CESSNA 182

Training Manual

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This Training Manual is intended to supplement information you receive from your flight instructor during your type conversion training. It should be used for training and reference use only, and is not part of the Civil Aviation Authority or FAA approved Aircraft Operating Manual or Pilot's Operating Handbook. While every effort has been made to ensure completeness and accuracy, should any conflict arise between this training manual and other operating handbooks, the approved aircraft flight manuals or pilot's operating handbook should be used as final reference. Information in this document is subject to change without notice and does not represent a commitment on the part of the authors, nor is it a complete and accurate specification of this product. The authors cannot accept responsibility of any kind from the use of this material.

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Note-
ENGLISH SPELLING has been used in this text, which differs slightly from that used by Cessna. Differences in spelling have no bearing on interpretation.

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Terminology

Airspeed		
KIAS	**Knots Indicated Airspeed**	Speed in knots as indicated on the airspeed indicator.
KCAS	**Knots Calibrated Airspeed**	KIAS corrected for instrument error. Note this error is often negligible and CAS may be omitted from calculations.
KTAS	**Knots True Airspeed**	KCAS corrected for density (altitude and temperature) error.
Va	**Maximum Manoeuvring Speed**	The maximum speed for full or abrupt control inputs.
Vfe	**Maximum Flap Extended Speed**	The highest speed permitted with flap extended. Indicated by the top of the white arc.
Vno	**Maximum structural cruising speed**	Sometimes referred to as "Normal operating range" Should not be exceeded except in smooth conditions and only with caution. Indicated by the green arc.
Vne	**Never Exceed speed**	Maximum speed permitted, exceeding will cause structural damage. Indicated by the upper red line.
Vs	**Stall Speed**	The minimum speed before loss of control in the clean configuration. Indicated by the bottom of the green arc. Sometimes referred to as minimum 'steady flight' speed.
Vso	**Stall Speed landing configuration**	The minimum speed before loss of control in the landing configuration, at the most forward C of G*. Indicated by the bottom of the white arc.
Vx	**Best angle of climb speed**	The speed which results in the maximum gain in altitude for a given horizontal distance.
Vy	**Best Rate of Climb speed**	The speed which results in the maximum gain in altitude for a given time, indicated by the maximum rate of climb for the conditions on the VSI.
Vref	**Reference speed**	The minimum safe approach speed, calculated as 1.3 x Vso.
Vr	**Rotation speed**	The speed which rotation should be initiated.
Vat	**Barrier speed**	The speed nominated to reach before the 50ft barrier or on reaching 50ft above the runway on approach.
Vto	**Takeoff Safety Speed**	The speed nominated to reach before the 50ft barrier or on reaching 50ft above the runway on takeoff.
*forward centre of gravity gives a higher stall speed and so is used for certification		

	Maximum Demonstrated Crosswind	The maximum demonstrated crosswind during flight testing and certification.
Meteorological Terms		
OAT	**Outside Air Temperature**	Free outside air temperature, or indicated outside air temperature corrected for gauge, position and ram air errors.
IOAT	**Indicated Outside Air Temperature**	Temperature indicated on the temperature gauge.
	Standard Temperature	The temperature in the International Standard atmosphere for the associated level, and is 15 degrees Celsius at sea level decreased by two degrees every 1000ft.
	Pressure Altitude	The altitude in the International Standard Atmosphere with a sea level. pressure of 1013 and a standard reduction of 1mb per 30ft. Pressure Altitude would be observed with the altimeter subscale set to 1013.
	Density Altitude	The altitude that the prevailing density would occur in the International Standard Atmosphere, and can be found by correcting Pressure Altitude for temperature deviations.
Engine Terms		
BHP	**Brake Horse Power**	The power developed by the engine (actual power available will have some transmission losses).
RPM	**Revolutions per Minute**	Engine drive and propeller speed.
	Static RPM	The maximum RPM obtained during stationery full throttle operation
Weight and Balance Terms		
	Arm (moment arm)	The horizontal distance in inches from reference datum line to the centre of gravity of the item.
C of G	**Centre of Gravity**	The point about which an aeroplane would balance if it were possible to suspend it at that point. It is the mass centre of the aeroplane, or the theoretical point at which entire weight of the aeroplane is assumed to be concentrated. It may be expressed in percent of MAC (mean aerodynamic chord) or in inches from the reference datum.

	Centre of Gravity Limit	The specified forward and aft point beyond which the CG must not be located. The forward limit defines the controllability of aircraft and aft limits – stability of the aircraft.
	Datum (reference datum)	An imaginary vertical plane or line from which all measurements of arm are taken. The datum is established by the manufacturer.
	Moment	The product of the weight of an item multiplied by its arm and expressed in inch-pounds. The total moment is the weight of the aeroplane multiplied by distance between the datum and the CG.
MZFW	**Maximum Zero Fuel Weight**	The maximum permissible weight to prevent exceeding the wing bending limits. This limit is not always applicable for aircraft with small fuel loads.
BEW	**Basic Empty Weight**	The weight of an empty aeroplane, including permanently installed equipment, fixed ballast, full oil and unusable fuel, and is that specified on the aircraft mass and balance documentation for each individual aircraft.
SEW	**Standard Empty Weight**	The basic empty weight of a standard aeroplane, specified in the POH, and is an average weight given for performance considerations and calculations.
OEW	**Operating Empty Weight**	The weight of the aircraft with crew, unusable fuel, and operational items (galley etc.).
	Payload	The weight the aircraft can carry with the pilot and fuel on board.
MRW	**Maximum Ramp Weight**	The maximum weight for ramp manoeuvring, the maximum takeoff weight plus additional fuel for start taxi and runup.
MTOW	**Maximum Take off Weight**	The maximum permissible takeoff weight and sometimes called the maximum all up weight, landing weight is normally lower as allows for burn off and carries shock loads on touchdown.
MLW	**Maximum Landing Weight**	Maximum permissible weight for landing. Sometimes this is the same as the takeoff weight for smaller aircraft.
Other		
AFM	**Aircraft Flight Manual**	These terms are inter-changeable and both refer to the approved manufacturers handbook. Cessna most often uses the term Pilot's Operating Handbook, early manuals were called Owners Manual and later texts used the term AFM. Most legal texts refer to Aircraft Flight Manual.
POH	**Pilot's Operating Handbook**	

Useful Factors and Formulas

Conversion Factors			
Lbs to kg	1kg =2.204lbs	kgs to lbs	1lb = .454kgs
USG to Lt	1USG = 3.785Lt	lt to USG	1lt = 0.264USG
Lt to Imp Gal	1lt = 0.22 Imp G	Imp.Gal to lt	1Imp G = 4.55lt
NM to KM	1nm = 1.852km	km to nm	1km = 0.54nm
NM to StM to ft	1nm = 1.15stm 1nm = 6080ft	Stm to nm to ft	1 stm = 0.87nm 5280ft
FT to Meters	1 FT = 0.3048 m	meters to ft	1 m = 3.281 FT
Inches to Cm	1 inch = 2.54cm	cm to inches	1cm = 0.394”
Hpa(mb) to “Hg	1mb = .029536”	“ Hg to Hpa (mb)	1” = 33.8mb

AVGAS FUEL Volume / weight SG = 0.72					
Litres	Lt/kg	kgs	Litres	lbs/lts	Lbs
1.39	1	0.72	0.631	1	1.58

Crosswind component per 10 kts of wind								
Kts	10	20	30	40	50	60	70	80
10	2	3	5	6	8	9	9	10

Useful Formulas	
Celsius (C) to Fahrenheit (F)	C = 5/9 x(F-32) F = Cx9/5+32
Pressure altitude (PA)	PA = Altitude AMSL + 30 x (QNH-1013) i.e. Altitude AMSL is 30ft higher than pressure altitude for every mb above 1013mb Memory aid – Subscale up/down altitude up/down
Standard Temperature (ST)	ST = 15 – 2 x PA/1000 ie. 2 degrees cooler per 1000ft altitude
Density altitude (DA)	DA = PA +(-) 120ft/deg above (below) ST i.e. 120Ft higher for every degree hotter than standard
Specific Gravity (SG)	SG x volume in litres = weight in kgs
One in 60 rule	1 degree of arc @ 1nm at a radius of 60nm i.e degrees of arc approximately equal length of arc at a radius of 60nm
Rate 1 Turn Radius	$R = GS/60/\pi \approx GS/20$
Percent to Gradient fpm	fpm ≈ % x G/S Or fpm = % x G/S x 1.013
Gust factor	Vat = Vref+1/2HWC + Gust eg. Wind 20kts gusting 25 at 30 degrees to Runway: Vat = Vref +.7x10+5 = Vref+12, If the Vref is 75kts, Vat should be 75+12 = 87kts

Aircraft Flight Manual Information

Aircraft manufacturers and international aviation organisations have standardized the format of the Aircraft Flight Manuals (AFM) for light aircraft for ease of use and improved safety. If conforming to the accepted standard the pilot's operating handbook will include the following sections in the following order:

Section 1	General	Definitions and abbreviations
Section 2	Limitations	Specific operating limits, placards and specifications
Section 3	Emergencies	Complete descriptions of action in the event of any emergency or non-normal situation
Section 4	Normal Operations	Complete descriptions of required actions for all normal situations
Section 5	Performance	Performance graphs, typically for stall speeds, airspeed calibration, cross wind calculation, takeoff, climb, cruise, and landing
Section 6	Weight and Balance	Loading specifications, limitations and loading graphs or tables
Section 7	Systems Descriptions	Technical descriptions of aircraft systems, airframe, controls, fuel, engine, instruments, avionics and lights etc.
Section 8	Servicing and Maintenance	Maintenance requirements, inspections, stowing, oil requirements etc.
Section 9	Supplements	Supplement sections follow the format above for additional equipment or modification.

The AFM is legally required to be on board the aircraft during flight, and is the master document for all flight information. For use in practical training this text should be used in conjunction with the AFM from on board the aircraft you are flying.

Note – even if you have an AFM of the same model of C182, you should review the AFM from your aircraft as supplements for modifications and optional equipment may have been added to the AFM.

Introduction

This training manual provides technical and operational descriptions for the Cessna 182 aircraft.

The information is intended as an instructional aid to assist with conversion training in conjunction with an approved training organisation and the POH or AFM. The text is arranged according to standard training syllabi rather than POH order for ease of use and assimilation with training programs.

This material does not supersede, nor is it meant to substitute any of the manufacturer’s operation manuals. The material presented has been prepared from the basic design data obtained in the pilot's operating handbook and from operational experience.

History

The Cessna aircraft company has a long and rich history. Founder Clyde Cessna built his first aeroplane in 1911, and taught himself to fly it!
He went on to build a number of innovative aeroplanes, including several race and award winning designs.

In 1934, Clyde's nephew, Dwane Wallace, fresh out of college, took over as head of the company. During the depression years Dwane acted as everything from floor sweeper to CEO, even personally flying company planes in air races (several of which he won!).
Under Wallace's leadership, the Cessna Aircraft Company eventually became the most successful general aviation company of all time.

Development of the C182

The Cessna 182 is one of the most popular aircraft for the private and recreational market.

Cessna's present marketing portrays the C182 as – “the SUV of the skies”, as it takes off-roading to a new dimension.

The C182 began it's life as the tricycle conversion of the popular C180 tail wheel model.

The first model C182 appeared in 1956, resembling very nearly a C180 with the tail wheel removed. The name Skylane was introduced a little later in reference to the C182A with additional equipment introduced. Major changes to the airframe were later introduced with the C182C.

The Cessna 182 can be one of the safest and most rewarding aircraft that you may fly, providing you know the aircraft well, understand the systems, abide by the limitations, and do not attempt to operate on or near the boundary of your own limitation.

Approximately 22,000 Cessna 182's have been built to date.

Models and Differences

As detailed on the previous page, the Cessna 182 model had a number of type variants during its production history. Additionally there are a number of modifications provided for the airframe, instruments/avionics equipment and electrics.

Speeds often vary between models by one or two knots, sometimes more for significant type variants. Whenever maximum performance is required the speeds will also vary with weight, and density altitude. For simplification the speeds have been provided for the model C182 Skylane, which was produced in the largest numbers.
All speeds have been converted to knots and rounded up to the nearest 5kts. Generally multiple provision of figures can lead to confusion for memory items and this application is safer for practical use during conversion training.

During practical training reference should be made to the flight manual of the aeroplane you will be flying to ensure that the limitations applicable for that aeroplane are adhered to. Likewise when flying different models it should always be remembered that MAUW, flap limitations, engine limitations and speeds may vary from model to model. Before flying different models, particularly if maximum performance is required, the AFM should be consulted to verify differences.

Model History

We provide the following information to outline significant differences from an operational perspective.

<u>C182</u>
The early model C182 had the same fuselage as the C180 (“straight back”), without the rear window.
The main operational differences of the C182 are
- manual flap lever and the limitation of 110mph (95kts) for all flap selections (nb:some models had electric flap installed but remained with the 110mph limitation)
- lower maximum all up weight (2500lbs)

<u>C182A,B,C,E,G Skylane</u>
Various minor airframe changes were made to gradually bring about the more commonly known version of the C182 including :
- C182C Third window on cabin, swept tail,
- C182E Wrap around rear window, re-profiled cowlings, improved fairings
- C182G Elliptical side windows
- C182G Tubular steel undercarriage, enlarged fin

The addition of the rear window and cowlings were mainly responsible for the present appearance of the C182, however more significant operational differences include:

- Electric flap, first 10 degrees of flap may be lowered below 140kts 160mph, this in normally denoted by the blue arc on the flap lever, and may be confirmed in the limitations section of the AFM
- less drag providing improved speeds in the cruise
- higher maximum all up weight (increased to 2800, followed by an increase in maximum take off weight to 2950lbs)

Major performance options were offered in the late 1970's including:

C182RG, 1977
Retractable version of the Skylane, improved speed but added responsibility

T182RG and T182, 1979
235hp turbo charged version, service ceiling 20,000 (with oxygen!), added power, added maintenance, increase in MAUW to 3100lbs

When Cessna resumed production of it's single engine range in the 90's, a new and improved C182S was available.

C182S, C182T, 1997
If you are lucky enough to find one of these it is really a dream to operate. After the recovery from public liability suits and the 80's recession, the C182 received upgraded systems and equipment to produce the same proven design with the latest accessories and support.

Significant differences include:

- IO540 engine, providing 230hp at 2400rpm with fuel injection,
- full IFR avionics as standard installation including auto pilot,
- warning and caution annunciator panel indications,
- increase in maximum takeoff weight to 3100lbs, maximum landing weight 2950lbs

Reims F182
Like all Reims productions we have to admit this model is also an excellent version. Only 169 aircraft were produced.

Significant differences include:

- Lower stall speeds, similar to the Robertson STOL conversion
- Slightly higher cruise speeds

Common Modifications:

Robertson STOL kits
Additions of Robertson STOL Kits (Sierra Industries) to the C182 produce remarkable short field performance and stall speeds that approach that of a 152, however without any significant increase drag in the cruise. It is an impressive modification, however must be taken carefully if you wish to use it to its limits. Care should be taken at low speed where operating near the wrong side of the drag curve, particularly when at MAUW and with high density altitudes.

