areas should make every effort to fly not less than 2000 feet above the surface, weather permitting, even though flight at a lower level may be consistent with the provisions of government regulations.

2. During departure from or approach to an airport, climb after takeoff and descent for landing should be made so as to avoid prolonged flight at low altitude near noise-sensitive areas. Avoidance of noise-sensitive areas, if practical, is preferable to over-flight at relatively low altitudes.

NOTE

The preceding recommended procedures do not apply where they would conflict with Air Traffic Control clearances or instructions, or where, in the pilot's judgment, an altitude of less than 2000 feet is necessary to adequately exercise his duty to see and avoid other airplanes.

Section 6
Performance

Table of Contents

INTRODUCTION

Section 6 of this User Guide contains performance information required to operate the airplane safely and to help you plan your flights in detail with reasonable accuracy. Safe and precise operation of the airplane requires the pilot to be thoroughly familiar and understand the data and calculations of this section.

Note that the cruise performance data makes no allowance for wind and/or navigational errors. Allowances for start, taxi, takeoff, climb, descent and 45 minutes reserve are provided in the range profile chart.

To determine pressure altitude at origin and destination airports, add 100 feet to field elevation for each .1 inch Hg. below 29.92, or subtract 100 feet from field elevation for each .1 inch Hg. above 29.92.

Airspeed Calibration

Normal Static Source

NOTE:

1. Indicated airspeed assumes zero instrument error.
2. The following calibrations are not valid in the prestall buffet.
3. The following calibrations are valid for the pilot's and copilot's airspeed indicators when the standard or optional dual static system is installed.

Gear Up Flaps 0°		Gear Down Flaps 15°		Gear Down Flaps 35°	
KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
70	71	70	72	70	71
80	81	80	82	80	81
90	91	90	92	90	91
--	--	--	--	93 *	94 *
100	101	100	102	100	101
110	111	110	112	110	111
120	121	120	122	120	121
140	142	130	132	130	131
160	162	140	142	139	140
180	182	150	152	---	---
200	202	158	160	---	---
220	223	---	---	---	---
223	227	---	---	---	---

*Recommended Minimum All Engines Approach Speed At 5400 Pounds With 35° Wing Flaps.

Airspeed Calibration

Alternate Static Source

PILOT'S FOUL WEATHER WINDOW CLOSED

Gear Up Flaps 0°		Gear Down Flaps 15°		Gear Down Flaps 35°	
KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
---	---	70	69	70	70
80	80	80	78	80	80
90	90	90	88	90	89
--	--	--	--	96 *	94 *
100	99	100	98	100	98
110	109	110	107	110	107
120	118	120	117	120	117
140	137	130	127	130	126
160	156	140	136	140	135
180	175	150	146	145	140
200	195	160	156	---	---
220	214	165	160	---	---
234	227	---	---	---	---
PILOT'S FOUL WEATHER WINDOW OPENED					
---	---	70	59	70	57
80	69	80	69	80	67
90	78	90	78	90	76
100	88	100	88	100	86
---	---	---	---	109 *	94 *
110	97	110	97	110	95
120	107	120	107	120	105
140	125	130	116	130	114
160	145	140	126	140	123
180	163	150	135	158	140
200	182	160	145	---	---
227	201	176	160	---	---
248	227	---	---	---	---

*Recommended Minimum All Engines Approach Speed At 5400 Pounds With 35° Wing Flaps.

Altimeter Correction

Normal Static Source

NOTE:
1. Add correction to indicated altimeter reading.
2. The following calibrations are valid for the pilot's and copilot's altimeters when the standard or optional dual static system is installed.

Altitude	Sea Level			10,000 Feet			20,000 Feet		
Gear	Up	Down	Down	Up	Down	Down	Up	Down	Down
Flaps	0°	15°	35°	0°	15°	35°	0°	15°	35°
KIAS	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet
80	6	14	7	8	19	9	11	26	13
93 *	7	15	7	10	21	10	14	29	14
100	8	19	8	11	26	11	15	35	15
120	10	23	10	14	32	14	19	44	19
140	17	27	13	23	37	19	32	50	25
160	30	30	--	42	41	--	57	55	--
180	37	--	--	51	--	--	69	--	--
200	40	--	--	56	--	--	76	--	--
220	67	--	--	93	--	--	126	--	--

*Recommended Minimum All Engines Approach Speed At 5400 Pounds With 35° Wing Flaps.

ALTITUDE CORRECTION PROCEDURE

[INDICATED ALTITUDE TO FLY] = [DESIRED ALTITUDE (MSL)] - [ALTIMETER CORRECTION]

Altimeter Correction

Alternate Static Source

NOTE:
1. Add correction to indicated altimeter reading.
2. The following calibrations are valid for pilot's and copilot's altimeters when the standard static system is installed.
3. An alternate static source is not available for copilot's instruments when the optional dual static system is installed.

PILOT'S FOUL WEATHER WINDOW CLOSED

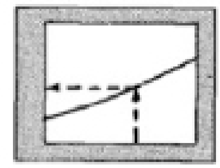
Altitude	Sea Level			10,000 Feet			20,000 Feet		
Gear	Up	Down	Down	Up	Down	Down	Up	Down	Down
Flaps	0°	15°	35°	0°	15°	35°	0°	15°	35°
KIAS	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet
80	0	-13	-4	0	-19	-6	0	-25	-8
96 *	-8	-19	-15	-11	-23	-23	-15	-32	-32
100	-8	-23	-18	-11	-32	-25	-15	-44	-34
120	-20	-34	-34	-28	-46	-46	-38	-63	-63
140	-34	-45	-57	-46	-62	-79	-63	-84	-107
160	-50	-59	----	-69	-81	----	-95	-111	----
180	-74	----	----	-102	----	----	-139	----	----
200	-94	----	----	-130	----	----	-176	----	----
220	-114	----	----	-157	----	----	-214	----	----
PILOT'S FOUL WEATHER WINDOW OPEN									
80	-69	-70	-86	-95	-97	-118	-130	-132	-161
100	-94	-94	-114	-130	-130	-157	-176	-176	-214
109 *	-109	-114	-134	-157	-157	-180	-214	-214	-246
120	-131	-131	-151	-180	-180	-208	-246	-246	-286
140	-174	-168	-194	-241	-231	-268	-328	-315	-365
160	-208	-207	----	-287	-287	----	-391	-391	----
180	-258	----	----	-356	----	----	-485	----	----
200	-304	----	----	-420	----	----	-572	----	----
220	-355	----	----	-490	----	----	-668	----	----

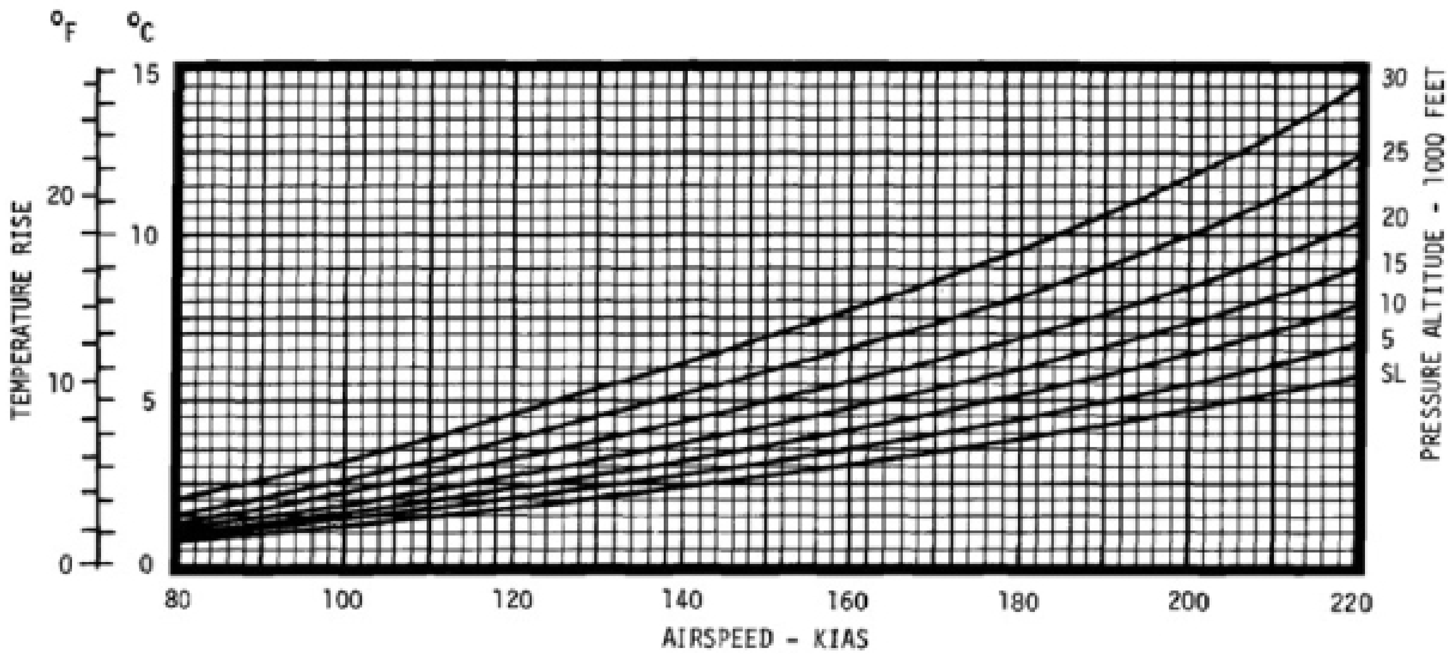
*Recommended Minimum All Engines Approach Speed At 5400 Pounds With 35° Wing Flaps.