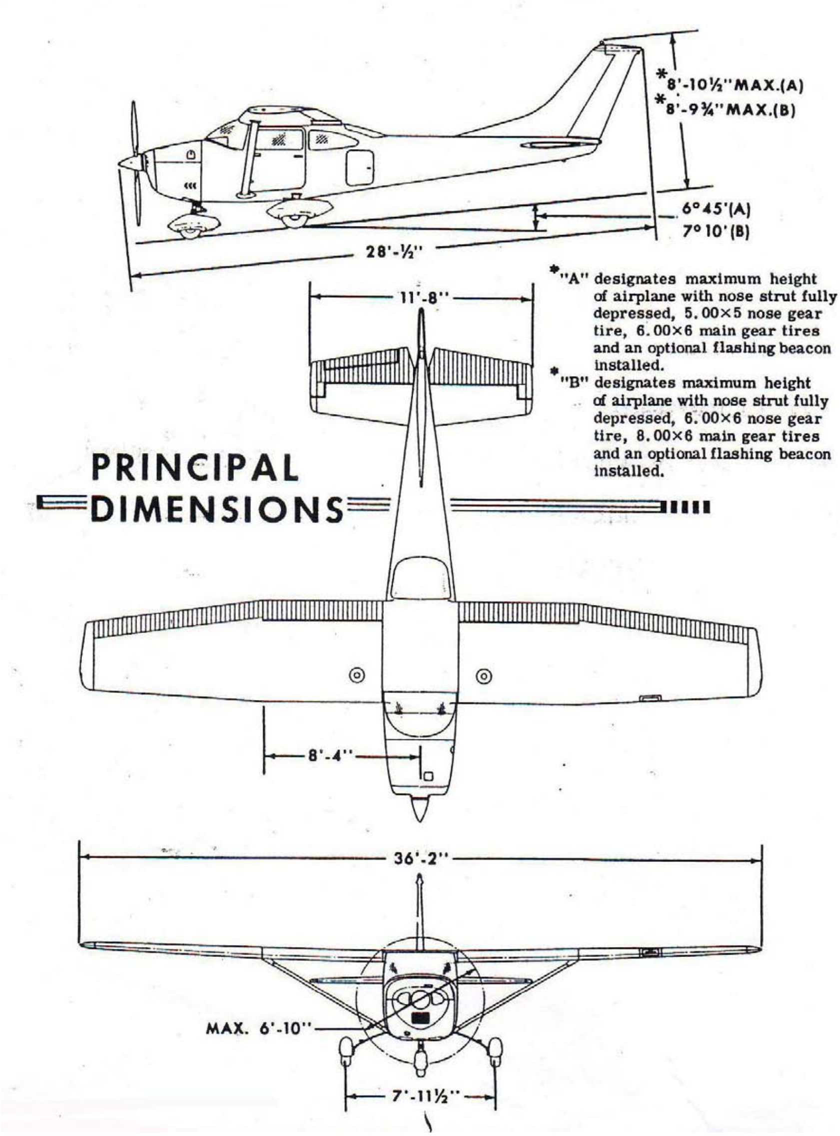
Early Model Straight Back C182

C182RG Skylane with Rear Window

AIRCRAFT TECHNICAL INFORMATION

General

The Cessna 182 aeroplane is a single engine, four seat, high wing monoplane aircraft, equipped with tricycle landing gear, and is designed for general utility purposes.



Airframe

The airframe is a conventional design similar to other Cessna aircraft you may have flown (for example the C152, C172).

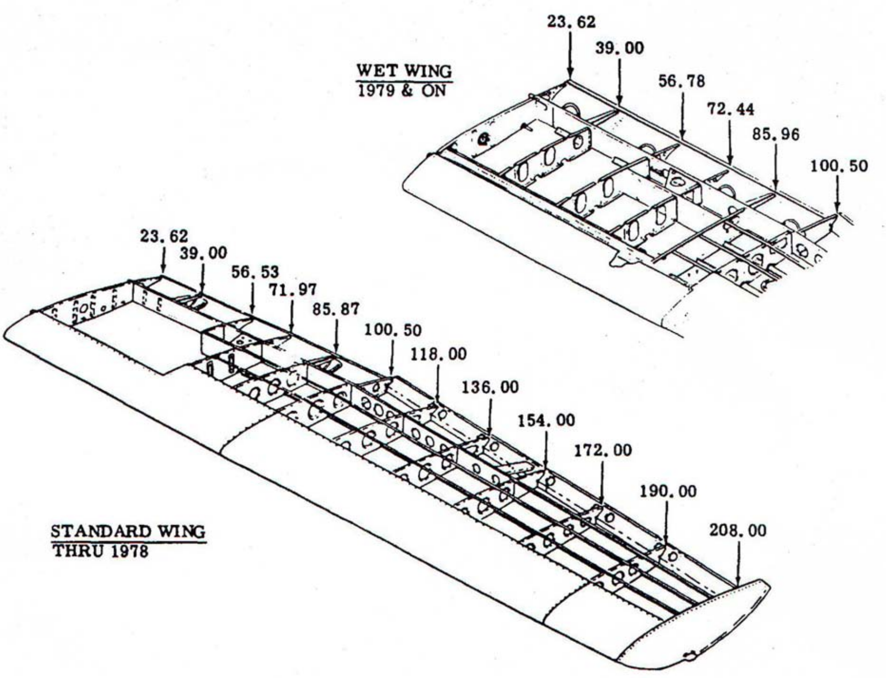
The construction is a semi-monocoque type consisting of formed sheet metal bulkheads, stringers and stressed skin.

Semi-monocoque construction is a light framework covered by skin that carries much of the stress. It is a combination of the best features of a strut-type structure, in which the internal framework carries almost all of the stress, and the pure monocoque where all stress is carried by the skin.

The fuselage forms the main body of the aircraft to which the wings, tail section and undercarriage are attached. The main structural features are:

- front and rear carry through spars for wing attachment
- a bulkhead and forgings for landing gear attachment
- a bulkhead and attaching plates for strut mounting
- four stringers for engine mounting attached to the forward door posts

The wings are all metal, semi-cantilever type with struts spanning the inner section of the wing. The wings contain either bladder or integral ie. non bladder type fuel tanks depending on the model as detailed in the picture below.



The empennage or tail assembly consists of the vertical stabilizer and rudder, horizontal stabilizer and elevator.

The construction of the wing and empennage sections consists of:

- a front (vertical stabilizer) or front and rear spar (wings/horizontal stabilizer)
- formed sheet metal ribs
- doublers and stringers
- wrap around and formed sheet metal/aluminum skin panels
- control surfaces, flap and trim assembly and associated linkages

Seats and Seat Adjustment

The pilot and copilot seats are adjustable in forward and aft position, and in most models also for both seat height and back inclination. Seat back and height should be adjusted to ensure adequate visibility and control before start-up.

When adjusting the seats forward and aft it is of vital importance to ensure the positioning pin is securely in position. As a result of accidents involving slipping of seat position during critical phases of flight, seat locks are available and installed on many aircraft. The seat lock must be disengaged before the seat can travel rearwards.

Seat stops should be installed on all aircraft as detailed in the picture adjacent to prevent seats derailing, however on many aircraft these are missing. Care should be taken not to derail seats when making adjustments and ensure both sides are secure if using the most forward or aft positions. Where possible consult with maintenance on seat stop installation.

Doors

There are two entrance doors provided, one on the left and one on the right, and a baggage door at the rear left side of the aircraft.

The door latch on early models was not locked, however on later models rotation of the handle 90 degrees provided a latched and locked position.

The latching mechanism is similar in most single engine Cessna aircraft and is provided by a splined gear and worm type unit. It is vital that the gears are meshed prior to attempting to lock the mechanism as damage to the teeth will occur if it is forced.

When the teeth become warn it may become difficult to mesh the locking mechanism without pressure on the door. It is also possible to achieve locking only on the last tooth of the worm gear where upon vibration or forces in flight may cause the door to open. The security of the door should be checked by positive pressure prior to takeoff.


SPLINED DOOR LATCHING MECHANISIM

Handle modifications are available with a locking pin that ensures the door is in the correct position when closed, and which prevent the handle from being lowered if the pin is not flush. These modifications are recommended and minimise the risks of doors inadvertently opening in flight.

Baggage Compartment

The baggage compartment consists of the area from the back of the rear passenger seats to the aft cabin bulkhead. A baggage shelf, above the wheel well, extends aft from the aft cabin bulkhead. Access to the baggage compartment and the shelf is gained through a lockable baggage door on the left side of the aeroplane, or from within the cabin. A baggage net with six tie-down straps may be provided for securing baggage, and are attached by tying the straps to tie-down rings provided inside the cabin.

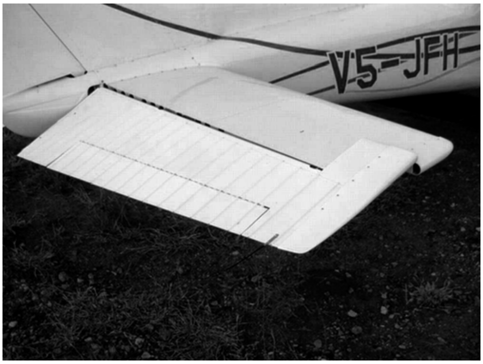
The baggage door has a push latch incorporating a key lock. Due to the low pressure around the aircraft baggage doors sometimes open during flight and care should be taken to ensure the door is closed securely. For this reason it is recommended whenever possible that the key lock is used.

Flight Controls

The aeroplane's flight control system consists of conventional aileron, rudder and elevator control surfaces. The control surfaces are manually operated through mechanical linkages to the control wheel for the ailerons and elevator, and rudder/brake pedals for the rudder. A manually-operated elevator trim tab is provided and installed on the right elevator.

The control surfaces are formed in a similar way to the wing and tail section with the inclusion of the balance weights, actuation system (control cables etc.) and trim tabs. Control actuation is provided by a series of push-pull rods, bellcranks, pulleys and cables with the required individual connections.

Elevator



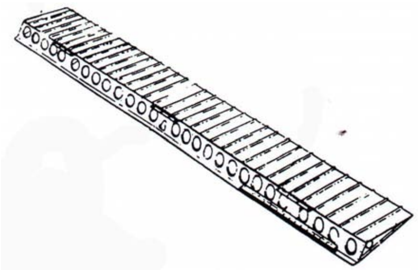
The elevator is hinged to the rear part of the horizontal stabilizer on both sides. The main features are:

- ✈ An inset hinge with balance weights
- ✈ Adjustable trim tab on RHS of elevator

The leading edge of both left and right elevator tips incorporate extensions which contain the balance weights which aerodynamically and mechanically assist with control input reducing the force required to move the control.

Ailerons

Conventional hinged ailerons are attached to the trailing edge of the wings. Main features of the aileron design include:



- ✈ A forward spar containing aerodynamic "anti-flutter" balance weights
- ✈ "V" type corrugated aluminium skin joined together at the trailing edge
- ✈ Differential and Frise design.
- ✈ Fixed ground adjustable trim tabs
- ✈

Differential and Frise Ailerons

The ailerons include Differential and Frise design. Differential refers to the larger angle of travel in the up position to the down position, increasing drag on the down-going wing. Frise-Type ailerons are constructed so that the forward part of the up-going aileron protrudes into the air stream below the wing to increase the drag on the down-going wing. Both features acting to reduce the effect of Adverse Aileron Yaw, reducing the required rudder input during balanced turns. These features have the additional advantage of assisting with aerodynamic balancing of the ailerons.

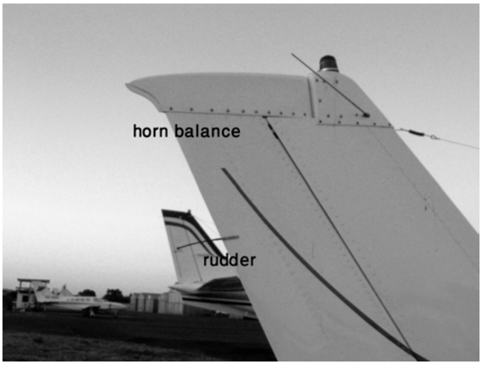
The ailerons control system additionally includes:
sprockets and roller chains,
a control "Y" which interconnects the control wheel to the aileron cables.

Rudder

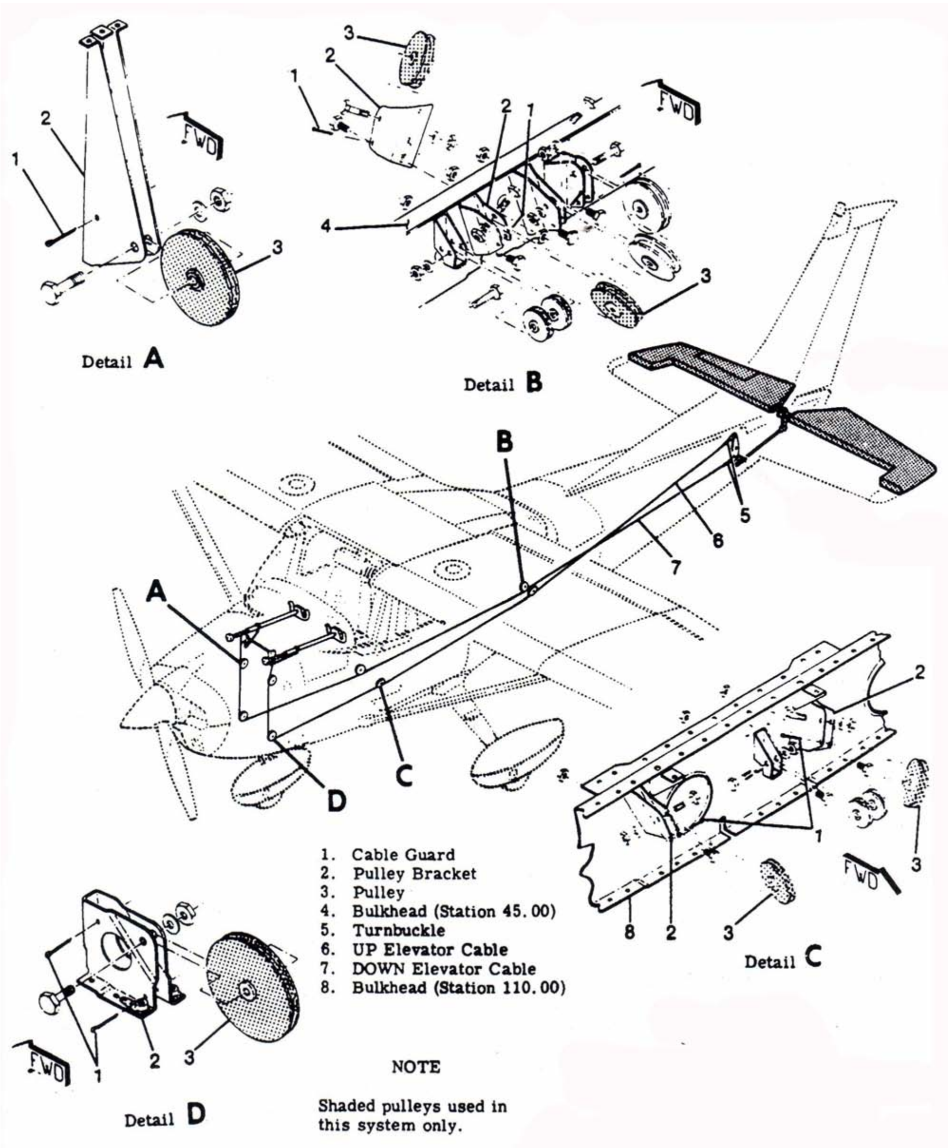
The rudder forms the aft part of the vertical stabilizer. The main features include