Temperature Rise Due To Ram Recovery

RECOVERY FACTOR (K) = .90

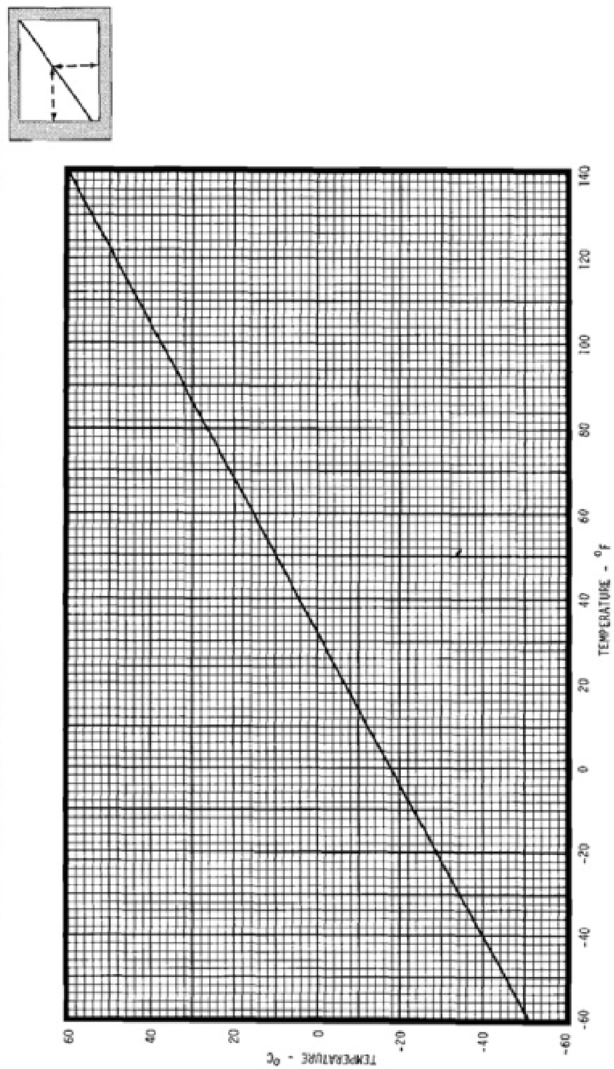
NOTE:
1. Subtract temperature rise from indicated outside air temperature to obtain true outside air temperature





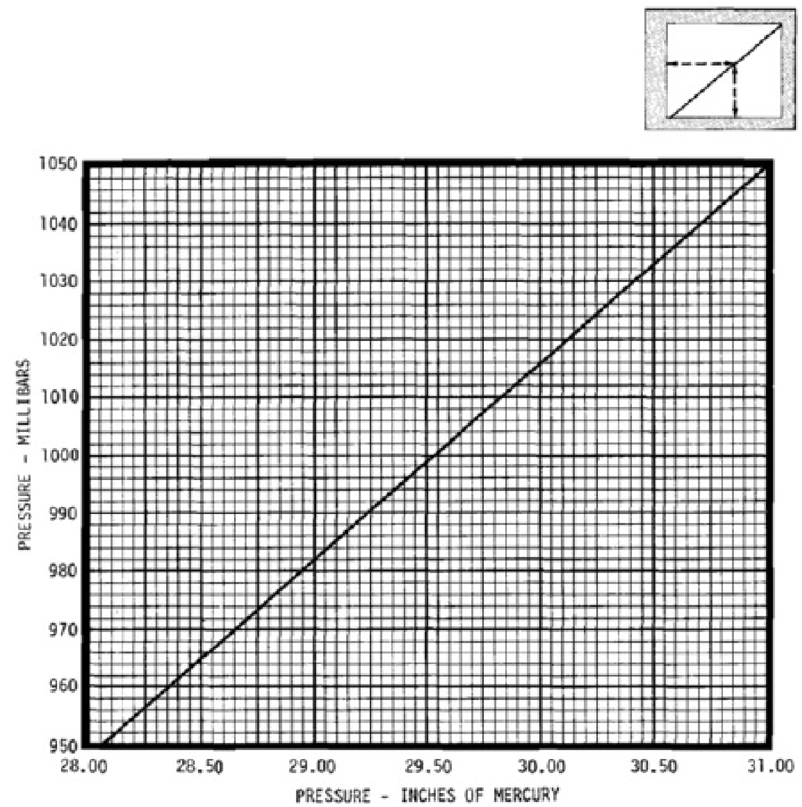
Temperature Conversion

Degrees °F to Degrees °C



Pressure Conversion

Inches of Mercury to Millibars



Stall Speeds

CONDITIONS:

Throttles - IDLE

NOTE:

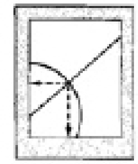
1. Maximum altitude loss during a conventional stall is approximately 320 feet.
2. Maximum nose down pitch attitude and altitude loss during recovery from an engine inoperative stall is approximately 5° below the horizon and 240 feet respectively.

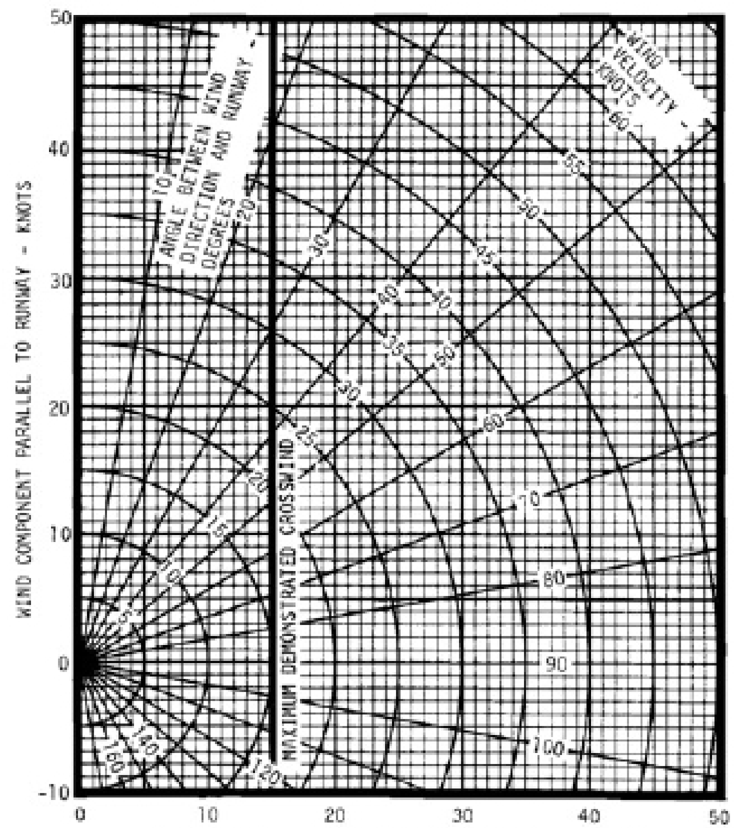
WEIGHT Pounds	Configuration		ANGLE OF BANK							
			0°		20°		40°		60°	
	Flaps	Gear	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
5500	0°	Up	79	78	82	81	91	90	112	111
	15°	Down	77	76	79	78	88	87	109	108
	35°	Down	72	70	74	72	82	80	101	99
5100	0°	Up	76	75	79	78	87	86	108	107
	15°	Down	74	73	77	76	85	84	105	104
	35°	Down	69	67	72	70	79	77	97	95
4700	0°	Up	73	72	76	75	84	83	103	102
	15°	Down	71	70	74	73	81	80	100	99
	35°	Down	67	65	69	67	76	74	94	92
4300	0°	Up	70	69	72	71	80	79	99	98
	15°	Down	68	67	70	69	78	77	96	95
	35°	Down	64	62	66	64	73	71	90	88

Wind Component

NOTE

Maximum Demonstrated Crosswind Velocity is 15 Knots (Not a limitation).





Normal Takeoff Distance

CONDITIONS:
1. Power - FULL THROTTLE and 2700 RPM Before Brake Release.
2. Mixtures - LEAN for field elevation (See Figure 5-27).
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.

NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 7% for each 10 knots headwind.
3. Increase distance 5% for each 2 knots tailwind.
4. Increase total distance 7.9% for operation on firm dry sod runway.

WEIGHT-POUNDS	TAKEOFF TO 50-FOOT OBSTACLE SPEED-KIAS	PRESSURE ALTITUDE-FEET	-20°C (-4°F)		-10°C (14°F)		0°C (32°F)		10°C (50°F)	
			GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET
5500	92	Sea Level	1330	1650	1440	1760	1550	1890	1660	2020
		1000	1470	1810	1580	1940	1700	2080	1830	2240
		2000	1610	1990	1740	2140	1880	2300	2020	2470
		3000	1780	2200	1920	2360	2070	2540	2300	2800
		4000	1970	2430	2130	2620	2370	2900	2550	3120
		5000	2180	2700	2430	2980	2620	3220	2820	3470
		6000	2490	3080	2690	3320	2900	3590	3130	3880
		7000	2770	3440	2990	3730	3240	4040	3500	4380
		8000	3090	3880	3350	4220	3620	4590	3920	5000
		9000	3470	4420	3760	4830	4080	5290	4420	5800
		10,000	3880	5050	4220	5550	4580	6130	4980	6810
5100	88	Sea Level	1110	1380	1200	1480	1290	1580	1380	1690
		1000	1220	1510	1320	1620	1420	1740	1520	1860
		2000	1340	1660	1450	1780	1560	1910	1680	2040
		3000	1480	1820	1600	1960	1720	2100	1850	2250
		4000	1630	2010	1760	2160	1900	2330	2050	2500
		5000	1800	2220	1940	2390	2100	2570	2330	2840
		6000	1990	2460	2150	2650	2400	2930	2580	3160
		7000	2210	2730	2470	3030	2660	3270	2870	3530
		8000	2540	3140	2750	3400	2970	3680	3210	3980
		9000	2840	3540	3080	3840	3330	4170	3610	4530
		10,000	3170	3990	3440	4340	3730	4730	4040	5160
4700	85	Sea Level	920	1140	990	1220	1060	1300	1140	1390
		1000	1010	1250	1080	1340	1170	1430	1250	1530
		2000	1100	1360	1190	1460	1280	1570	1370	1670
		3000	1210	1500	1310	1600	1410	1720	1510	1840
		4000	1340	1650	1440	1770	1550	1900	1670	2030
		5000	1470	1810	1590	1940	1710	2090	1840	2240
		6000	1620	2000	1750	2150	1890	2310	2030	2480
		7000	1800	2210	1940	2380	2090	2560	2260	2760
		8000	1990	2460	2160	2650	2330	2860	2600	3170
		9000	2230	2750	2490	3050	2690	3300	2900	3560
		10,000	2560	3160	2770	3420	3000	3700	3240	4010
4300	81	Sea Level	750	930	800	1000	860	1060	920	1130
		1000	820	1020	880	1090	940	1160	1010	1240
		2000	890	1110	960	1190	1030	1270	1110	1360
		3000	980	1210	1050	1300	1130	1390	1220	1490
		4000	1080	1330	1160	1430	1250	1530	1340	1630
		5000	1180	1460	1270	1560	1370	1680	1470	1790
		6000	1300	1600	1400	1720	1510	1840	1620	1980
		7000	1440	1770	1550	1900	1670	2040	1800	2190
		8000	1590	1960	1720	2100	1850	2260	2000	2430
		9000	1770	2180	1910	2340	2060	2530	2230	2720
		10,000	1960	2420	2120	2610	2290	2810	2560	3120

Maximum Performance Takeoff Distance

CONDITIONS:
1. Power - FULL THROTTLE and 2700 RPM Before Brake Release.
2. Mixtures - LEAN for field elevation (See Figure 5-27).
3. Wing Flaps - DOWN 15°.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.

NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 3% for each 4 knots headwind.
3. Increase distance 5% for each 2 knots tailwind.
4. Increase total distance 7.9% for operation on firm dry sod runway.

WEIGHT-POUNDS	TAKEOFF TO 50-FOOT OBSTACLE SPEED-KIAS	PRESSURE ALTITUDE-FEET	-20°C (-4°F)		-10°C (14°F)		0°C (32°F)		10°C (50°F)	
			GROUND ROLL - REET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50 FEET
5500	82	Sea Level	1040	1340	1120	1440	1200	1540	1290	1650
		1000	1140	1480	1230	1580	1320	1700	1420	1820
		2000	1250	1620	1350	1740	1460	1870	1570	2000
		3000	1380	1780	1490	1920	1610	2060	1730	2210
		4000	1520	1970	1650	2130	1780	2290	1910	2460
		5000	1680	2180	1820	2350	1960	2540	2120	2740
		6000	1860	2420	2010	2620	2170	2830	2350	3060
		7000	2070	2710	2240	2940	2420	3180	2620	3460
		8000	2300	3060	2500	3320	2700	3620	2930	3940
		9000	2580	3480	2800	3800	3040	4160	3410	4690
		10,000	2880	3970	3140	4370	3530	4950	3830	5490
5100	78	Sea Level	870	1130	940	1210	1010	1290	1080	1380
		1000	960	1240	1030	1320	1110	1420	1190	1520
		2000	1050	1350	1130	1450	1210	1550	1310	1660
		3000	1150	1490	1240	1590	1340	1710	1440	1830
		4000	1270	1640	1370	1760	1480	1890	1590	2030
		5000	1400	1800	1510	1940	1630	2090	1750	2240
		6000	1540	1990	1670	2150	1800	2310	1940	2490
		7000	1710	2210	1850	2390	2000	2580	2160	2790
		8000	1900	2480	2060	2680	2220	2900	2400	3140
		9000	2120	2790	2300	3030	2490	3280	2700	3570
		10,000	2360	3140	2570	3420	2780	3730	3020	4070
4700	75	Sea Level	720	940	770	1000	830	1070	890	1140
		1000	790	1030	850	1100	910	1170	980	1250
		2000	860	1120	930	1200	1000	1280	1070	1370
		3000	950	1230	1020	1310	1100	1410	1180	1500
		4000	1040	1350	1120	1440	1210	1550	1300	1660
		5000	1140	1480	1230	1590	1330	1700	1430	1820
		6000	1260	1630	1360	1750	1470	1880	1580	2020
		7000	1390	1800	1510	1930	1620	2080	1750	2240
		8000	1550	2000	1670	2150	1810	2320	1950	2500
		9000	1720	2230	1860	2410	2010	2600	2180	2820
		10,000	1910	2490	2070	2700	2240	2920	2430	3170

Accelerate Stop Distance

CONDITIONS:
1. Power - FULL THROTTLE and 2700 RPM Before Brake Release.
2. Mixtures - LEAN for field elevation (See Figure 5-27).
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level, Hard Surface, Dry Runway.
6. Engine Failure at Engine Failure Speed.
7. Idle Power and Maximum Effective Braking After Engine Failure.

NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 3% for each 4 knots headwind.
3. Increase distance 5% for each 2 knots tailwind.

WEIGHT - POUNDS	ENGINE FAILURE SPEED - KIAS	PRESSURE ALTITUDE - FEET	TOTAL DISTANCE - FEET						
			-20°C -4°F	-10°C +14°F	0°C 32°F	+10°C +50°F	+20°C +68°F	+30°C +86°F	+40°C +104°F
5500	92	Sea Level	3020	3190	3370	3550	3740	3930	4120
		1000	3220	3400	3590	3790	3990	4210	4490
		2000	3430	3630	3830	4050	4340	4570	4820
		3000	3660	3880	4100	4400	4650	4910	5180
		4000	3920	4160	4480	4730	5000	5290	5590
		5000	4200	4530	4810	5090	5390	5700	6030
		6000	4590	4880	5180	5490	5820	6170	6530
		7000	4950	5270	5600	5940	6310	6700	7110
		8000	5360	5710	6070	6460	6870	7310	7780
		9000	5830	6210	6630	7060	7530	8020	8560
		10,000	6330	6770	7230	7720	8250	8810	9420
5100	88	Sea Level	2540	2680	2830	2980	3140	3300	3470
		1000	2710	2860	3020	3180	3350	3530	3710
		2000	2880	3050	3220	3390	3580	3770	3970
		3000	3070	3250	3440	3630	3830	4040	4330
		4000	3290	3480	3680	3900	4190	4420	4660
		5000	3520	3730	3950	4250	4500	4750	5020
		6000	3770	4010	4320	4580	4850	5130	5430
		7000	4060	4390	4660	4950	5240	5560	5890
		8000	4470	4750	5050	5360	5690	6050	6420
		9000	4840	5160	5490	5840	6220	6610	7030
		10,000	5250	5600	5970	6370	6790	7230	7710
4700	85	Sea Level	2110	2230	2350	2470	2600	2740	2870
		1000	2250	2370	2500	2640	2770	2920	3070
		2000	2390	2520	2660	2810	2960	3120	3280
		3000	2540	2690	2840	3000	3160	3340	3510
		4000	2720	2880	3040	3210	3390	3580	3780
		5000	2900	3080	3260	3440	3640	3840	4130
		6000	3110	3300	3500	3700	3910	4210	4450
		7000	3340	3550	3760	3990	4300	4550	4820
		8000	3600	3830	4070	4390	4660	4940	5230
		9000	3900	4230	4490	4770	5070	5380	5710
		10,000	4300	4580	4870	5180	5510	5860	6240
4300	81	Sea Level	1730	1820	1920	2020	2120	2230	2340
		1000	1830	1940	2040	2150	2260	2380	2500
		2000	1950	2060	2170	2290	2410	2530	2660
		3000	2070	2190	2310	2440	2570	2710	2850
		4000	2210	2340	2470	2610	2750	2900	3060
		5000	2360	2500	2640	2790	2950	3110	3280
		6000	2520	2680	2830	2990	3160	3340	3530
		7000	2710	2870	3040	3220	3410	3600	3880
		8000	2910	3090	3280	3470	3680	3970	4200
		9000	3140	3340	3550	3760	4070	4310	4570
		10,000	3390	3610	3830	4150	4410	4680	4970

Accelerate Go Distance

CONDITIONS:
1. Power - FULL THROTTLE and 2700 RPM Before Brake Release.
2. Mixtures - Lean for field elevation (See Figure 5-27).
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Level Hard Surface Dry Runway.
6. Engine Failure At Engine Failure Speed.
7. Propeller Feathered and Landing Gear Retracted During Climb.
8. Maintain Engine Failure Speed Until Clear of Obstacle.

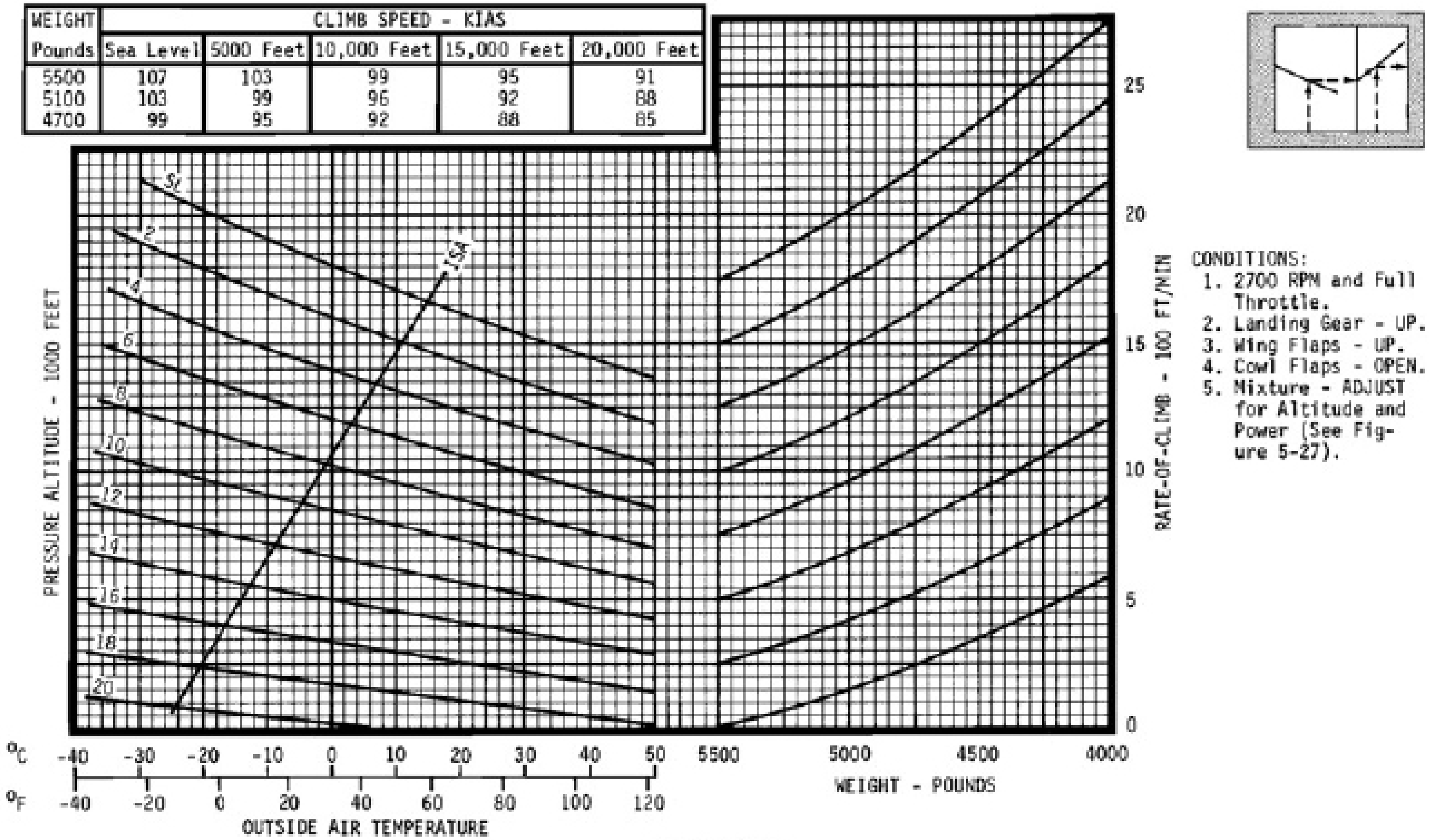
NOTE:
1. If full power is applied without brakes set, distances apply from point where full power is applied.
2. Decrease distance 6% for each 10 knots headwind.
3. Increase distance 2% for each knot of tailwind.
4. Distance in boxes represent rates of climb less than 50 ft/min.