- ✈ Horn balance tab and balance weight
- ✈ Adjustable rudder trim

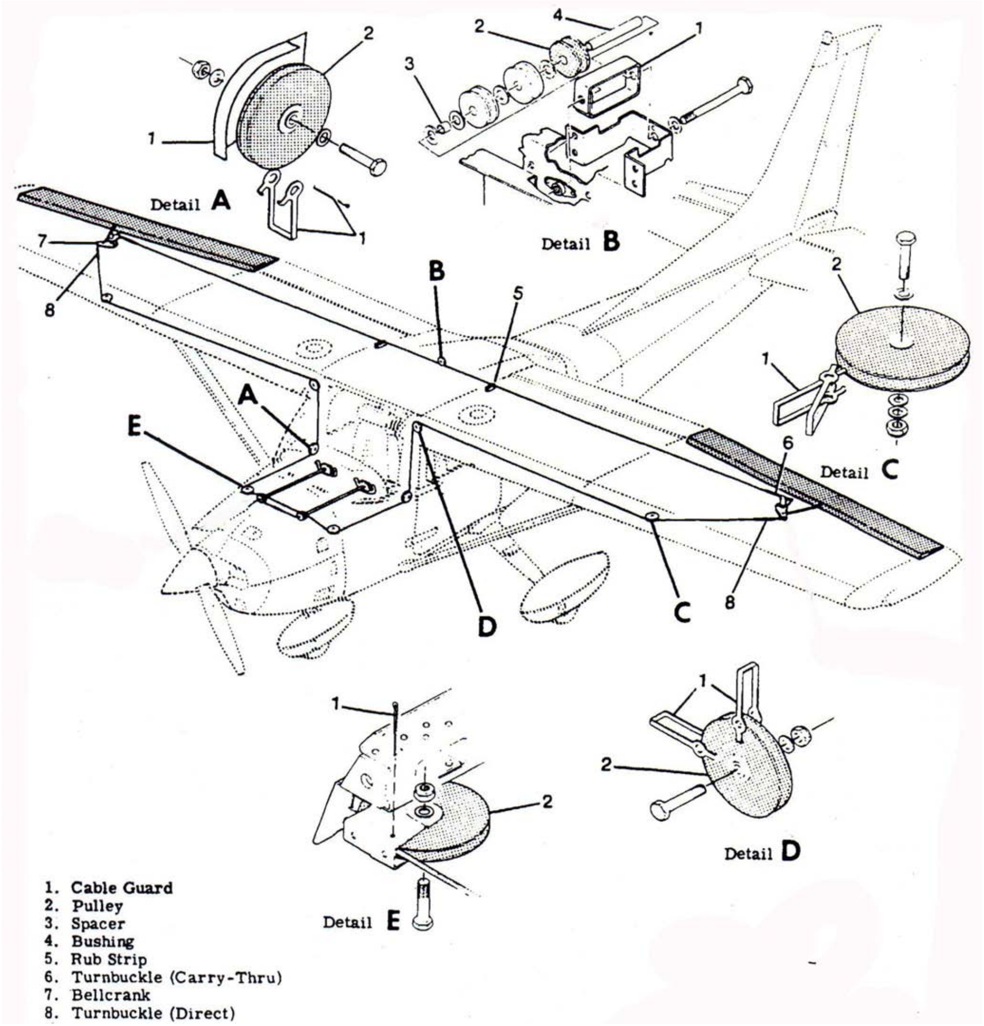
he top of the rudder incorporates a leading edge extension which contains a balance weight and aerodynamically assists with control input in the same way as the elevator hinge point. The rudder movement is limited by stop at 23 degrees either side of neutral. The rudder linkage is additionally connected to the nose wheel steering to assist with ground control.



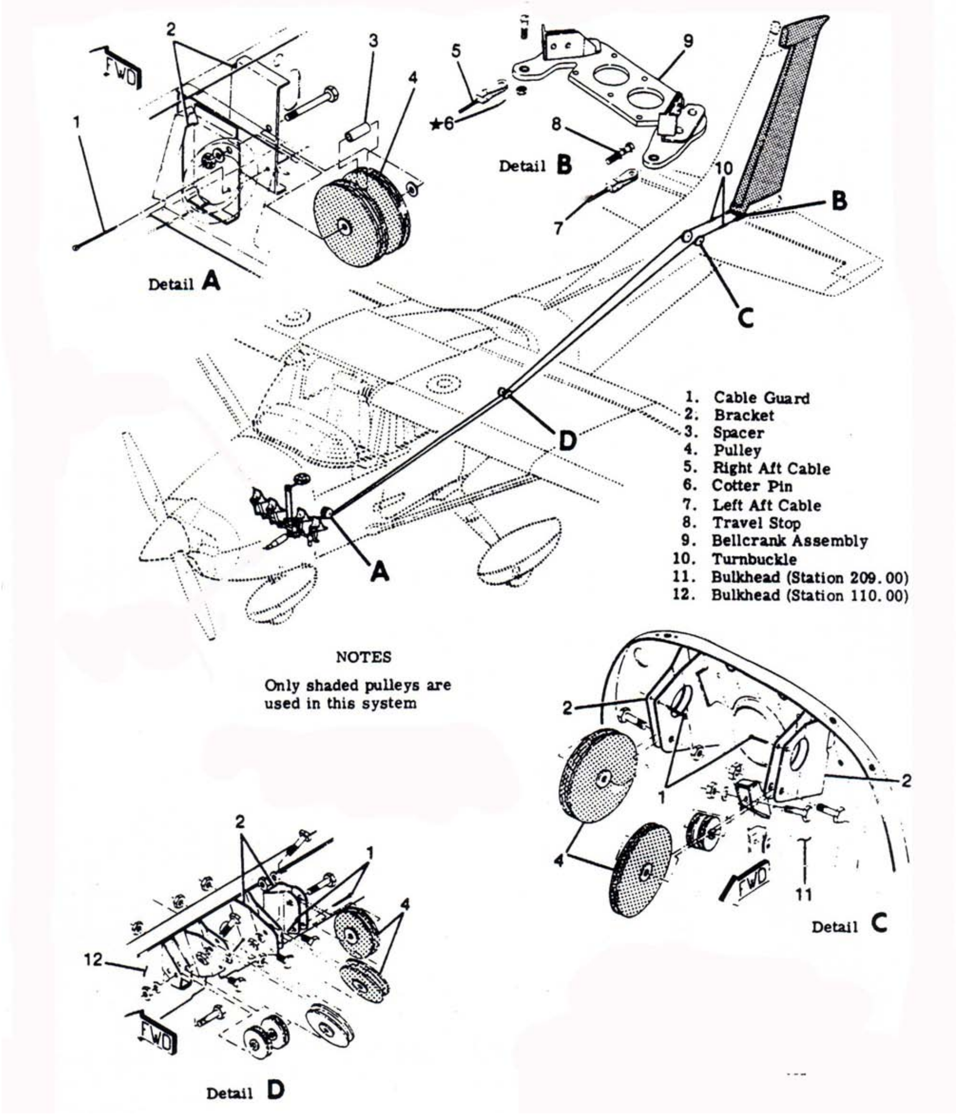
Elevator Control Linkages Diagram



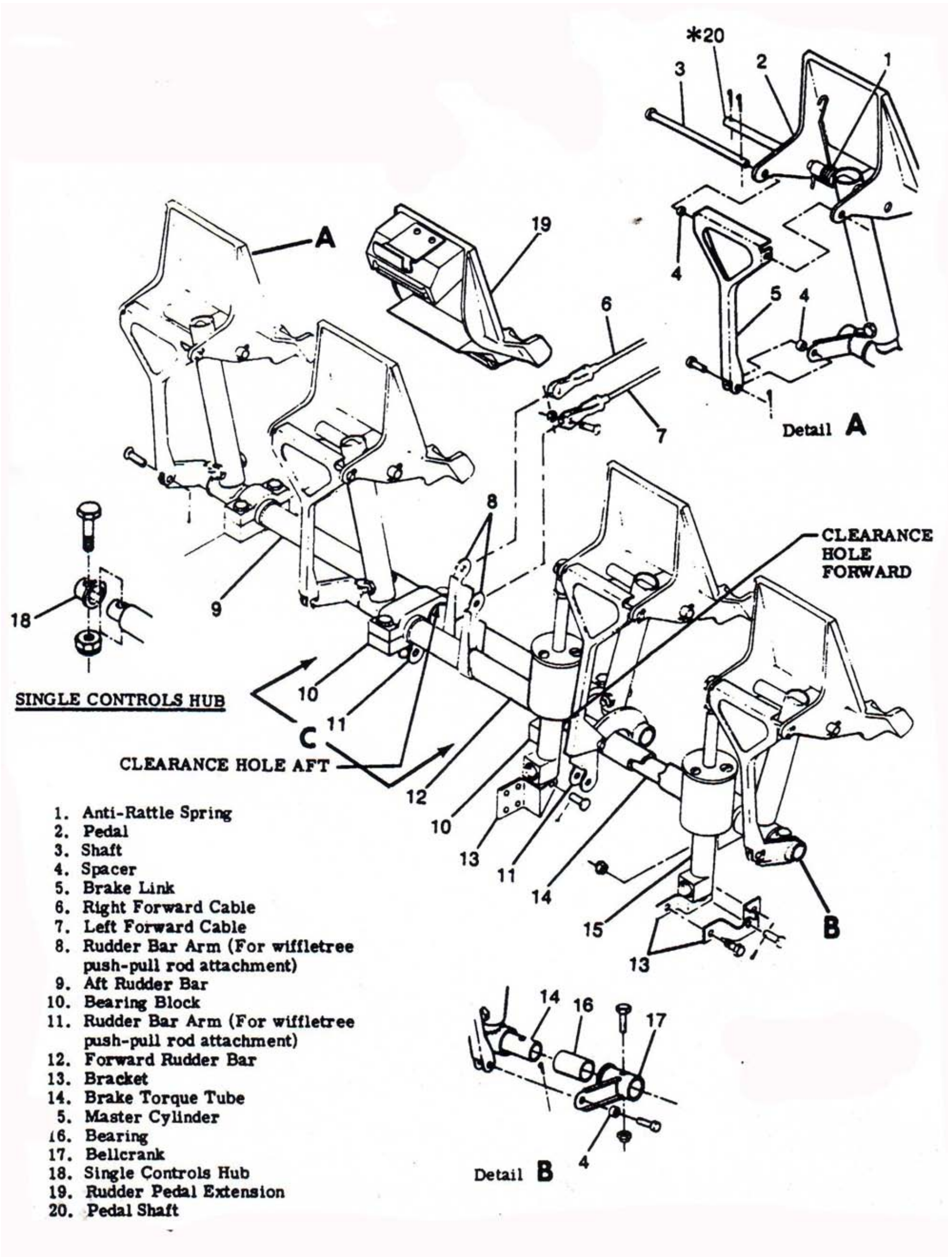
Aileron Control Linkages Diagram



Rudder Control Linkages Diagram



Rudder Pedal and Brake Construction Diagram



Trim

Both the elevator and rudder contain a trim tab for balancing aerodynamic forces.

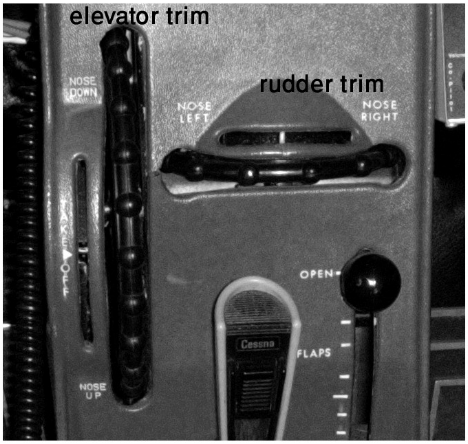
The elevator trim tab is provided on the right side of the elevator, spanning most of the the rear section of the right elevator. The trim tab operates conventionally, moving opposite to the control surface, reducing the aerodynamic force on the control surface in order to hold the selected position.

Rudder trimming is accomplished through a direct linkage of the trim wheel to the rudder control system. The trim control wheel is mounted on the control pedestal between the pilot seats as illustrated.

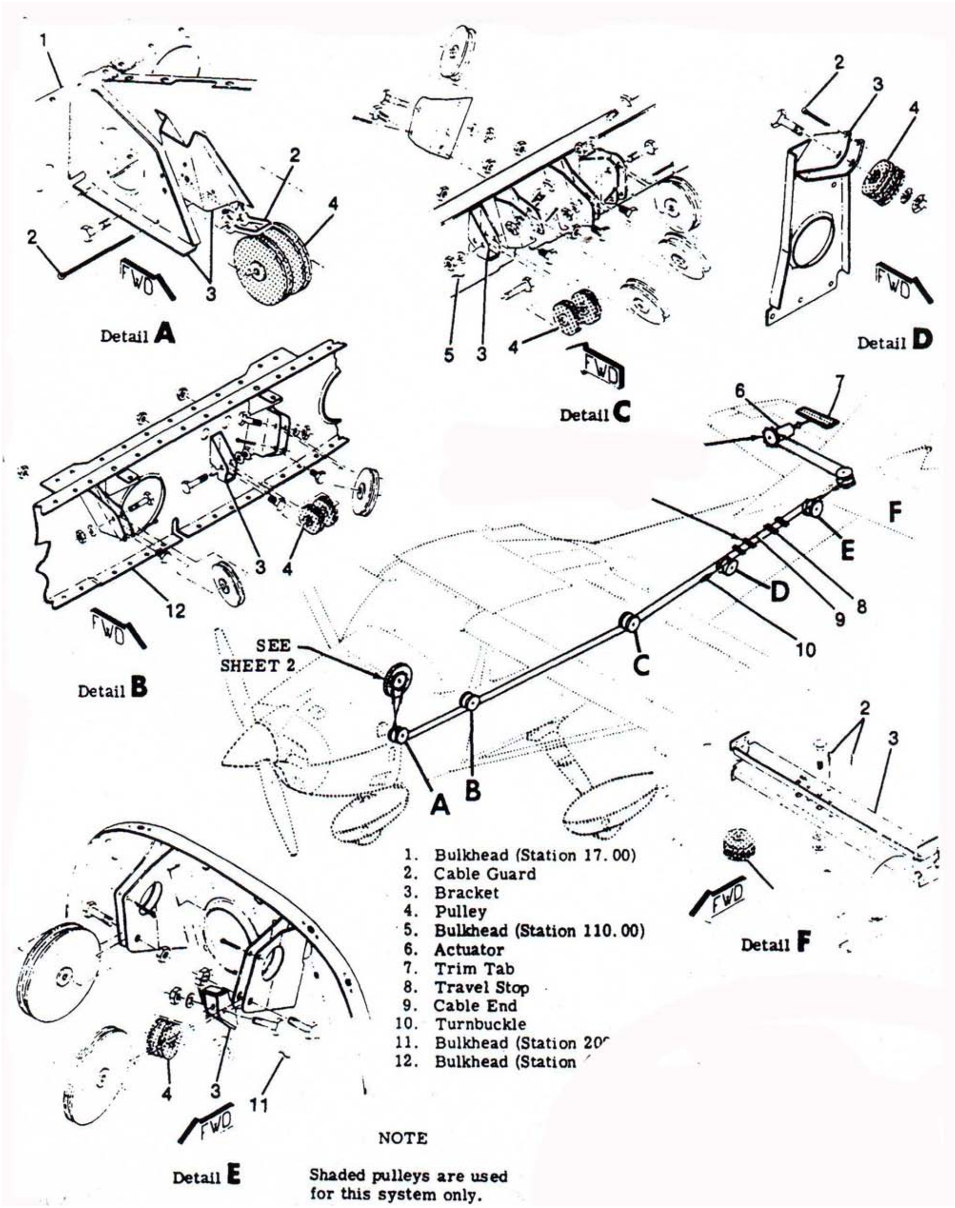
The trim tabs operate as follows:

ELEVATOR trim: Forward (up) rotation of the trim wheel will trim nose-down, conversely, aft (down) rotation will trim nose-up.