WEIGHT - POUNDS	ENGINE FAILURE - SPEED - KIAS	PRESSURE ALTITUDE - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE						
			-20°C -4°F	-10°C +14°F	0°C 32°F	+10°C +50°F	+20°C +68°F	+30°C +86°F	+40°C +104°F
5500	92	Sea Level	2600	2850	3120	3460	3840	4320	4950
		1000	3010	3330	3700	4160	4760	5560	6810
		2000	3530	3970	4520	5250	6370	8080	11,540
		3000	4310	4990	5950	7520	10,380	------	------
		4000	5650	7020	9550	15,790	------	------	------
		5000	8470	13,010	------	------	------	------	------
		6000	------	------	------	------	------	------	------
		7000	------	------	------	------	------	------	------
		8000	------	------	------	------	------	------	------
		9000	------	------	------	------	------	------	------
		10,000	------	------	------	------	------	------	------
5100	88	Sea Level	2030	2190	2360	2560	2780	3030	3320
		1000	2280	2470	2690	2940	3220	3540	3940
		2000	2580	2820	3090	3400	3770	4230	4810
		3000	2960	3270	3630	4060	4600	5330	6430
		4000	3490	3910	4430	5110	6130	7620	10,430
		5000	4200	4820	5680	7030	9280	14,630	------
		6000	5350	6500	8480	12,550	------	------	------
		7000	7800	11,240	------	------	------	------	------
		8000	------	------	------	------	------	------	------
		9000	------	------	------	------	------	------	------
		10,000	------	------	------	------	------	------	------
4700	85	Sea Level	1600	1720	1840	1980	2130	2290	2460
		1000	1780	1910	2060	2210	2390	2580	2800
		2000	1980	2130	2300	2490	2700	2930	3200
		3000	2210	2400	2600	2830	3090	3390	3740
		4000	2510	2730	2990	3280	3620	4030	4540
		5000	2860	3140	3460	3050	4320	4930	5820
		6000	3320	3690	4130	4700	5450	6610	8370
		7000	3960	4500	5200	6190	7820	10,780	------
		8000	4990	5920	7350	10,020	16,800	------	------
		9000	7040	9510	15,370	------	------	------	------
		10,000	13,110	------	------	------	------	------	------
4300	81	Sea Level	1270	1360	1450	1550	1650	1760	1890
		1000	1400	1500	1600	1710	1830	1960	2100
		2000	1540	1650	1760	1890	2030	2180	2340
		3000	1700	1820	1960	2110	2270	2440	2640
		4000	1890	2040	2190	2370	2560	2770	3020
		5000	2100	2270	2460	2670	2900	3170	3470
		6000	2360	2570	2790	3050	3340	3690	4100
		7000	2690	2940	3220	3550	3950	4430	5110
		8000	3110	3430	3810	4280	4860	5720	6850
		9000	3690	4150	4710	5460	6610	8330	11,760
		10,000	4490	5190	6160	7730	10,510	------	------

Rate-of-Climb

Maximum Climb

WEIGHT Pounds	CLIMB SPEED - KIAS Sea Level	5000 Feet	10,000 Feet	15,000 Feet	20,000 Feet
5500	107	103	99	95	91
5100	103	99	96	92	88
4700	99	95	92	88	85



CONDITIONS:
1. 2700 RPM and Full Throttle.
2. Landing Gear - UP.
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Mixture - ADJUST for Altitude and Power (See Figure 5-27).

Rate-of-Climb

Cruise Climb

CONDITIONS:
1. 2500 RPM and 24.5 Inches Hg.*
2. Landing Gear - UP.
3. Wing Flaps - UP.
4. Cowl Flaps - AS REQUIRED.
5. Airspeed - 120 KIAS.
6. Mixtures - Recommended Fuel Flow.

*Above 5200 feet, use full throttle.

RATE-OF-CLIMB - FT/MIN								
WEIGHT-POUNDS	PRESSURE ALTITUDE-FEET	OUTSIDE AIR TEMPERATURE						
		-20°C (-4°F)	-10°C (14°F)	0°C (32°F)	10°C (50°F)	20°C (68°F)	30°C (86°F)	40°C (104°F)
5500	Sea Level	1101	1034	969	906	844	784	726
	1000	1131	1062	995	930	867	805	744
	2000	1160	1089	1020	953	888	824	762
	3000	1189	1115	1044	976	909	843	779
	4000	1216	1141	1068	997	929	861	796
	5000	1239	1162	1087	1015	944	876	808
	6000	1167	1093	1021	951	883	817	752
	7000	1063	993	925	859	795	732	670
	8000	964	899	835	773	712	652	594
	9000	866	804	744	686	629	573	518
	10,000	770	712	656	601	548	495	443
	11,000	674	621	569	518	468	418	370
	12,000	577	528	480	433	386	340	295
	13,000	487	442	397	354	310	268	226
	14,000	394	353	312	272	232	193	154
	15,000	306	267	230	194	157	121	85
	16,000	215	182	148	115	82	49	16
5100	Sea Level	1264	1189	1116	1046	977	910	844
	1000	1297	1220	1145	1072	1002	933	865
	2000	1329	1250	1173	1098	1025	954	885
	3000	1362	1280	1201	1124	1049	976	905
	4000	1391	1307	1226	1147	1070	996	923
	5000	1419	1333	1250	1169	1090	1014	939
	6000	1337	1254	1174	1096	1020	946	874
	7000	1229	1150	1074	1000	929	858	790
	8000	1121	1047	975	905	837	771	706
	9000	1015	946	878	812	748	686	624
	10,000	910	845	782	720	660	601	543
	11,000	808	747	688	630	574	519	464
	12,000	706	650	595	541	489	437	386
	13,000	607	555	504	455	406	357	310
	14,000	509	461	414	368	323	278	234
	15,000	412	369	326	284	242	200	159
	16,000	316	277	238	199	161	123	85
4700	Sea Level	1449	1364	1283	1204	1127	1052	979
	1000	1485	1398	1314	1233	1154	1077	1002
	2000	1520	1431	1344	1261	1179	1100	1023
	3000	1556	1464	1375	1289	1206	1124	1045
	4000	1587	1492	1401	1313	1228	1145	1064
	5000	1622	1525	1432	1341	1253	1168	1085
	6000	1537	1444	1353	1266	1181	1099	1018
	7000	1425	1336	1250	1167	1086	1008	931
	8000	1315	1231	1149	1070	994	919	846
	9000	1208	1128	1051	977	904	833	763
	10,000	1097	1023	950	880	811	744	678
	11,000	993	923	855	789	724	660	598
	12,000	891	825	761	699	638	578	519
	13,000	791	730	670	611	554	498	443
	14,000	691	634	578	524	470	418	366
	15,000	594	541	490	439	389	340	292
	16,000	496	448	400	353	307	262	217

Rate-of-Climb

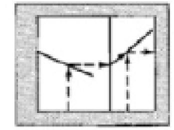
One Engine Inoperative

NOTE:
Approximate Effect of Configuration on Single Engine Rate-of-Climb.

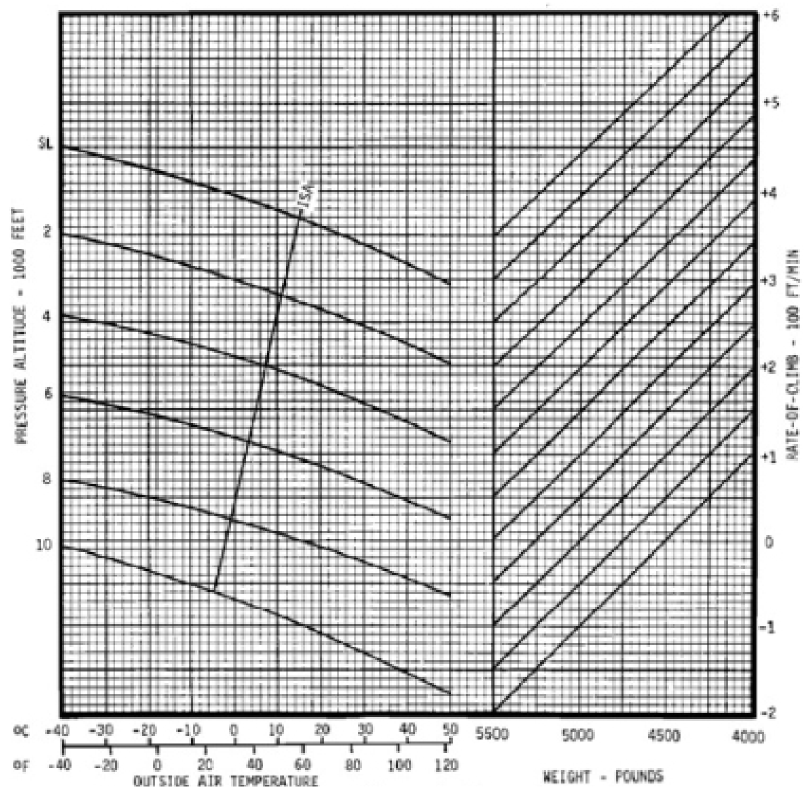
Subtract values listed below from value obtained in the graph. Effects for a combination of gear, flap or windmilling propeller may be obtained by adding the effects for each.

Inoperative Engine Windmilling	400 Ft/Min
Gear Down	300 Ft/Min
Flaps - 15°	150 Ft/Min
Flaps - 35°	550 Ft/Min

CONDITIONS:
1. 2700 RPM and Full Throttle.
2. Mixture - CHECK Full Power Fuel Flow (See Figure 5-27).
3. Landing Gear - UP.
4. Wing Flaps - UP.
5. Inoperative Propeller - FEATHERED.
6. Wings Banked 5° Toward Operative Engine with Approximately 1/2 Ball Slip Indicated on the Turn and Bank Indicator.
7. Cowl Flaps - CLOSED on Inoperative Engine.

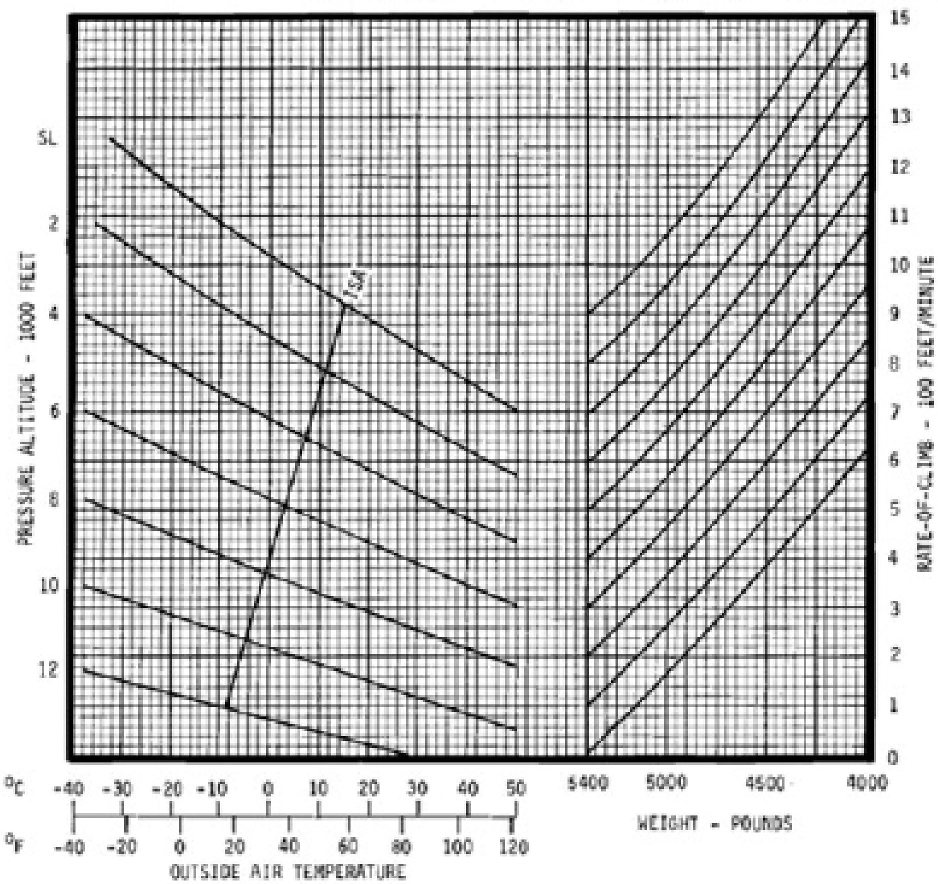


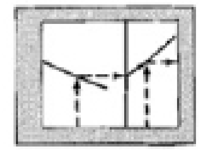
WEIGHT-POUNDS	CLIMB SPEED - KIAS				
	Sea Level	2500 Feet	5000 Feet	7500 Feet	10,000 Feet
5500	106	103	100	97	94
5100	102	99	96	93	90
4700	98	95	92	89	86



Rate-of-Climb

Balked Landing Climb



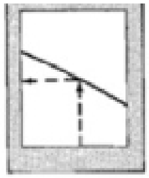


CONDITIONS:
1. 2700 RPM and Full Throttle.
2. Mixtures - AS REQUIRED.
3. Landing Gear - DOWN.
4. Wing Flaps - 35°.
5. Cowl Flaps - OPEN.

CLIMB AIRSPEEDS	
PRESSURE ALTITUDE - FEET	AIRSPEED - KIAS
Sea Level	85
5,000	80
10,000	72
12,000	70

One Engine Inoperative

Service Ceiling

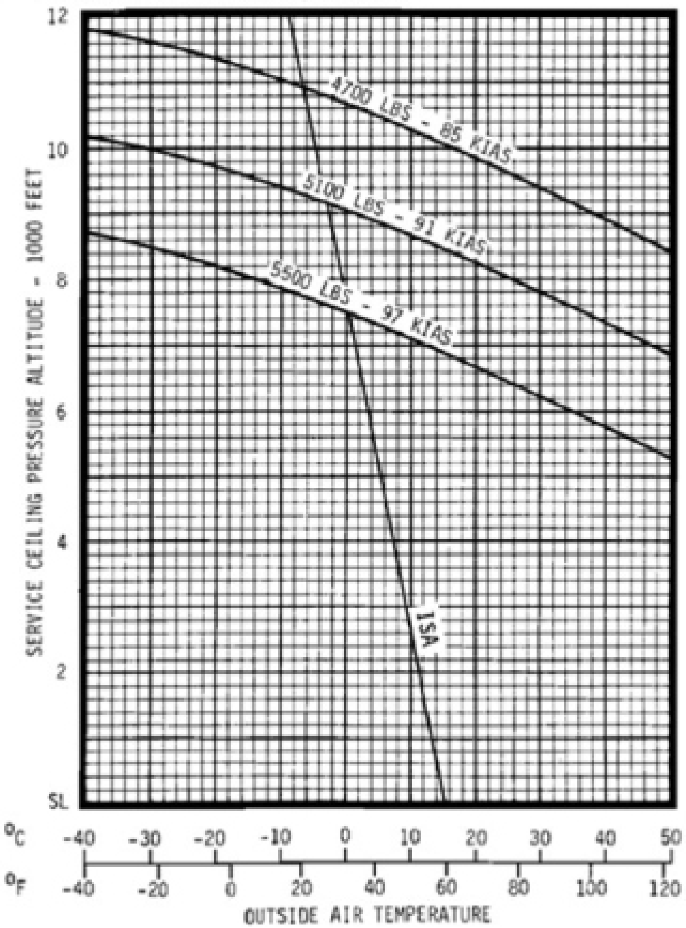


CONDITIONS:

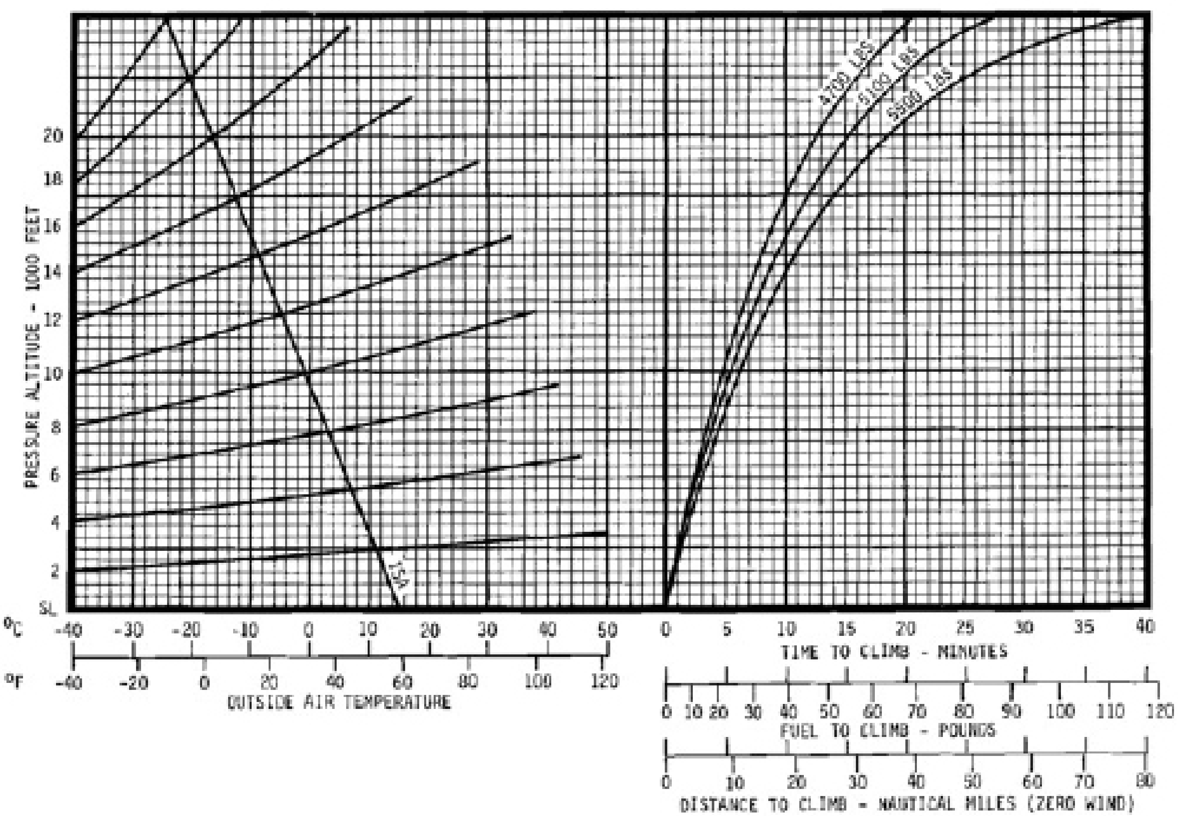
1. One Engine Inoperative Climb Configuration.

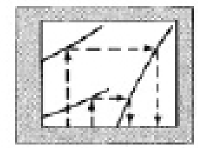
NOTE:

1. Engine inoperative service ceiling is the maximum altitude where the airplane has the capability of climbing 50 feet per minute with one engine inoperative and feathered.
2. Increase indicated service ceiling 100 feet for each 0.10 inches Hg. altimeter setting greater than 29.92.
3. Decrease indicated service ceiling 100 feet for each 0.10 inches Hg. altimeter setting less than 29.92.
4. This chart provides performance information to aid in route selection when operating under FAR 135.181 and 91.119 requirements.