RUDDER trim: Left rotation of the trim wheel will apply left yaw, right rotation will apply right yaw. The trim wheel should be rotated towards direction of the applied rudder (i.e. towards the heavy foot) until the force required on the rudder pedal to maintain balance is removed.



Trim Control Linkages Diagram



Flaps

The flaps are constructed basically the same as the ailerons with the exception of the balance weights and the addition of a formed sheet metal leading edge section. The maximum deflection of the flaps is 40º.

Flap actuation is either by manual flap lever or electrically through a flap switch and electric motor.

The wing flaps are of the single-slot, fowler type. Both design features act to further reduce the stalling speed.
The single slot modifies the direction of the airflow to maintain laminar flow longer.
The fowler design increasing the size of the wing surface area on extension.

Manual Flap

The manual flap system installed on the early models of C182 consists of .

- an actuation lever
- locking push button
- mechanical linkages to the flap

Actuation of the manual flap requires depressing the locking push button and raising or lowering the flap to the desired position. Releasing the push button will allow the flap to lock into the next position. If you are unfamiliar with manual operation raise and lower the flaps into each position before flight until you are comfortable with the selections.

Mechanical flaps are directly linked to the flaps so forces required to activate are directly related to the air pressure on the flaps. Extending flaps close to the flap limiting speed can be difficult, proper approach planning should be adhered to to avoid this situation.

Electric Flap

The electric flap control system is comprised of:

- an electronic motor
- transmission assembly,
- drive pulley, cables, and push-pull rods
- follow-up control.

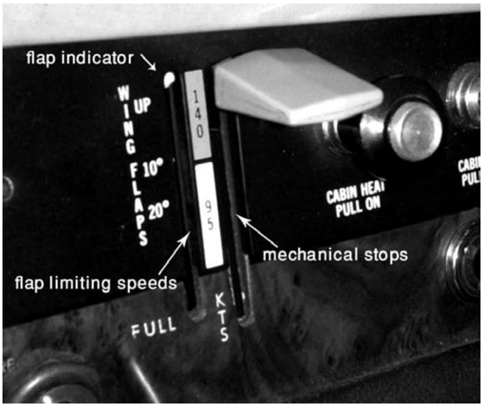
Power from the motor and transmission assembly is transmitted to the flaps by the drive pulley, cables and push-pull rods.

Electrical power to the motor is controlled by two microswitches mounted on a floating arm assembly, through a camming lever and follow-up control. They are extended or retracted by positioning the flap lever on the instrument panel to the desired flap deflection position.

Flap Lever

The flap lever is moved up or down in a slot in the instrument panel that provides mechanical stops at the 10º and 20º positions.

For settings greater than 10º, to clear the mechanical stops move the switch lever to the right, clear of the detent and position it as desired. A scale and pointer on the left side of the switch level indicates flap travel in degrees.



The flap system is protected by a 15-ampere circuit breaker, labeled FLAP, on the right side of the instrument panel.

When the flap control lever is moved to the desired flap setting, an attached cam trips one of the microswitches, activating the flap motor. As the flaps move to the position selected, the floating arm is rotated by the follow-up control until the active microswitch clears the cam, breaking the circuits and stopping the motor. To reverse flap direction the control lever is moved in the opposite direction causing the cam to trip a second microswitch which reverses the flap motor. The follow-up control moves the cam until it is clear of the second switch, shutting off the flap motor. Failure of a microswitch will render the system inoperative without indication as to why.

Limit switches on flap actuator assembly prevent over-travel of the flaps in the full UP or DOWN positions. Failure of limit switches will cause the motor to continue to run after the desired position is reached.

Note on Use of Flap

Although the 40 degrees of flap is what makes the C182 so versatile it is also one of the added complications and possible traps for the unaware pilot. From trigonometry it should be remembered that 40 degrees of flap causes considerably greater drag than a selection of 30 degrees, and requires much more power to overcome a small loss of height or speed on approach.

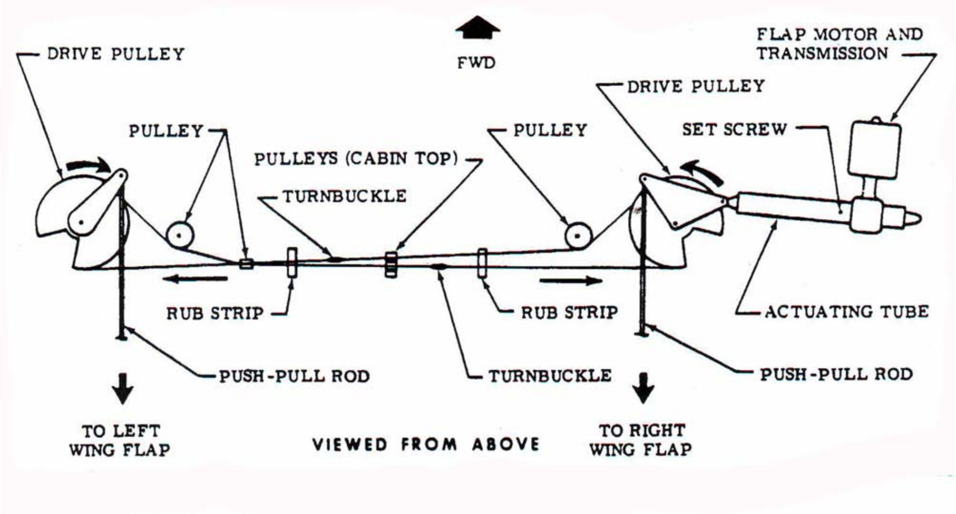
Once the aircraft has been put in a position low on approach and behind the drag curve with 40 degrees of flap, if combined with another contributing factor for example high density altitude, heavy loads or windshear, results can be catastrophic. This logic may be equally applied to the short field takeoff with 20 degrees of flap combined with low speed and high power settings.

It should be remembered that although the performance and capability is there, maximum performance takeoffs and landings are maneuvers that should be given the full respect they deserve and practiced thoroughly during dual training, and attempted during solo flying only once proficient and with the application of adequate safety margins.

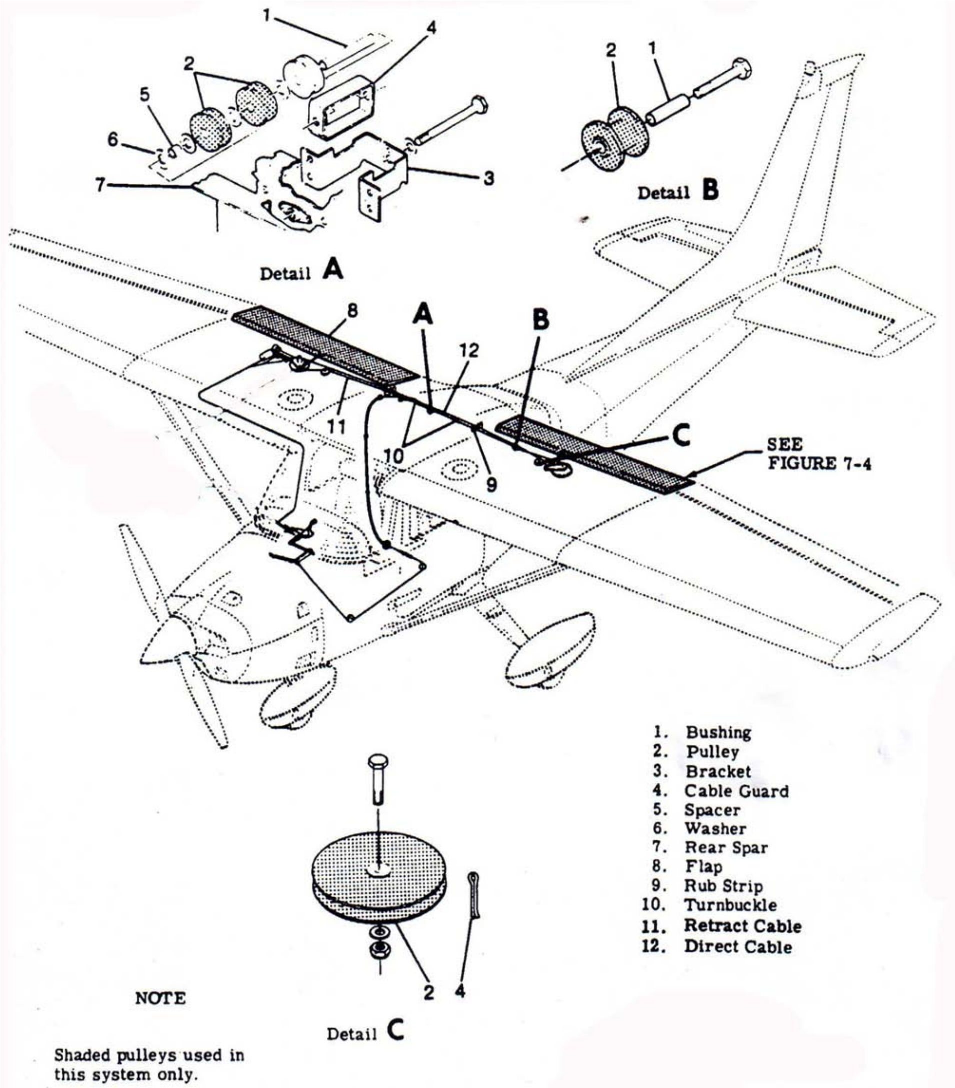
For normal approaches use of full flap generally provides better handling in the flare, smoother transition to landing attitude and speed, lower touch down speeds and better pitching moments.

Full flap can be used in moderate and even strong crosswind conditions depending on pilot comfort level. Full flap crosswind landings should be practiced dual.
When solo and with little experience on the aircraft lower flap settings will improve the lateral stability and higher touchdown speeds will provide better control.

Flap System Schematic



Flap Linkage Diagram

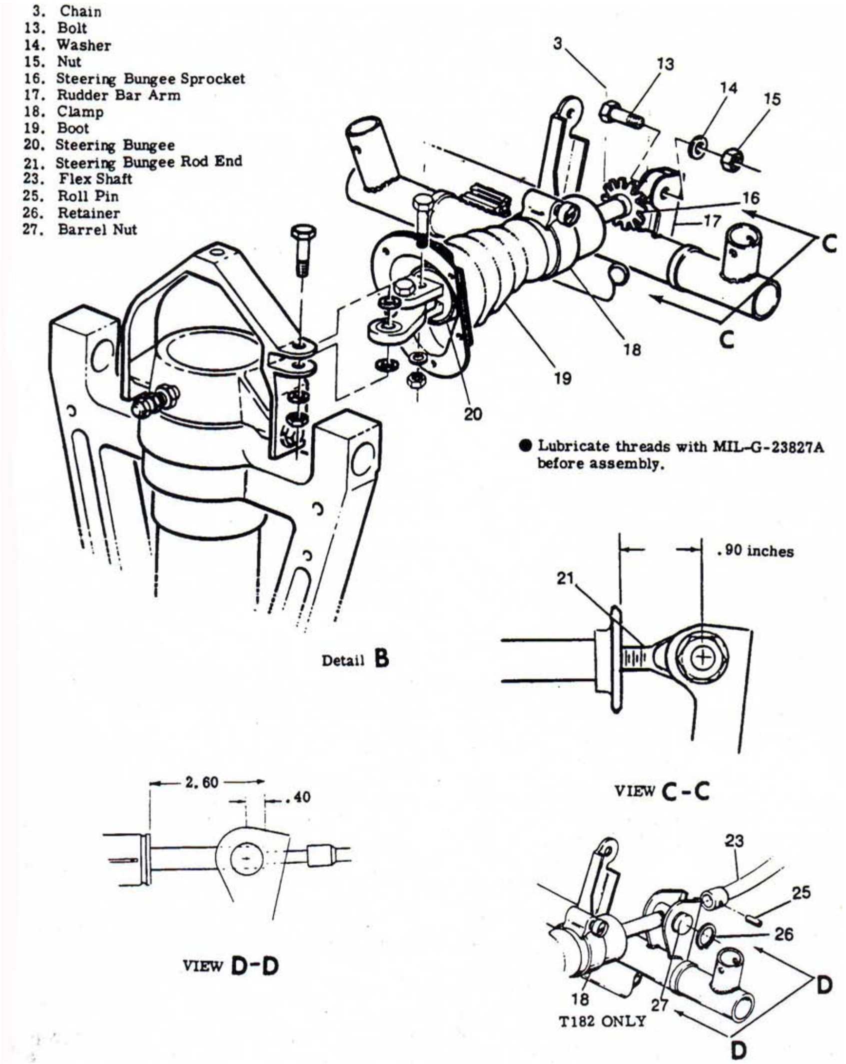


Landing Gear

The landing gear is of the tricycle type with a steerable nose wheel and two fixed main wheels. The landing gear may be equipped with wheel fairings for reducing drag.

The steerable nose wheel is mounted on a forked bracket attached to an air/oil (oleo) shock strut. The shock strut is secured to the tubular engine mount.

Steerable Nose Strut Construction Diagram



Nose wheel steering is accomplished by two spring-loaded steering bungees linking the nose gear steering collar to the rudder pedal bars. Steering is afforded up to 8.5 degrees each side of neutral, after which brakes may be used to gain a maximum deflection of 30 degrees right or left of centre. During flight the nose wheel leg extends fully, bringing a locking mechanism into place which holds the nose wheel central and free from rudder pedal action.