Time, Fuel and Distance to Climb - Maximum Climb

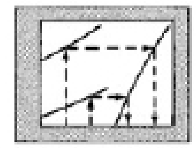


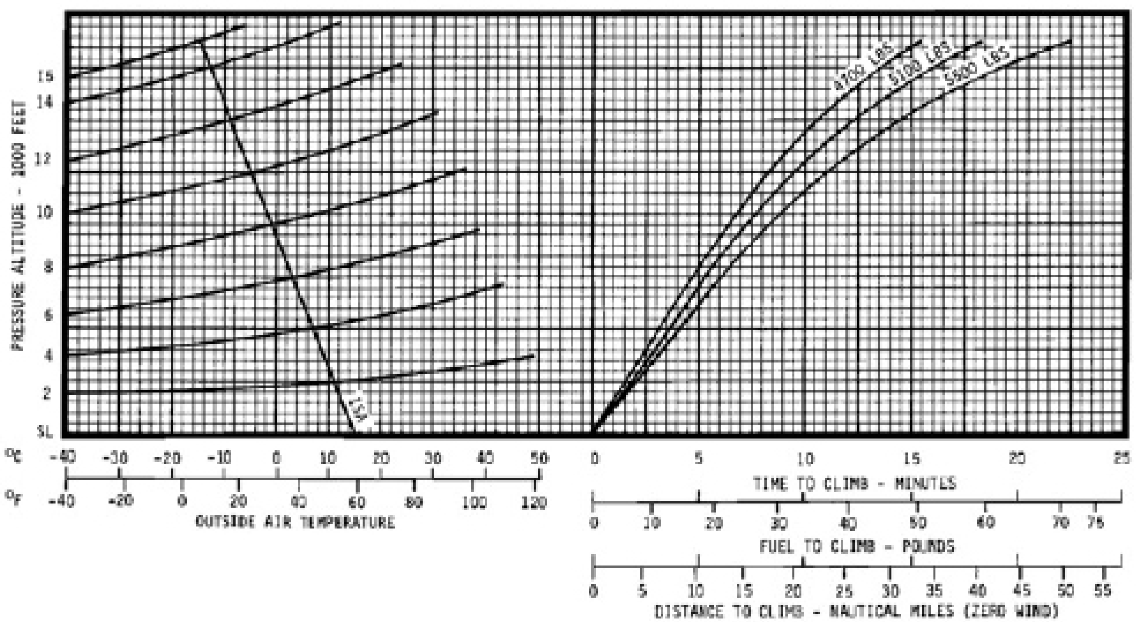


CONDITIONS:
1. Power - 2700 RPM and Full Throttle.
2. Landing Gear - UP.
3. Wing Flaps - UP.
4. Cowl Flaps - OPEN.
5. Mixture - ADJUST for altitude and power (See Figure 5-27).

NOTE:
1. Time, fuel and distance for the climb are determined by taking the difference between the airport altitude and initial cruise altitude conditions.
2. For total fuel used, add 25 pounds for start, taxi and takeoff

Time, Fuel and Distance to Climb - Cruise Climb





CONDITIONS:
1. 2500 RPM and 24.5 Inches Hg.*
2. Landing Gear - UP.
3. Wing Flaps - UP.
4. Cowl Flaps - AS REQUIRED.
5. Airspeed - 120 KIAS.
6. Fuel Flow - Adjust to climb fuel flow (See Figure 5-27).

*Above 5200 Feet, Use Full Throttle.

NOTE:
1. Time, fuel and distance for the climb are determined by taking the difference between the airport altitude and initial cruise altitude conditions.
2. For total fuel used, add 25 pounds for start, taxi and takeoff.

Cruise Performance

With Recommended Lean Mixture

1. At 2500 feet, increase speed by 2 KTAS for each 400 pounds below 5500 pounds.
2. At 5000 feet, increase speed by 2 KTAS for each 400 pounds below 5500 pounds.
3. Operations at peak EGT may be utilized with power settings within the boxes if the airplane is equipped with the optional EGT system.

ALTITUDE	RPM	MP	-10°C (14°F) PERCENT BHP	KTAS	TOTAL LB/HR	10°C (STD TEMP) (50°F) PERCENT BHP	KTAS	TOTAL LB/HR	30°C (86°F) PERCENT BHP	KTAS	TOTAL LB/HR
2500 FEET	2500	24.5	76.5	181	191	73.8	182	185	71.1	184	179
	2500	23.0	69.9	175	176	67.4	176	170	65.0	177	164
	2500	22.0	65.8	171	166	63.5	172	161	61.1	172	156
	2500	21.0	61.5	166	156	59.3	167	152	57.2	167	147
	2400	24.5	73.3	178	184	70.7	179	178	68.1	180	171
	2400	23.0	67.1	172	169	64.8	173	164	62.4	174	158
	2400	22.0	63.1	168	160	60.9	169	155	58.7	169	150
	2400	21.0	59.2	163	151	57.1	164	147	55.0	164	142
	2300	24.5	68.3	173	172	65.9	174	166	63.5	175	161
	2300	23.0	62.7	167	159	60.5	168	154	58.3	169	149
	2300	22.0	59.1	163	151	57.0	164	146	54.9	164	142
	2300	21.0	55.3	158	143	53.4	159	138	51.4	159	133
	2200	24.5	63.9	169	162	61.7	170	157	59.4	170	152
	2200	23.0	58.7	163	150	56.7	163	146	54.6	163	141
	2200	22.0	55.4	158	143	53.4	159	138	51.5	159	134
	2200	21.0	51.9	154	135	50.1	154	130	48.2	153	126
	2200	20.0	48.4	149	126	46.7	148	122	45.0	147	118
	2100	24.5	58.7	163	150	56.7	163	146	54.6	163	141
	2100	23.0	53.8	156	139	51.9	157	135	50.0	156	130
	2100	22.0	50.6	152	131	48.8	152	127	47.0	151	123
	2100	21.0	47.2	146	123	45.5	146	119	43.9	144	115
	2100	20.0	44.0	141	116	42.4	140	112	40.9	138	108
	2100	19.0	40.8	134	108	39.4	133	105	37.9	130	101

ALTITUDE	RPM	MP	-15°C (5°F) PERCENT BHP	KTAS	TOTAL LB/HR	5°C (STD TEMP) (41°F) PERCENT BHP	KTAS	TOTAL LB/HR	25°C (77°F) PERCENT BHP	KTAS	TOTAL LB/HR
5000 FEET	2500	24.5	80.7	188	201	77.8	190	194	75.0	192	188
	2500	23.0	73.6	182	185	70.9	184	178	68.4	185	172
	2500	22.0	69.1	178	174	66.7	179	168	64.2	180	162
	2500	21.0	64.5	173	163	62.3	174	158	60.0	174	153
	2400	24.5	76.9	185	192	74.2	187	186	71.5	188	180
	2400	23.0	70.4	179	177	67.9	181	171	65.4	181	165
	2400	22.0	66.1	175	167	63.8	176	161	61.5	176	156
	2400	21.0	62.0	170	157	59.8	171	153	57.7	171	148
	2300	24.5	71.4	180	179	68.9	182	173	66.4	182	167
	2300	23.0	65.5	174	165	63.2	175	160	60.9	176	155
	2300	22.0	61.9	170	157	59.7	171	152	57.5	171	147
	2300	21.0	57.8	165	148	55.8	165	144	53.7	165	139
	2200	24.5	66.5	175	168	64.2	176	162	61.8	177	157
	2200	23.0	61.2	169	156	59.0	170	151	56.9	170	146
	2200	22.0	57.8	165	148	55.8	165	144	53.7	165	139
	2200	21.0	54.3	160	140	52.4	160	136	50.5	160	131
	2200	20.0	50.7	155	132	48.9	154	127	47.2	153	123
	2100	24.5	61.0	169	155	58.8	170	150	56.7	170	146
	2100	23.0	56.2	163	145	54.2	163	140	52.2	163	135
	2100	22.0	53.0	158	137	51.1	158	133	49.2	157	128
	2100	21.0	49.7	153	129	47.9	153	125	46.2	151	121
	2100	20.0	46.4	147	121	44.8	146	117	43.1	145	114
	2100	19.0	43.1	141	113	41.6	139	110	40.0	136	106
	2100	18.0	39.9	134	106	38.5	131	102	37.1	126	99

NOTE:
1. At 7500 feet, increase speed by 3 KTAS for each 400 pounds below 5500 pounds.
2. At 10,000 feet, increase speed by 4 KTAS for each 400 pounds below 5500 pounds.
3. Operations at peak EGT may be utilized with power settings within the boxes if the airplane is equipped with the optional EGT system.

ALTITUDE	RPM	MP	-20°C (-4°F) PERCENT BHP	KTAS	TOTAL LB/HR	0°C (STD TEMP) (32°F) PERCENT BHP	KTAS	TOTAL LB/HR	20°C (68°F) PERCENT BHP	KTAS	TOTAL LB/HR
7500 FEET	2500	23.2	77.9	190	194	75.2	192	188	72.4	194	182
	2500	22.0	72.2	185	181	69.7	187	175	67.1	187	169
	2500	21.0	67.3	180	170	64.9	181	164	62.6	181	159
	2500	20.0	63.0	175	160	60.8	176	155	58.5	176	150
	2400	23.0	73.4	186	184	70.8	188	178	68.2	189	172
	2400	22.0	68.9	182	173	66.6	183	168	64.0	183	162
	2400	21.0	64.7	177	163	62.4	178	158	60.1	178	153
	2400	20.0	60.6	172	154	58.4	172	150	56.3	172	145
	2300	23.0	68.2	181	172	65.8	182	166	63.4	183	160
	2300	22.0	64.4	176	163	62.1	177	158	59.0	178	153
	2300	21.0	60.2	171	153	58.1	172	149	56.0	172	144
	2300	20.0	56.5	166	145	54.5	167	141	52.5	166	136
	2200	23.0	63.4	175	161	61.2	176	156	58.9	176	151
	2200	22.0	60.1	171	153	57.9	172	148	55.8	172	144
	2200	21.0	56.5	166	145	54.5	167	141	52.6	166	136
	2200	20.0	52.8	161	137	50.9	161	132	49.0	159	128
	2200	19.0	49.3	155	128	47.6	154	124	45.9	153	120
	2200	18.0	45.7	148	120	44.1	147	116	42.5	144	112
	2100	22.0	55.3	165	143	53.4	165	138	51.4	164	133
	2100	21.0	52.0	160	135	50.2	159	130	48.3	158	126
	2100	20.0	48.7	154	127	47.0	153	123	45.3	151	119
	2100	19.0	45.3	148	119	43.7	146	115	42.1	143	111
	2100	18.0	42.0	141	111	40.5	138	107	39.0	133	104

ALTITUDE	RPM	MP	-25°C (-13°F) PERCENT BHP	KTAS	TOTAL LB/HR	-5°C (STD TEMP) (23°F) PERCENT BHP	KTAS	TOTAL LB/HR	15°C (59°F) PERCENT BHP	KTAS	TOTAL LB/HR
10,000 FEET	2500	21.0	69.9	187	176	67.5	188	170	65.0	189	164
	2500	20.0	65.5	182	166	63.2	183	160	60.9	183	155
	2500	19.0	61.1	176	156	59.0	177	151	56.8	176	146
	2500	18.0	56.8	170	146	54.8	170	142	52.8	169	137
	2500	17.0	52.4	163	136	50.5	163	131	48.7	161	127
	2400	21.0	67.0	184	169	64.7	185	163	62.3	185	158
	2400	20.0	62.9	179	159	60.7	179	155	58.5	179	150
	2400	19.0	58.7	173	150	56.6	173	146	54.6	172	141
	2400	18.0	54.5	167	141	52.5	166	136	50.6	165	131
	2400	17.0	50.2	159	131	48.5	158	126	46.7	157	122
	2300	21.0	62.5	178	158	60.3	179	154	58.1	179	149
	2300	20.0	58.7	173	150	56.7	173	146	54.6	173	141
	2300	19.0	55.0	168	142	53.0	167	137	51.1	166	133
	2300	18.0	51.1	161	133	49.3	160	128	47.5	158	124
	2300	17.0	47.2	153	123	45.5	152	119	43.8	149	115
	2200	21.0	58.4	172	150	56.4	173	145	54.3	172	140
	2200	20.0	54.7	167	141	52.8	167	137	50.8	165	132
	2200	19.0	51.1	161	133	49.3	160	128	47.5	158	124
	2200	18.0	47.5	154	124	45.8	153	120	44.2	150	116
	2200	17.0	43.9	147	115	42.4	144	112	40.8	139	108
	2100	21.0	54.3	166	140	52.4	166	136	50.4	165	131
	2100	20.0	50.9	161	132	49.1	160	128	47.3	158	124
	2100	19.0	47.4	154	124	45.7	153	120	44.0	149	116
	2100	18.0	44.0	147	116	42.4	144	112	40.9	140	108
	2100	17.0	40.5	138	107	39.1	133	104	37.6	123	100

Cruise Performance

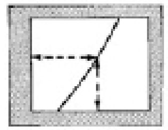
With Recommended Lean Mixture (Cont.)

NOTE:
1. At 15,000 Feet, increase speed by 4 KTAS for each 400 pounds below 5500 pounds.
2. Operations at peak EGT may be utilized with power settings within the boxes if the airplane is equipped with the optional EGT system.

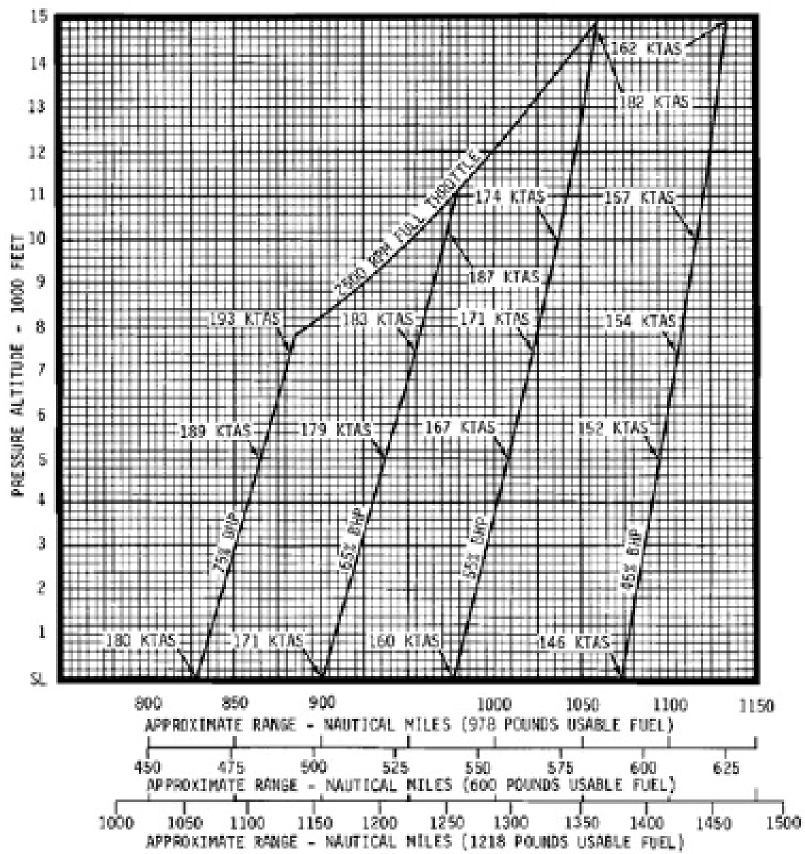
ALTITUDE	RPM	MP	-35°C (-30°F)			-15°C (STD TEMP) (6°F)			5°C (42°F)		
			PERCENT BHP	KTAS	TOTAL LB/HR	PERCENT BHP	KTAS	TOTAL LB/HR	PERCENT BHP	KTAS	TOTAL LB/HR
15,000 FEET	2500	16.0	52.7	170	137	50.9	168	132	49.0	165	128
	2500	15.0	48.1	160	125	46.4	157	121	44.7	153	117
	2500	14.0	43.4	148	114	41.8	143	110			
	2400	16.0	50.9	166	132	49.1	164	128	47.3	161	124
	2400	15.0	46.4	156	121	44.8	153	118	43.2	147	114
	2400	14.0	42.2	144	111	40.7	138	108	----	---	---
	2300	16.0	47.2	158	123	45.5	155	119	43.9	150	115
	2300	15.0	43.3	147	114	41.7	142	110	----	---	---
	2200	16.0	42.9	146	113	41.4	141	.109	----	---	---
	2100	16.0	40.6	139	107	39.2	127	104	----	---	---

Range Profile

CONDITIONS:
1. Starting Weight - 5500 Pounds.
2. Cruise Climb to Desired Altitude.
3. Recommended Lean Fuel Flow.
4. Zero Wind.
5. Standard Day.

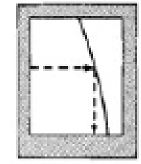


NOTE:
1. Range computations include fuel required for start, taxi, takeoff, cruise climb to altitude, cruise, descent and 45 minutes holding fuel at 45% power.
2. The distances shown are the sum of the distances to climb, cruise and descend.

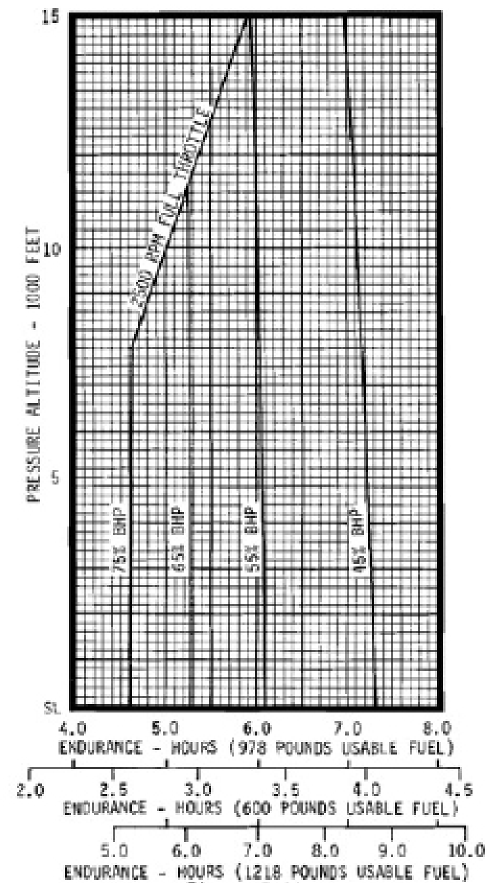


Endurance Profile

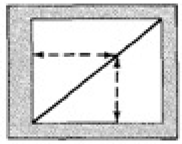
CONDITIONS:
1. Starting Weight - 5500 Pounds.
2. Cruise Climb to Desired Altitude.
3. Cruise Fuel Flow - Recommended Lean Mixture.
4. Standard Day.



NOTE:
1. Endurance computations include fuel required for start, taxi, takeoff, cruise climb to altitude, cruise, descent and 45 minutes holding fuel at 45% power.
2. The endurance shown is the sum of the time to climb, cruise and descend



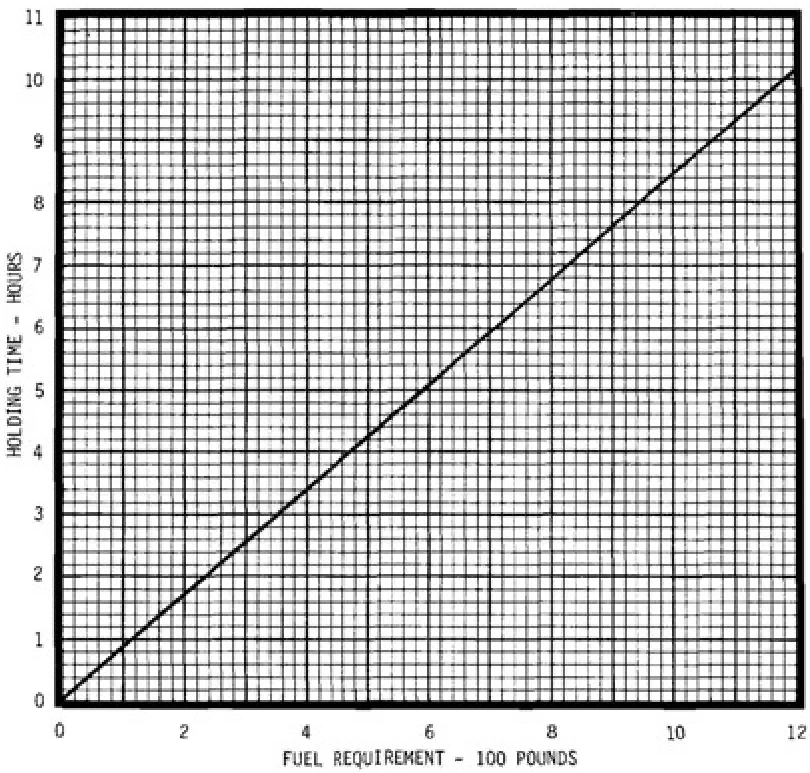
Holding Time



CONDITIONS:
1. Power - 45% *.
2. Recommended Lean Fuel Flow (118 Pounds Per Hour Total).

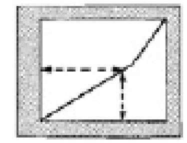
*45% power can be maintained at 2100 RPM with the following manifold pressure.