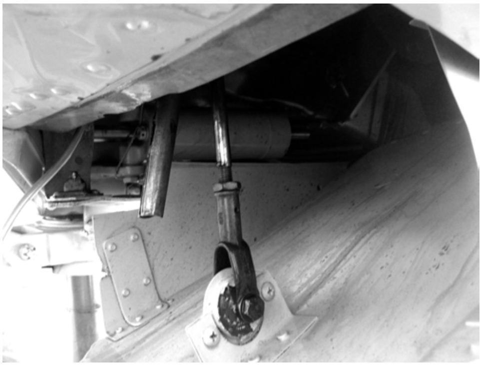
Each main gear wheel is equipped with a hydraulically actuated single-disc brake on the inboard side of each wheel.

The Cessna 182RG incorporates the standard landing gear arrangement with a modification for extension and retraction. The landing gear operating system is a conventional electrically actuated and hydraulically controlled.

Shock Absorption

Shock absorption on the main gear is provided by the tubular spring-steel main landing gear struts and air/oil nose gear shock strut. Because of this the main gear is far more durable than the nose gear and is thus intended for the full absorption of the landing.
Correct extension of shock strut is important to proper landing gear operation. Too little
extension will mean no shock absorption resulting in shock damage during taxi and landing, too much and proper steering will become difficult and premature nose wheel contact on landing may occur. Should the strut extend fully while on the ground the locking mechanism will cause a complete loss of nose wheel steering.

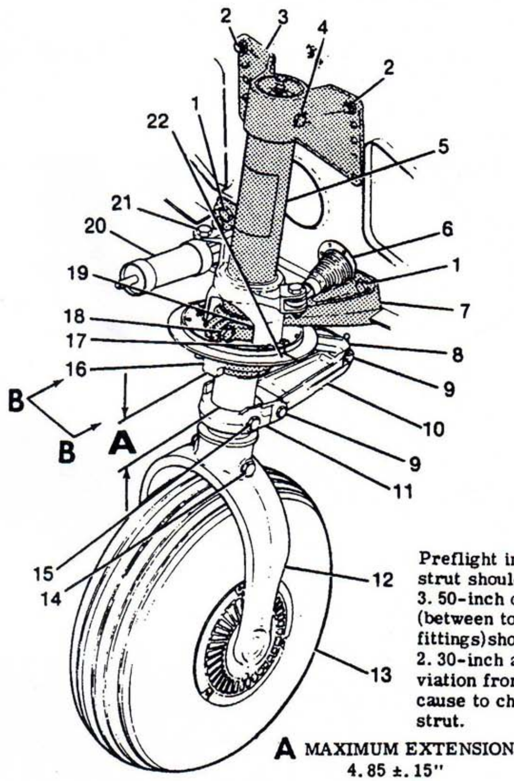
A hydraulic fluid-filled shimmy damper is provided to minimize nose wheel shimmy. The shimmy damper offers resistance to shimmy (nose wheel oscillation) by forcing hydraulic fluid through small orifices in a piston. The dampener piston shaft is secured to a stationary part and the housing is secured to the nose wheel steering collar which moves as the nose wheel is turned right or left, causing relative motion between the dampener shaft and housing. This movement in turn provides the resistance to the small vibrations of the nose wheel.

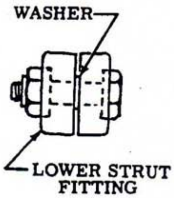


Nose Gear Construction Diagram

NOTE

Unshaded parts of the nose gear turn as the nose gear steering system is operated on the ground, but do not turn while airborne. As the lower strut extends, a centering block on the upper torque link contacts a flat spot on the bottom end of the upper strut, thus keeping the lower strut and wheel from turning.





B-B

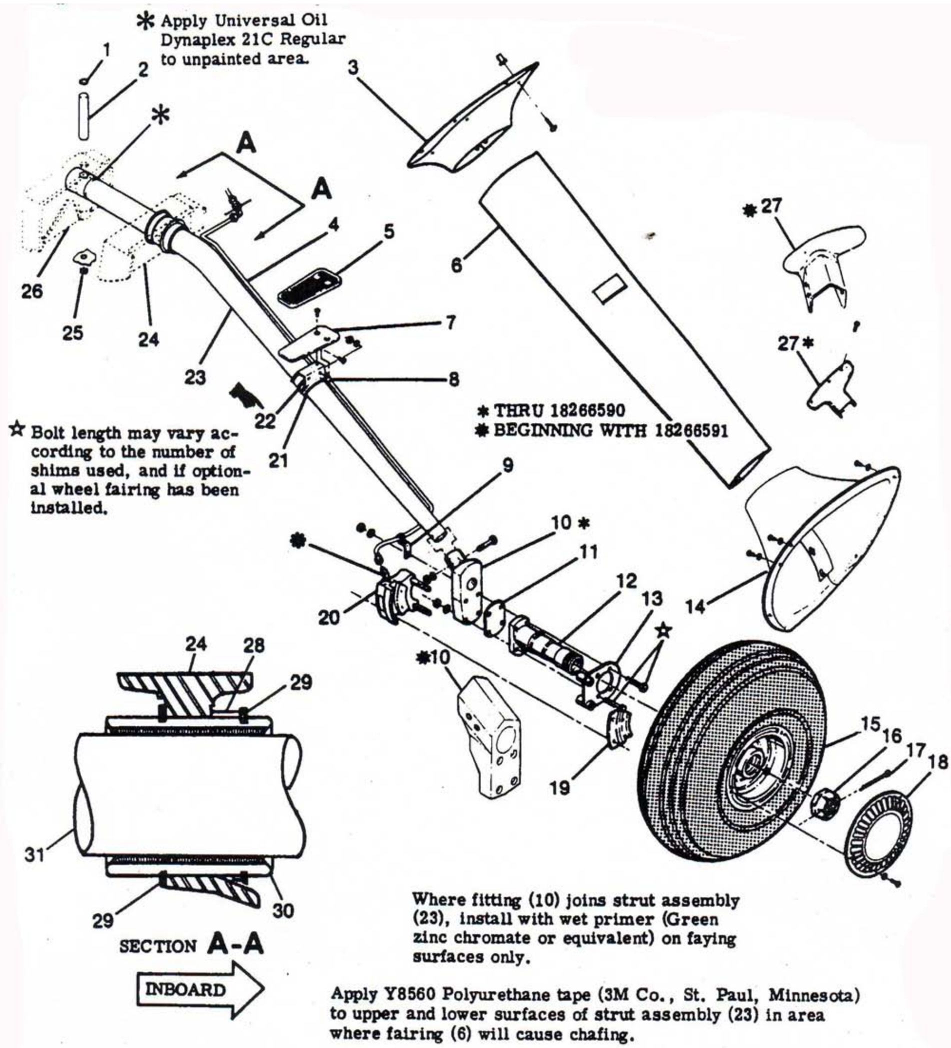
NOTE

Preflight inspection of nose gear strut should reveal 1.75-inch to 3.50-inch of nose strut barrel (between torque link attachment fittings) showing (or approximately 2.30-inch after bouncing). Deviation from these dimensions are cause to check and service the strut.

A MAXIMUM EXTENSION 4.85 ±.15"

1. Bolt
2. Bolt
3. Upper Forging
4. Bolt
5. Upper Strut
6. Steering Bungee
7. Lower Forging
8. Upper Torque Link
9. Bolt
10. Lower Torque Link
11. Torque Link Fitting
12. Nose Gear Fork
13. Wheel and Tire
14. Bolt
15. Bolt
16. Steering Collar
17. Screw
18. Bolt
19. Steering Torque Arm
20. Shimmy Dampener
21. Bolt
22. Closure Assembly

Main Gear Construction Diagram



1. Snap Ring	10. Fitting	17. Cotter Pin	24. Outboard Forging
2. Strut-Attach Pin	11. Shim	18. Hub Cap	25. Plug Button
3. Upper Fairing	12. Axle	19. Back Plate	26. Inboard Forging
4. Brake Line	13. Torque Plate	20. Brake Cylinder	27. Cover Plate
5. Step Tread	14. Lower Fairing	21. Bracket	28. Spacer
6. Strut Fairing	15. Wheel Assembly	22. Sta-Strap	29. Retainer Ring
7. Step Assembly	16. Axle Nut	23. Strut Assembly	30. Bushing
8. Hose			31. Main Gear Spring
9. Bracket			

Hydraulic System (RG model only)

Hydraulic power is supplied by an electrically-driven hydraulic power pack located behind the firewall between the pilot's and copilot's rudder pedals. The power pack's function is to supply hydraulic power for operation of the retractable landing gear.

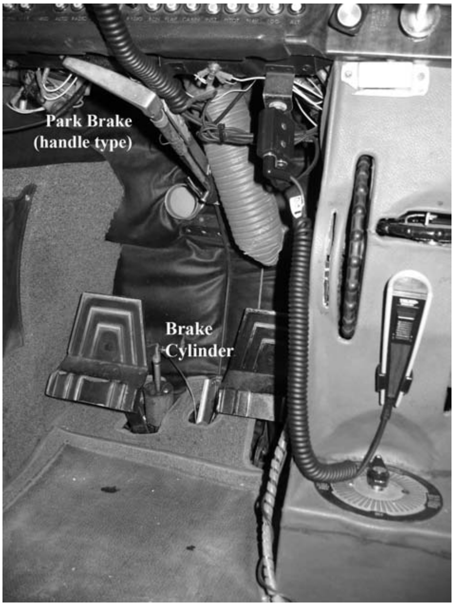
This is accomplished by applying hydraulic pressure to actuator cylinders which extend or retract the gear. The hydraulic system normally operates at 1000 PSI to 1500 PSI, and is protected by relief valves which prevent high pressure damage to the pump and other components in the system. The electrical portion of the power pack is protected by a 30-amp push-pull type circuit breaker switch, labeled GEAR PUMP, on the left switch and control panel.

The hydraulic power pack is turned on by a pressure switch on the power pack when the landing gear lever is placed in either the GEAR UP or GEAR DOWN position. When the lever is placed in the GEAR UP or GEAR DOWN position, it mechanically rotates a selector valve which applies hydraulic pressure in the direction selected. As soon as the landing gear reaches the selected position, a series of electrical switches will illuminate one of two indicator lights on the instrument panel to show gear position and completion of the cycle. After indicator light illumination, (GEAR DOWN cycle only), hydraulic pressure will continue to build until the power pack pressure switch turns the power pack off.

The hydraulic system includes an emergency hand pump to permit manual extension of the landing gear in the event of hydraulic power pack failure. The hand pump is located on the cabin floor between the front seats.

During normal operations, the landing gear should require from 5 to 7 seconds to fully extend or retract. For malfunctions of the hydraulic and landing gear systems, refer to Section 3 of this handbook.

Brakes



Each main gear wheel is equipped with a hydraulically actuated disc-type brake on the inboard side of each wheel. When wheel fairings are installed the aerodynamic fairing covers each brake.

The hydraulic brake system is comprised of:

- ✈ two master cylinders immediately forward of the pilot's rudder pedals
- ✈ a brake line and hose connecting each master cylinder to its wheel brake cylinder
- ✈ a single-disc, floating cylinder-type brake assembly on each main wheel

The brake master cylinders located immediately forward of the pilot's rudder pedals, are actuated by applying pressure at the top of the rudder pedals. A small reservoir is incorporated into each master cylinder for the fluid supply. Mechanical linkage permits the co-pilot (instructor) pedals to operate the master cylinders.

Through their operation it is easily possible to inadvertently use brakes whilst under power. This increases wear on brakes and increases stopping distances. Prior to applying brakes to stop the aircraft always ensure the throttle is closed.

Park Brake

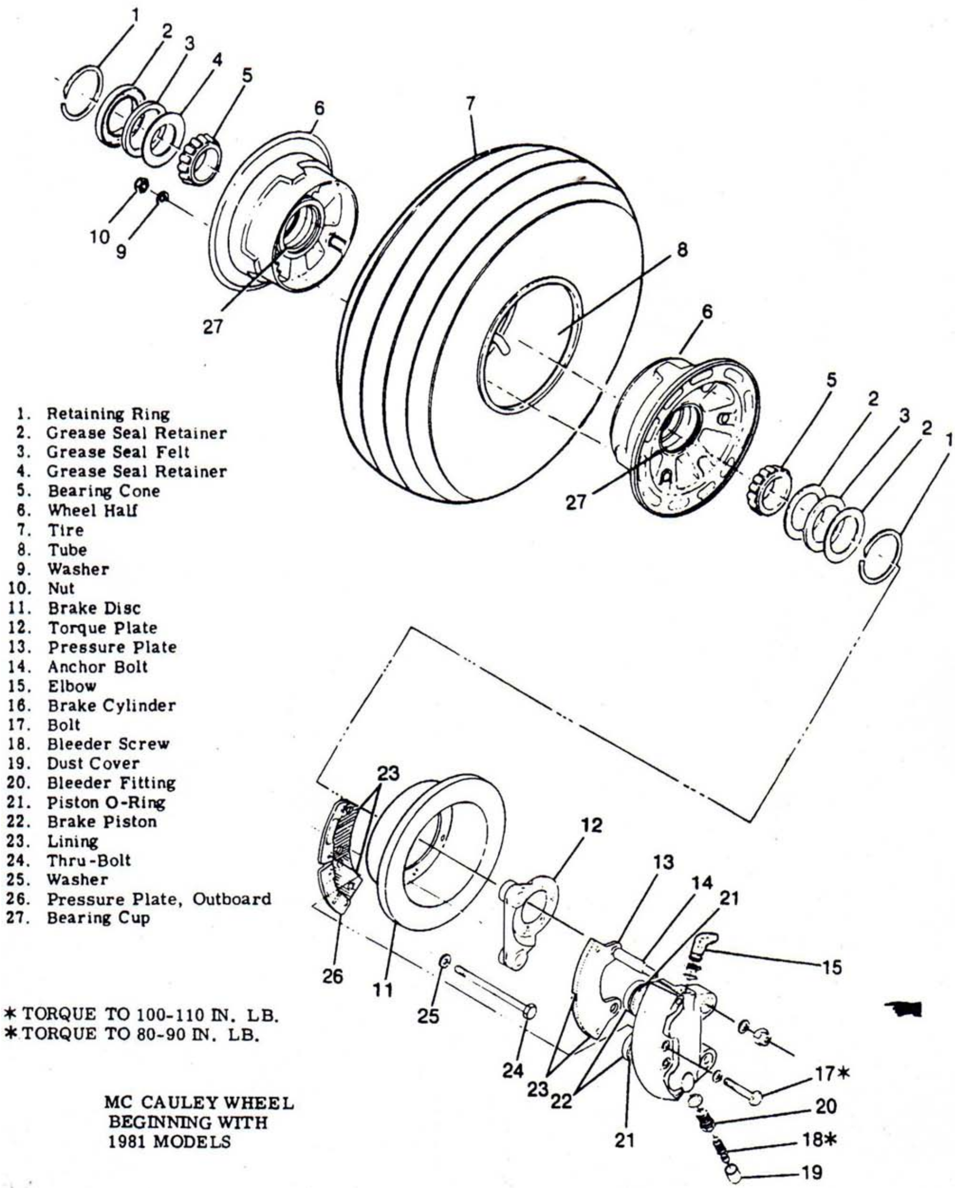
The park brake system consists of a control lever on the instrument panel which is connected to linkage at the brake master cylinders. At the brake master cylinders, the control operates locking plates which trap pressure in the system after the master cylinder piston rods have been depressed by toe operation of the rudder pedals.

The method of using the parking brake system is:
1. Apply pressure on the top of the rudder pedals
2. Pull parking brake control to the out position
3. Rotate the control downwards to the locked position
4. Release toe pressure

To release the parking brake apply the reverse procedure, pull the park brake and rotate in the reverse direction then push fully in towards the control panel.
The park brake should be released when securing the aircraft after installing chocks to prevent locking.

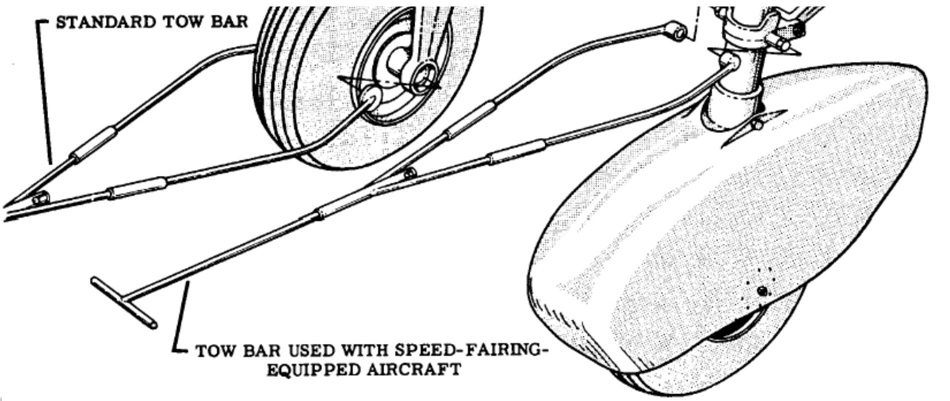
Note: some brake systems may differ in actuation and control.

Brake Construction Diagram



Towing

Moving the aircraft by hand is best accomplished by using the wing struts and landing gear struts as a push point. A tow bar attached to the nose gear should be used for steering and manoeuvering the aircraft on the ground. When towing the aircraft, never turn the nose wheel more then 30 degrees either side of centre or the nose gear will be damaged.
When no tow bar is available, the aircraft may be manoeuvered by pressing down on the tail section. Do not to press on the control surfaces or horizontal/vertical stabilizers as structural damage will occur to the mounting or skin surface. Press down on the tail section or aft fuselage immediately forward of the vertical stabilizer leading edge.



Engine & Engine Controls

The aeroplane is powered by a flat 6 cylinder horizontally opposed piston engine.

With the exception of the turbo model, the C182 models prior to 1996 are equipped with the 230hp Continental 0-470-R carburettor, normally aspirated engine, producing at sea level maximum continuous power of 230hp at 2600rpm.

After beginning production in 1996 later models were fitted with fuel injected 230hp Lycoming IO-540 engine.

The propeller is a two-bladed, constant speed, aluminium alloy McCauley propeller. The propeller is approximately 2m (6'10" metres) in diameter.
Optional three blade installations are available for some models.

Engine Controls

The engine control and monitoring consists of:

- ✈ Throttle control
- ✈ Propeller pitch control
- ✈ Mixture control
- ✈ Carb. Heat selector
- ✈ Engine monitoring gauges:
    - Manifold pressure gauge
    - Tachometer
    - Oil temperature and pressure
    - Exhaust Gas Temperature
    - Cylinder Head Temperature

Some optional equipment

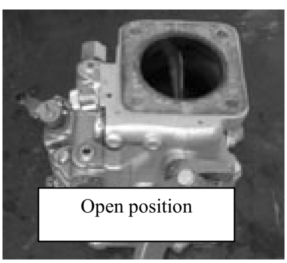
- Carburettor heat indicator
- Fuel flow indicators (Fuel injected models)
- Fuel pressure indicators
- Annunciator panel (C182T)

Throttle

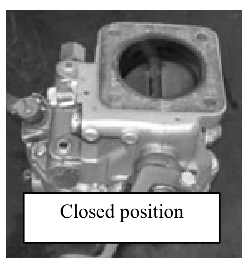
Engine power is controlled by a throttle, located on the lower center portion of the instrument panel.

The throttle controls a throttle valve (or butterfly) – an oval metal disc pivoted on a central spindle that is perpendicular to the axis of the carburettor's manifold. The closed position of the valve is when the disc is rotated to an angle of about 70° to the axis of the manifold, preventing all but enough fuel/air for idling to pass through the manifold. When the valve is rotated to a position parallel to the axis of the manifold it offers very little restriction to airflow. This is the fully open position of the valve providing maximum fuel/air mixture to the manifold.

The picture below shows a carburettor in the open and closed positions of the throttle butterfly.



Open position



Closed position

The throttle control operates conventionally as follows:

- ✈ **full forward** position, the throttle is **open** and the engine produces **maximum** power,
- ✈ **full aft** position, it is **closed** and the engine is **idling** or windmilling.

Fuel Injection (C182 R and S)

On the latest models of C182 a fuel injection system was installed, which is a low pressure, multi nozzle, continuous flow system which injects raw fuel into the engine cylinder heads. The injection system is based on the principle of measuring engine air consumption to control fuel flow, proportional to the mixture setting. More air flow through the venturi will result in more fuel being delivered to the engine, and less air flow through the venturi results in a decreased flow of fuel to engine. System components consist of the fuel/air control unit, the fuel distribution valve (flow divider), injection nozzles (4 total) and lines used to connect the components.

A description of the components is as follows:

Fuel/Air Control Unit - The fuel/air control unit, also known as the 'servo regulator,' is located on the underside of the engine and integrates the functions of measuring airflow and controlling fuel flow. The control unit consists of an airflow sensing system, a regulator section and a fuel metering section.
Fuel Distribution Valve - The fuel distribution valve, also known as a 'spider' or a flow divider, is located on top of the engine and serves to distribute fuel evenly to the four cylinders once it has been regulated by the fuel/air control unit. Also attached to the fuel distribution valve is a rigid line which feeds into a pressure transducer. This transducer measures fuel pressure and translates that reading into fuel flow at the cockpit indicator. The engine with the fuel injection system will have an fuel flow indicator in the cockpit.
Injection Nozzles - Each cylinder contains an injection nozzle, also known as an air bleed nozzle or a fuel injector. This nozzle incorporates a calibrated jet that determines, in conjunction with fuel pressure, the fuel flow entering each cylinder. Fuel entering the nozzle is discharged through the jet into an ambient air pressure chamber within the nozzle assembly. This nozzle assembly also contains a calibrated opening which is vented to the atmosphere, and allows fuel to be dispersed into the intake portion of the cylinder in an atomized, cone-shaped pattern.

Manifold Pressure and Throttle Setting

When the engine is below governing speed the indication of power provided by the throttle is a measure of engine rpm. The manifold pressure is below the indicating scale, and the propeller is at the fine pitch stop, therefore increases and decreases in engine speed are transmitted directly to the propeller. Once the engine reaches governing speed then the throttle controls the manifold pressure. Engine power is indicated by manifold pressure and the rpm is maintained by the Constant Speed Unit (propeller governor).

Full Throttle Height

Although we are aware of power reduction with height with a fixed pitch propeller, with a CSU we can see this directly by the manifold throttle relationship. As we climb and the ambient pressure drops to maintain our climb power setting in this case 23” we will have to progressively increase the throttle. This will continue until we reach a point that the throttle is fully forward, so termed “ full throttle height”. Climbing above this level will result in reducing manifold pressure as we climb, until we reach the aircraft ceiling where the power is just enough to maintain level flight.

Throttle Friction Nut

A friction lock, which is a round knurled disk, is located at the base of the throttle and is operated by rotating the lock clockwise to increase friction or counter-clockwise to decrease it. This allows for reducing friction for smooth operations when frequent or large power changes are required or increasing friction when a fixed power setting or minimum changes are required.

Pitch Control

The propeller pitch is controlled by the constant speed unit (CSU), which consists of the propeller pitch vernier control knob, propeller governor, linkages and actuators.
The CSU provides a propeller governing function by altering the propeller blade angle (pitch) to maintain the selected rpm when there are changes in aircraft attitude, speed or power setting.

The pilot sets the rpm on the pitch control in the cockpit, then once the power is increased above the governing range and the selected rpm is reached, the prop governor will increase or decrease the pitch to maintain the rpm.
When below the governing range the propeller reverts to normal governing operation whereupon the throttle controls the propeller speed. This is normally occurs in flight around 12" manifold pressure and is applicable for most ground operations.

The governor controls flow of engine oil, boosted to high pressure by the governing pump, to or from a piston in the propeller hub. Oil pressure acting on the piston twists the blades towards high pitch (low propeller rpm). When oil pressure to the piston in the propeller hub is relieved, centrifugal force, assisted by an internal spring, twist the blades toward low pitch (high rpm).

The Propeller Control knob is labelled PROP RPM, PUSH INC. When the control knob is pushed in, blade pitch will decrease, giving a high rpm ("fine pitch") for maximum power. Inversely, when the control knob is pulled out, the blade pitch increases, thereby decreasing rpm ("coarse pitch") providing less drag and noise in the cruise . The propeller control knob is equipped with a vernier feature which allows slow or fine rpm adjustment by rotating the knob clockwise to increase rpm, and counter-clockwise to decrease. To make rapid adjustment, the button on the end of control knob shall be depressed and the control be repositioned as desired. To avoid unnecessary stress on the engine this control should not be used above the governing range in flight.

With the pitch control set to maximum and the throttle fully forward the engine must develop the maximum rpm specified. This can be checked in a stationery run-up if needed. Should full rpm not be developed after application of full throttle for take-off, it is an indication that there is a possible fault in the CSU unit, take-off should be discontinued.

Functioning of the CSU is checked during the engine run-up at 1700rpm. The propeller pitch is selected momentarily to coarse and back to full fine, ensuring a rpm drop, manifold pressure increase and oil pressure drop and return. Full fine should be selected to ensure the rpm drop is not more than 300rpm, to avoid excessive loading on the engine. This cycling action should be repeated two to three times, as it also ensures that warm engine oil is cycled through the system providing proper lubrication before full loads are applied.

Mixture

The mixture control, mounted on the right of the throttle, is a red vernier type control. It is used for adjusting fuel/air ratio in the conventional way as follows:

- ✈ **full forward** position is the **fully rich** position (maximum fuel to air ratio)
- ✈ **full aft** position is the **idle cut-off** position (no fuel)

For fine adjustments, the control may be moved forward by rotating the vernier knob clockwise (enriching the mixture), and aft by rotating it counterclockwise (leaning the mixture). For rapid or large adjustments, the control may be moved forward or aft by depressing the lock button on the end of the control, and then positioning the control as desired. When setting in flight the vernier should always be used.
The mixture control should be set to “full rich” for take-off below 3,000 feet of **density** altitude. Above 3,000 feet it is recommended the mixture be leaned to the correct setting before take-off.

Mixture Setting

For carburettor engines the setting should be always be slightly rich of the “peak rpm” or maximum power setting to allow for cooling and prevent detonation. This is achieved by rotating the knob counter-clockwise until maximum rpm is obtained with fixed throttle where upon the rpm begins to decrease on further leaning accompanied by slight rough running as cylinders begin to misfire. Then the control is rotated clockwise until rpm starts to decrease again, normally one turn to reach peak rpm again then two turns thereafter.

The Exhaust gas temperature (EGT) Indicator may be used as an aid for mixture leaning in cruising flight at 75% power or less. To adjust mixture, lean the mixture to establish the peak EGT, and then enrich the mixture till 25-50ºF rich of peak EGT. There is normally a small reference needle on the EGT gauge which is manually set to the peak on leaning for monitoring of changes.

For high altitude operations leaning for take-off is carried out during the engine run-up at 1700rpm. This setting is normally maintained to top of climb although further leaning during extended climbs may be needed. At 1700rpm the EGT is too cool to obtain accurate information, however it may be checked against the reference line during the climb.

Any change in altitude or throttle position will require a readjusting of the mixture setting.

Note on fuel injected models:
The fuel injected C182 will require different operating procedures, including the starting, mixture for takeoff, climb, descent, and fuel pump use.
Fuel injected models will additionally have a fuel flow gauge to indicate correct fuel flow on the respective phases of flight mentioned above.
As this is not common to a C182 the fuel injection system has not been covered in detail in the operations section, if this is the first time you are operating on a fuel injected aeroplane we would recommend a thorough briefing from you instructor.

Engine Gauges

Engine operation is monitored by the following instruments:

- ✈ Manifold pressure gauge
- ✈ Tachometer
- ✈ Fuel flow gauge (fuel injected models)
- ✈ Oil pressure gauge and Oil temperature gauge
- ✈ Cylinder Head Temperature gauge
- ✈ EGT indicator
- ✈ Manifold pressure gauge

The engine power output is most closely measured by the pressure in the inlet manifold. This pressure, the pressure of the air charge entering the cylinder, is proportional to the pressure being developed in the cylinder.
In aircraft with constant speed propellers, whereupon above a certain power range the rpm remains constant, the power is displayed by the manifold pressure gauge.

Manifold Pressure Gauge

Manifold pressure is typically indicated in inches of mercury (“Hg).

The manifold pressure has only a green arc for normal operations. It is not possible to exceed ambient pressure with a normally aspirated engine, and therefore not possible to “over boost” the engine.

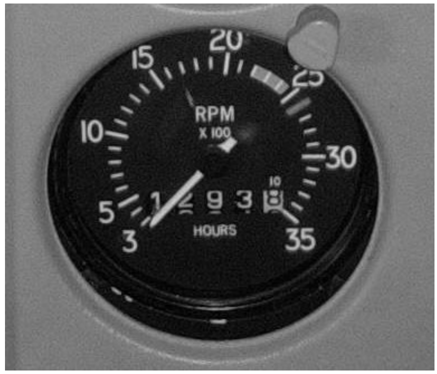
Normally there are some losses in the engine and so the indicated manifold pressure at full throttle application will be one or two inches below ambient pressure.
If the losses are greater than two inches, it is possible the engine is not developing full power and takeoff should not be attempted.

At sea level the manifold pressure at full throttle should be around 27-31”Hg depending on the ambient atmospheric pressure (QNH), standard pressure at sea level (QNE) is 29.92”Hg.

Turbo boosted engines will have a yellow arc and a red line on the manifold pressure, the red line is the power that must be obtained by the engine on full throttle(although need not be used for a normal takeoff) and must never be exceeded, the yellow arc is provided for take-off and normally has a 5 minute limitation.