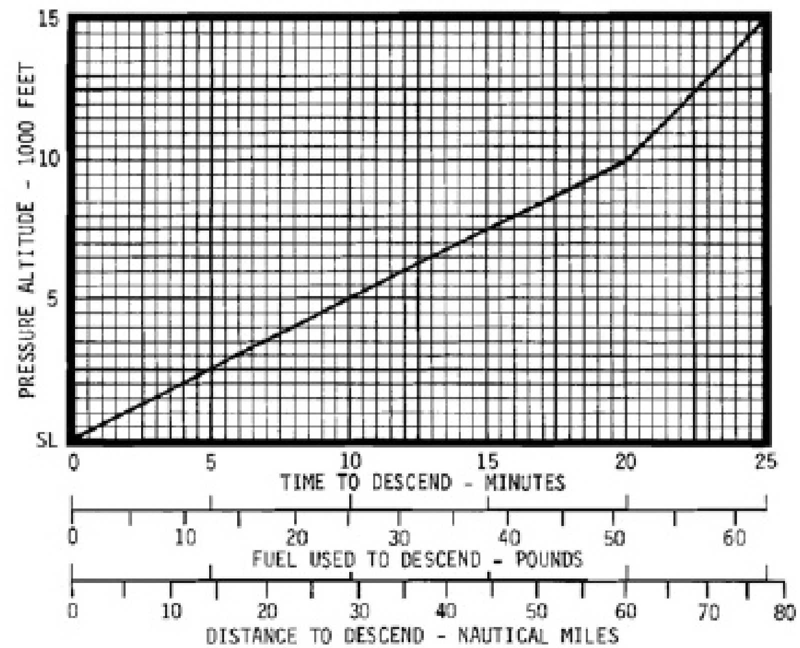
PRESSURE ALTITUDE	MANIFOLD PRESSURE
Sea Level	21.5
5,000	20.0
10,000	19.0
15,000	18.0



Time, Fuel and Distance to Descend

CONDITIONS:
1. Power - As Required.
2. Above 10,000 Feet, Descend at 1000 Feet Per Minute.
3. Below 10,000 Feet, Descend at 500 Feet Per Minute.
4. Landing Gear - UP.
5. Wing Flaps - UP.
6. Airspeed - 170 KIAS.





Normal Landing Distance

CONDITIONS:
1. Throttles - IDLE.
2. Landing Gear - DOWN.
3. Wing Flaps - 35°.
4. Cowl Flaps - CLOSE.
5. Level, Hard Surface Runway.
6. Maximum Effective Braking.

NOTE:
1. Increase distance by 25% of ground run for operation on firm sod runway.
2. If necessary to land with wing flaps UP, the approach speed should be increased above the normal approach speed by 12 knots. Expect total landing distance to increase by 35%.
3. Decrease total distances by 3% for each 4 knots headwind. For operations with tailwinds up to 10 knots, increase total distances by 5% for each 2 knots wind.

WEIGHT-POUNDS	SPEED AT 50-FOOT OBSTACLE KIAS	PRESSURE ALTITUDE - FEET	-20°C (-4°F)		-10°C (14°F)		0°C (32°F)		10°C (50°F)	
			GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE	GROUND ROLL - FEET	TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE
5400	93	Sea Level	570	1720	590	1740	610	1760	630	1780
		1000	590	1740	610	1760	630	1780	660	1810
		2000	610	1760	630	1780	660	1810	680	1830
		3000	630	1780	660	1810	680	1830	710	1860
		4000	660	1810	680	1830	710	1860	730	1880
		5000	680	1830	710	1860	730	1880	750	1910
		6000	710	1860	730	1880	760	1910	790	1940
		7000	730	1880	760	1910	790	1940	820	1970
		8000	760	1910	790	1940	820	1970	850	2000
		9000	790	1940	820	1970	850	2000	880	2030
		10,000	820	1970	850	2000	890	2040	920	2070
5000	89	Sea Level	480	1630	500	1650	520	1670	540	1690
		1000	500	1650	520	1670	540	1690	560	1710
		2000	520	1670	540	1690	560	1710	580	1730
		3000	530	1680	560	1710	580	1730	600	1750
		4000	550	1700	580	1730	600	1750	620	1770
		5000	580	1730	600	1750	620	1770	640	1790
		6000	600	1750	620	1770	640	1790	670	1820
		7000	620	1770	640	1790	670	1820	690	1840
		8000	640	1790	670	1820	690	1840	720	1870
		9000	670	1820	700	1850	720	1870	750	1900
		10,000	700	1850	720	1870	750	1900	780	1930
4600	86	Sea Level	400	1550	420	1570	430	1580	450	1600
		1000	410	1560	430	1580	450	1600	460	1610
		2000	430	1580	450	1600	460	1610	480	1630
		3000	460	1600	460	1610	480	1630	500	1650
		4000	460	1610	480	1630	500	1650	520	1670
		5000	480	1630	500	1650	520	1670	540	1690
		6000	500	1650	520	1670	540	1690	560	1710
		7000	520	1670	540	1690	560	1710	580	1730
		8000	540	1690	560	1710	580	1730	600	1750
		9000	560	1710	580	1730	600	1750	620	1770
		10,000	580	1730	600	1750	620	1770	650	1800
4200	82	Sea Level	330	1480	340	1490	350	1500	370	1520
		1000	340	1490	350	1500	370	1520	380	1530
		2000	350	1500	370	1520	380	1530	390	1540
		3000	370	1520	380	1530	390	1540	410	1560
		4000	380	1530	390	1540	410	1560	420	1570
		5000	390	1540	410	1560	420	1570	440	1590
		6000	410	1560	420	1570	440	1590	460	1610
		7000	420	1570	440	1590	460	1610	470	1620
		8000	440	1590	460	1610	470	1620	490	1640
		9000	460	1610	480	1630	490	1640	510	1660
		10,000	480	1630	490	1640	510	1660	530	1680

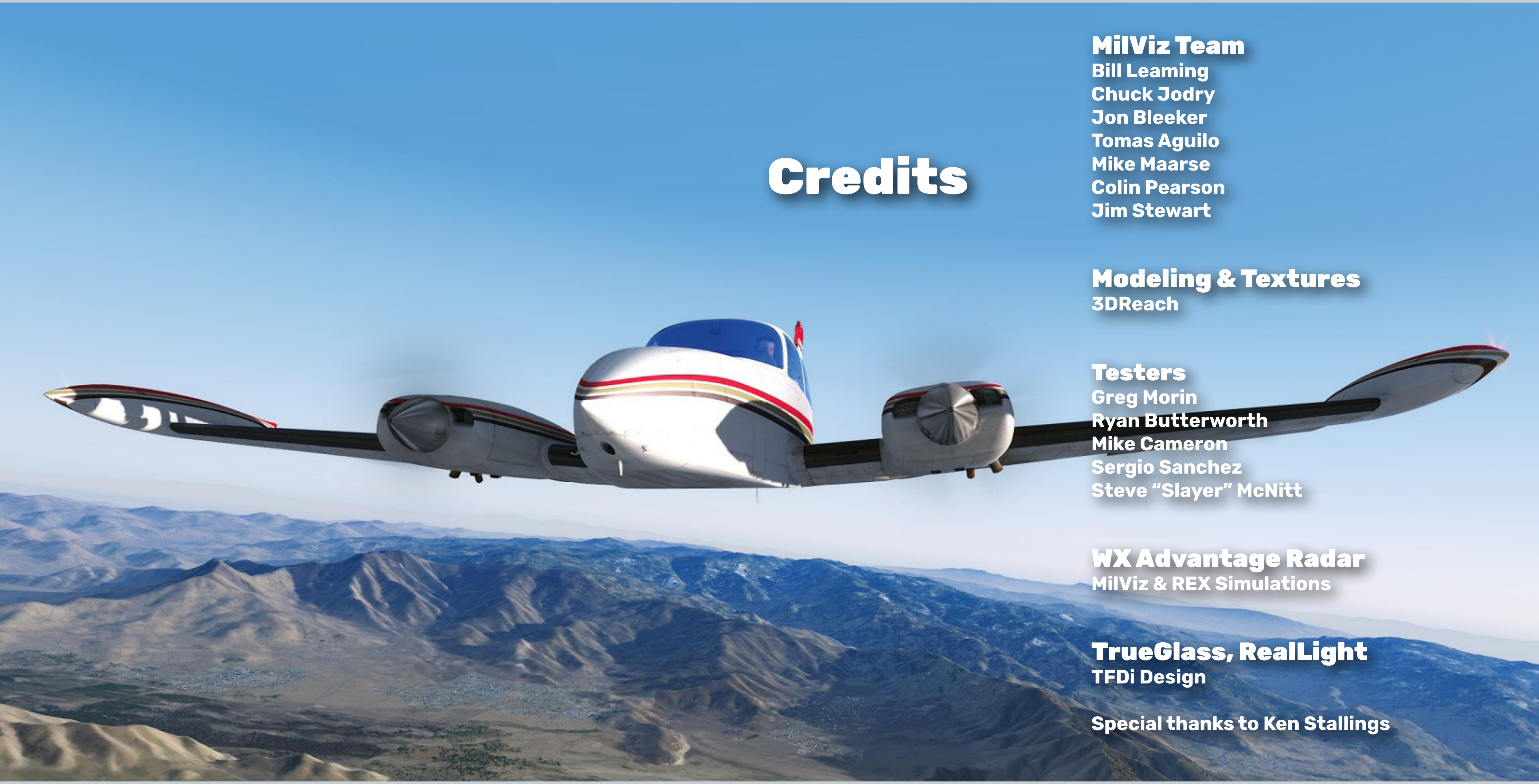
Fuel Flow Schedule

FULL POWER FUEL FLOW VERSUS ALTITUDE

Power - FULL THROTTLE and 2700 RPM	
PRESSURE ALTITUDE - FEET	FUEL FLOW - POUNDS/HOUR
Sea Level	147
2000	134
4000	124
6000	116
8000	108
10,000	101
12,000	94
14,000	87
16,000	80

CRUISE CLIMB FUEL FLOW VERSUS ALTITUDE

Power - 24.5 Inches Hg. Manifold Pressure and 2500 RPM to 5200 Feet then FULL THROTTLE and 2500 RPM	
PRESSURE ALTITUDE - FEET	FUEL FLOW - POUNDS/HOUR
Sea Level to 5200	107
6000	103
8000	96
10,000	88
12,000	83
14,000	78
16,000	73



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Special thanks to Ken Stallings