Tachometer

The engine-driven mechanical tachometer is located near the upper center portion of the instrument panel. The instrument is calibrated in increments of 100 rpm and indicates engine and propeller speed. An hours meter inside the tachometer dial records elapsed engine time and runs at full speed only when the engine develops full power. Hence total flight time from chock to chock is usually higher than “tacho” time.



The normally aspirated C182 does not have a yellow arc on the tachometer. This means the engine is rated its maximum power (230hp) for continuous operations. However it is better practice to use maximum power for takeoff (full throttle, full fine pitch 2600rpm) and a more economical and engine friendly setting for cruise, eg 23” 2400rpm. The propeller is normally balanced at 2400rpm, but some workshops may choose a different setting. This rpm is the one that will provide the smoothest cruise operations, however for endurance or range the power settings provided in the AFM should be consulted.

Pressure and Temperature gauges

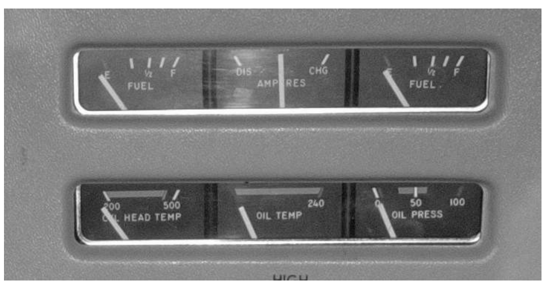
The oil pressure and temperature gauges are located on the left bottom side of the instrument panel. The normal operating range on both gauges is marked by a green arc.

The temperature gauge is an electric resistance type device powered by the electrical system. The pressure gauge is a mechanical direct reading device based on a “bordon tube” design.

Indications vary from engine to engine, however any deviation from the green range requires immediate action. This may include reduction in power, increasing airspeed, richening mixture as applicable and contemplation of a landing when possible.

CHT Gauge

The Cylinder Head Temperature (CHT) indicator, if installed, is a more accurate means of measuring the engine operating condition. It is a direct indication of engine temperature compared with oil temperature which is surrounding the engine and has inertia and damping effects. As this is one of the hottest part of the engine probes are often prone to failure, and may fail in a high or low position. Indications should be used in conjunction with the Oil Temperature and Pressure readings.



CHT gauges may often after failure be replaced by alternative gauges located in a different position.

EGT Indicator

The Exhaust Gas Temperature (EGT) indicator is located near the tachometer. A thermocouple probe in the muffler tailpipe measures exhaust gas temperature and transmits it to the indicator. Exhaust gas temperature varies with fuel-to-air ratio, power, and rpm. The indicator is equipped with a manually positioned reference pointer.

Induction System and Carb. Heat

The engine receives air through an intake in the lower portion of the engine cowling. The intake is covered by an air filter which removes dust and other foreign matter from the induction air. Airflow passing through the filter enters the inlet in the updraft-type carburettor underneath the engine intake. The air then is mixed with the fuel and ducted to the engine cylinders through intake manifold tubes.

In the event carburettor ice is encountered or the intake filter becomes blocked, alternate heated air can be used. A selector knob mounted on the instrument panel (see picture above) controls the selection of hot air to the induction system. The control operates a Bowden cable which terminates at a butterfly valve in the carburettor air mixing box. Air enters this box from two sources:

- ✈ Normal cold induction air – through the intake mounted in the nose and protected by a filter screen;
- ✈ Hot air intake, mounted on the starboard front shelf of the engine cowling connected to a heat exchanger unit fitted to the engine exhaust system.

Carb. Heat

The purpose of the hot air is to prevent the formation of ice in the induction line of the engine. Ice formation of this type is recognized by a gradual or sharp drop in the engine rpm and/or rough running. When icing is suspected, the hot air knob (Carb. Heat) should be pulled into the fully out position. Confirmation of the icing will be by a further drop (from the hot air), followed by an increase when the ice is cleared.

The C182 is particularly prone to carburettor icing because of the location of the carburettor away from the engine heat. Use carb. heat periodically enroute and whenever operating at low power settings in icing conditions.

Operation of the carb. heat should be always fully out or in, partial operation may increase icing due to small heat raising temperature to the icing range. A functioning test for the system should be carried out at 1700 rpm during engine run up. With the selection of hot air, a positive drop in power should occur. Use of full carburettor heat at full throttle during flight will result in a loss of approximately 150 rpm.

It should be remembered that heated air is obtained from an **unfiltered** outside source, thus the system should not be used on the ground for prolonged time. Dust inducted into the intake system of the engine is probably the greatest single cause of early engine wear. When operating under high dust conditions, the carburettor heat system should not be used and the induction air filter should be serviced after the flight.

Carb. Temperature Gauge

Due to the prevalence of carburettor ice in the C182 some models were fitted with carb temperature gauges. If fitted this is a great way of ensuring carb ice is avoided. Monitor the carb temperature during and select carb heat to ensure the temperature is above the freezing range (normally indicated in yellow). It should be noted that in extremely cold temperatures the selection of carb heat may increase the temperature into the freezing range, if the temperature is on the lower limit of the yellow range heat should be applied for longer periods to ensure the temperature increases above the yellow and is maintained there.

Oil System

A wet sump, pressure lubricated oil system is fitted. Oil is supplied from a sump on the bottom of the engine. A wet sump engine has a sump attached to it in which the oil is stored. The capacity of the sump is 12 imperial quarts of which 2 quarts are unusable.

Oil is drawn from the sump through the engine-driven oil pump to a thermostatically controlled bypass valve. If the oil is cold, the bypass valve allows the oil to bypass the oil cooler and flow directly to the oil filter. If the oil is hot, the oil is routed to the engine oil cooler mounted on the left forward side of the engine and then to the filter. The filtered oil then enters a pressure relief valve which regulates engine oil pressure by allowing excessive oil to return to the sump, while the balance of the pressure oil is circulated to the various engine parts for engine lubrication and cooling, Oil is returned by gravity to the engine sump.

Because oil viscosity changes with temperature and due to the nature of this system, there will be a small change in the pressure with changes in operating temperatures, the warmer the temperature the lower the pressure. It should be noted that any large increases in temperature or decreases in pressure, or deviation from normal operating (green) range are an indication of possible malfunction. Discontinuation of the flight or landing at the nearest suitable location should be contemplated.

The oil dipstick is accessible through the inspection panel on the left side of the engine cowling. Oil should be added if the level is below 9 quarts. To minimize loss of oil through the breather, fill to a maximum of 10 quarts for normal flights of less than three hours.

Recommendation from C182 aircraft engineers is to operate on the low side of this, eg fill to not more than 9 quarts for all operations, unless the engine is known to have a high oil consumption. If it is your first flight on the aeroplane and no other advice is given, you may wish to fill to 10 quarts.

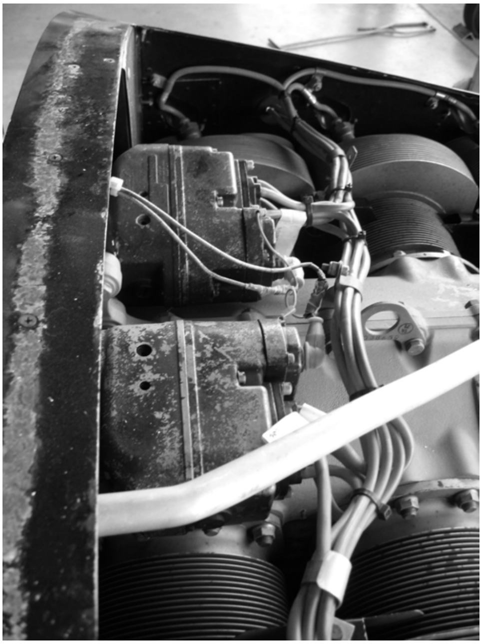
The oil tank filler cap is separate from the oil dipstick. It is therefore required to separately check the filler cap is secure during the preflight inspection when oil is not required.

Access to the filler cap is through the inspection panel on the top left side of the engine cowling. The filler cap can also be seen through the left intake opening behind the propeller.

Make sure that the filler cap is firmly on. Over turning may result in damage to the cap or difficulty in loosening, under turning may result in loss of oil or cap during flight.

Oil temperature and pressure gauges are fitted on the lower part of the instrument panel. If normal oil pressure is not indicated within 30 seconds of starting, the engine should be shut down immediately.

Ignition System



The necessary high-tension electrical current for the spark plugs comes from self-contained spark generation and distribution units called the magnetos. The magneto consists of a magnet that is rotated near a conductor which has a coil of wire around it. The rotation of the magnet induces an electrical current to flow in the coil. The voltage is fed to each spark plug at the appropriate time, causing a spark to jump between the two electrodes. This spark ignites the fuel/air mixture.
While the engine is running, the magneto is a completely self-sufficient source of electrical energy. The aircraft is equipped with a dual ignition system (two engine-driven magnetos, each controlling one of the two spark plugs in each cylinder). A dual ignition system is safer, providing backup in event of failure of one ignition system, and results in more even and efficient fuel combustion. The left magneto is fitted on the left hand side of the engine, as viewed from the pilot's seat, and fires the plugs fitted into the top of the left cylinders and the bottom of the right cylinders, the right magneto is on the right hand side and fires the opposite plugs (although the selector switch is normally fitted in reverse, see below). The dual system has an added bonus of being able to isolate left and right parts for easy plug and magneto fault finding during engine run up.

Ignition and starter operation is controlled by a rotary type switch located on the left bottom side of the instrument panel. The switch is labeled clockwise: OFF, R, L, BOTH and START. When the ignition switch is placed on L (left) the left ignition circuit is working and the right ignition circuit is off and vice versa. The engine should be operated on both magnetos (BOTH position) in all situations apart from magneto checks and in an emergency. When the switch is rotated to the spring-loaded START position (with master switch in the ON position), the starter is energized and the starter will crank the engine. When the switch is released, it will automatically return to the BOTH position.

Dead Cut and Live Mag. Check

It is important to understand, that if the ignition is live, the engine may be started by moving the propeller, even though the master switch is OFF. The magneto does not require outside source of electrical energy. A Dead-Cut check is completed for safety and convenience to prevent leaving an aircraft with a live mag. Fault.

Placing the ignition switch to OFF position grounds the primary winding of the magneto system so that it no longer supplies electrical power. With a loose or broken wire, or some other fault, switching the ignition to OFF may not ground both magnetos.

To prevent leaving the aircraft with a live magneto fault, the dead cut check is completed by making a “dead-cut” of the ignition system should be made just before shutting an engine down. The dead-cut check is made by switching the ignition momentarily to OFF and a sudden loss of power should be apparent. This is carried out most effectively from R, not from Both, to prevent inadvertent sticking in OFF.

On start up, a live mag check is performed, to ensure both magnetos are working before taxi. This is not a system function check detailed below, as the engine is still cold and plugs may be fouled, rather just a check to ensure both magnetos are working by switching from Both to L, then R, and back to Both, noting a small drop from Both in L and R positions. A dead-cut check may be carried out at the same time.

The engine will run on just one magneto, but the burning is less efficient, not as smooth as on two, and there is a slight drop in rpm. The magneto check to confirm both magnetos and plugs are operational should be made at 1700 rpm as follows:

- ✈ Move ignition switch to R position, allow to stabilise and note the rpm.
- ✈ Then move switch back to BOTH to clear the other set of plugs.
- ✈ Repeat for the L position and return to BOTH position.

Rpm drop should not exceed 125 rpm on either magneto or show greater than 50 rpm difference between magnetos.
An absence of rpm drop may be an indication of faulty grounding of one side of the ignition system, a disconnected ground lead at the magneto, or possibly the magneto timing is set too far in advance.
Excessive drop or differential normally indicates a faulty magneto.

Fouled spark plugs (lead deposits on the spark plug preventing ignition) are indicated by rough running usually combined with a large drop in rpm (i.e. one or more cylinders not firing). This is due to one of the two plugs becoming fouled, normally the lower plug. Plug fouling, if not excessive, may be burnt off. Run the engine at a correct or slightly lean mixture setting and a high power setting (+/-2000rpm) for a few minutes, caution engine temperatures and surrounds.

Cooling System

The engine cooling system is designed to keep the engine temperature within those limits designed by the manufacturer. Engine temperatures are kept within acceptable limits by:

- ✈ The oil that circulates within the engine;
- ✈ The air cooling system that directs and circulates fresh air around the engine compartment.

- ✈ Cowl flaps that increase or decrease the flow of air through the engine compartment

The engine is air-cooled by exposing the cylinders and their cooling fins to the airflow. Air for engine cooling enters through two openings in the front of the engine cowling. The cooling air is directed around the cylinders and other areas of the engine by baffling, and is then exhausted through an opening at the bottom aft edge of the cowling. No manual cooling system control is provided.

Air cooling is least effective at high power and low airspeed, for instance on take-off and climb. At high airspeed and low power, for instance on descent, the cooling might be too effective. It is therefore important to monitor the cylinder-head temperature gauge throughout the flight, and also on the ground when air-cooling will be poor.

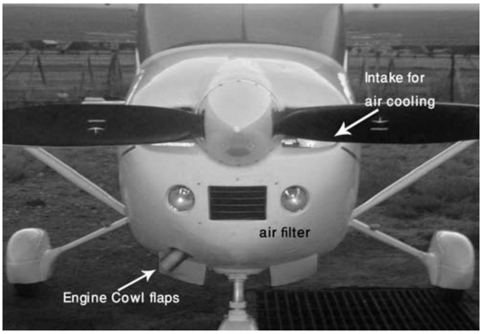
The propeller spinner in addition to streamlining and balance is a director for the cooling air, and so the aeroplane should generally not be operated without the spinner.

Operation of Cowl Flaps

The cowl flaps should be thought of as part of the power quadrant. Whenever a change in power is selected it should be made from right to left for increasing beginning with the cowl flaps, or from left to right for decreasing ending with the cowl flaps.

Cowls may be selected to open, closed or partial settings.
Cowl flaps should be open whenever the temperatures require for assisted cooling. This includes

- ✈ high power operations (takeoff and climb);
- ✈ whenever the air cooling is insufficient (ground operations);
- ✈ high ambient temperatures of with high indicated engine temperatures.



Cowl flaps should be selected closed

- ✈ cruise;
- ✈ descent and approach;
- ✈ low power operations.

During cruise, after extended climbs or in high outside temperatures it may be required to select cowls to half or open until the engine temperature has stabilised.

Cowls may be left open for circuit operations, however it is found that more stable temperatures are achieved when cowls are selected to half or closed after reaching circuit altitude. This also reinforces a routine to remember to open and close the cowls when power changes are effected and on final approach.

On short final cowls should be opened to ensure cooling is available for ground operations, or in case of a go round. This should not be carried out on base for fear of forgetting as too much cooling will result while the engine is still at low power settings with cooling airflow. This check will be part of your final approach checks, and is rechecked on the ground in after landing checks, or on climb out for the missed approach in after take off checks.

Other Cooling Methods

If excessive temperatures are noted in flight, additional cooling of the engine can be provided by:

- ✈ Making the mixture richer (extra fuel has a cooling effect in the cylinders, because more fuel is evaporated, so rich mixture cools better that a lean mixture);
- ✈ Reducing the engine power;
- ✈ Increasing the airspeed;

The propeller spinner in addition to streamlining and balance is a director for the cooling air, and so the aeroplane should generally not be operated without the spinner.

Fuel System

Fuel is supplied to the engine from either:

- ✈ 60 US gallon (225 litres) standard wing tanks;
- ✈ 79 US gallon (300 litres) long range wing tanks.

From these, fuel flows by gravity feed through the fuel shut-off valve and the fuel strainer, manual primer to the carburettor.

The amount of fuel we can put into fuel tanks is limited by the volume of the tanks, and therefore usable fuel is always provided in volume, such as gallons and litres.
However, the carburettor and engine are only sensitive to the mass of fuel, and not to the volume. The engine will consume a certain mass (lbs or kgs) of fuel per hour.
Fuel has a wide variation in specific gravity (weight of fuel per volume) mostly depending on temperature and type of fuel. Therefore, variations in specific gravity of fuel can have a significant effect on the mass of fuel in the tanks and therefore the range and endurance.
For practical purposes the specific gravity of Avgas is taken as 0.72 kgs/lt.

The fuel valve is located on the floor of the cockpit between the pilot and co-pilot seats. The valve has four positions: LEFT, BOTH, RIGHT and OFF.
With the valve in the BOTH position, fuel flows from both left and right tanks, through a strainer to the carburettor.

The BOTH position must be selected for takeoff and landing as this ensures the fuel supply is not interrupted if one tank sump is uncovered during manoeuvring.

LEFT or RIGHT may be selected during level flight to restore imbalances. Uneven draining normally occurs regardless of aircraft balance because of the venting system, more fuel being used from the vented tank, see more below on fuel venting.

When parked the fuel should be selected to OFF or the lower tank. If the fuel is left on BOTH fuel will drain by gravity through the fuel selector or vent line to the lower tank resulting in imbalance, and a possible loss of fuel, see more below under fuel vents.

Fuel Tanks and Caps

Some of the early model C182's between 1958 and 1978 were installed with bladder tanks. That is the tank consists of a rubber bladder fitted inside with wing, instead of the preferred integral type, which are a solid construction and incorporated into the wing structure.

Bladder tanks have a tendency to develop wrinkles and trap water in folds. If this occurs even though the tanks have been drained there may be still water present. Shaking the wings to ensure water is dislodged from creases and draining again after settling is recommended, especially if the aeroplane has been standing outside overnight in moist or wet weather.

Some models are additionally more susceptible to moisture intake due to their retaining the original flush style fuel caps. These caps have a small indent where water may collect and seep through the vent. Although these caps were originally fitted by Cessna, most have been replaced, be aware if you have these type of cap fitted.

Fuel Measuring and Indication

Fuel quantity is measured by two float-type fuel quantity transmitters (one in each tank), and indicated by two electrically-operated fuel quantity indicators on the lower left portion of the instrument panel.

The full position of float produces a minimum resistance through transmitter, permitting maximum current flow through the fuel quantity indicator and maximum pointer deflection.
As fuel level is lowered, resistance in the transmitter is increased, producing a decreased current flow through the fuel quantity indicator and a smaller pointer deflection.
An empty tank is indicated by a red line and letter E. When an indicator shows an empty tank, approximately 2.5 gallons remain in each tank as unusable fuel in normal flight maneuvers.

The float gauge will indicate variations with changes in the position of fuel in the tanks and cannot be relied upon for accurate reading during skids, slips, or unusual attitudes.

Considering the nature of the system, takeoff is not recommended with less than 1 hour total fuel remaining. Fuel quantity should always be confirmed by dipstick during the preflight inspection and on intermediate stops enroute.

Priming System

The priming system contains a manually operated pump located on left bottom corner of the instrument panel, and distribution lines to all engine cylinders.
Operation of the pump plunger forces fuel directly into the engine cylinders bypassing the carburettor.
Although priming may be achieved by operation of the throttle, the primer is a more effective method as fuel enters directly into the cylinders and it is that specified in the pilots operating handbook.

Priming the engine is normally required when starting a cold engine, when the fuel in the carburettor is reluctant to vaporize. One to three pumps of the primer is recommended depending on the temperature and should be carried out immediately prior to starting.
If priming is carried out too early the fuel is ineffective in the start cycle, but effective in washing oil from the cylinder walls and causing additional frictional wear on start.

The primer should be locked when the engine is running to avoid excessive fuel being drawn through the priming line into the cylinders, which could cause an engine failure from the fuel/air mixture becoming too rich.

Fuel Venting

Fuel system venting is essential to system operation and is necessary to allow normal fuel flow or pressure venting as fuel is used. Blockage of the venting system will result in a decreasing fuel flow and eventual engine failure through fuel starvation.

A vent line is installed in the outboard end of the left fuel cell and extends overboard down through the lower wing skin. The lower portion forms an L shape protruding into the forward airstream below the left strut.

The inboard end of the vent line extends into the fuel tank, then forward and slightly upward. A vent valve is installed on the inboard end of the vent line inside the fuel tank. A crossover vent line connects the right tank to the vented air in the left.

When the tank is full, the vent line is covered and fuel used from the right tank is replaced by fuel in the left. This situation unfortunately continues even after the vent line is uncovered as movement in fuel from manoeuvring or turbulence momentarily closes the line. Although if this condition was allowed to continue until the left tank was empty the right tank would still provide fuel and no interruption would be experienced, it is better practice when uneven feeding occurs to use the right fuel selection periodically during level flight to balance the fuel levels.

The right fuel tank filler cap is also vented although due to the low pressure normally occurring over the wing surface the vent is less effective.

From 1979 Cessna introduced an integral wet wing system with pressure vents on both wings. This alleviates most of the problem of uneven draining and all of the problems associated with bladder tanks.

The vent line opens to the highest part of the tank. Although there is a non return check valve to prevent loss of fuel through the vent, to allow for expansion of fuel through heating there is a small hole provided in the check valve. It is normal if the tanks are full to see a small amount of overflow fuel leaking through the fuel vent. If when parked the vented tank is lower than the other tank fuel will be fed through the crossover tube by gravity and out of the tank through the vent.

To prevent cross draining while parked the fuel selector should be selected to the lowest tank or to off.

Fuel Drains

The fuel system is equipped with drain valves to provide a means for the examination of fuel in the system for contamination and grade. The system should be examined before the first flight of every day and after each refueling, by using the sampler cup to drain fuel from the wing tanks and sump.

Fuel drains are spring-loaded valves at the bottom of each fuel tank. There is usually a drop in air temperature overnight and, if the tank is not full, the fuel tanks' walls will become cold and there will be a lot more condensation than if the tanks were full of fuel. The water, as it is heavier than fuel, will accumulate at the bottom of the fuel tanks.
If water is found in the tank, fuel should be drained until all the water has been removed, and wings should be rocked to allow any other water to gravitate to the fuel strainer drain valve.

There are normally two under wing drains, however some models may have additional drain points installed often to attempt to combat the moisture problems with bladder tanks.

The drains are seated by rubber 'O' rings. These rings need periodic replacement, evidence is sometimes indicated by black rubber particles in the fuel sample or fuel staining (green or blue dye from the fuel) around the strain point, development of a slow leak or improper seating when checking the fuel (valve does not close properly). In any of these cases the situation should be reported to the maintenance provider.

A fuel sump strainer is mounted at the firewall in the lower engine compartment. The strainer is equipped with a quick-drain valve which provides a means of draining trapped water and sediment from the fuel system. The quick-drain control is located adjacent to the oil dipstick and is accessible through the oil dipstick door (some early models have the fuel strainer valve located in the cockpit adjacent to the park brake).
The strainer should be opened for a few seconds before the first flight of the day to ensure removal of any water and sediment. Care should always be taken to ensure the quick drain valve is selected to fully closed after straining.

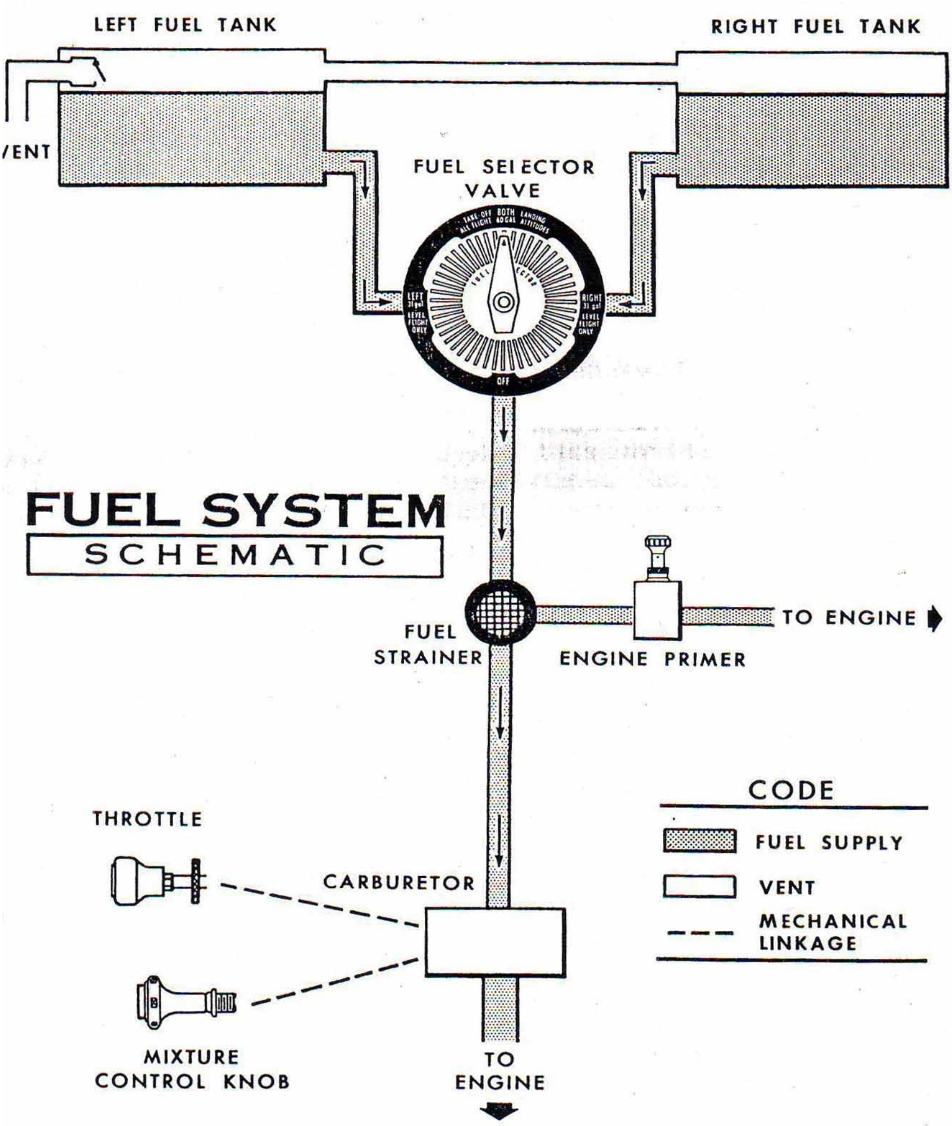
The strainer outlet is normally located on the opposite side of the fuselage, so with some stretching a sample may be taken. Some early models have the fuel strainer control located inside the cockpit next to the primer. In this case it is impossible to strain and sample without assistance so if you are without help only straining need be accomplished.

Auxiliary Pump (fuel-injection engine only)

An electrically driven auxiliary fuel pump is mounted on the firewall and is connected in parallel with the fuel flow of the primary pump. This pump is designed to be used if the primary pump should fail. It is controlled by the Auxiliary Fuel Pump Switch located adjacent to the Master Switch. As the fuel pressure and plunger spring tension become equal. the pumping action is automatically reduced due to limited plunger movement which maintains low tolerance output pressure. The auxiliary fuel pump also serves the function of primer in fuel injected models with by selecting the spring loaded high position and increasing the throttle to the desired amount of fuel flow.

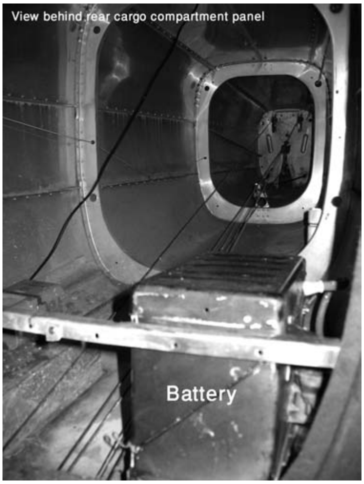
Fuel System Schematic

Below a schematic of the fuel system is shown.



Electrical System

Electrical energy for the aircraft is supplied by a direct-current, single wire, negative ground, electrical system with a lead acid battery.



The system is either

For models before 1978:

- ✈ 14 Volt system;
- ✈ 12 volt battery;
- ✈ 25 or 33 amp-hours.

Or for models after 1978 :

- ✈ 28 volt system;
- ✈ 24 volt battery;
- ✈ 12.75 or 15.5 amp-hours.

Battery

The battery supplies power for starting and furnishes a reserve source of power in the event of alternator failure.

Battery capacity in amp-hours provides a measure of the amount of load the battery is capable of supplying. This capacity provides a certain level of current for a certain time. A 25 amp-hour battery is capable of steadily supplying a current of 1 amp for 25 hours and 5 amp for 5 hours and so on.

In all models the battery is located behind the rear cargo compartment panel, similar to the position in the picture above.

Alternator

The engine-driven alternator is the normal source of power during flight and maintains a battery charge, controlled by a voltage regulator/alternator control unit. The charging system capacity (28 or 14 volt), is the output from the alternator after voltage regulation. This is always slightly more than the battery (24 or 12 volt) to ensure continuous charge to the battery when using the electrical system in normal operations.

External Power

An external power source receptacle is offered, to supplement the battery alternator system, for starting and ground operation. An External power receptacle for connection of a secure power supply for starting is provided

The external power receptacle is either on the left front nose cowling or on the rear cowling near the baggage compartment door depending on the model.

Electrical Equipment

The following standard equipment on the Cessna-182 requires electrical power for operation (there may be additional optional equipment which uses electrical power):

- ✈ Fuel quantity indicators;
- ✈ All internal and external lights and beacon, including warning lights;
- ✈ Pitot heat;
- ✈ Wing flaps;
- ✈ Starter;
- ✈ All radio and radio-navigation equipment.

System Protection and Distribution

Electrical power for electrical equipment and electronic installations is supplied through the split bus bar. The bus bar is interconnected by a wire and attached to the circuit breakers on the lower, centre of the instrument panel.
The circuit breakers are provided to protect electrical equipment from current overload. If there is an electrical overload or short-circuit, a circuit breaker (CB) will pop out and break the circuit so that no current can flow through it.
It is normal procedure (provided there is no smell or other sign of burning or overheating) to reset a CB once only, after a cooling period, by pushing it back in.
Most of the electrical circuits in the aeroplane are protected by “push-to-reset” type circuit breakers. However, alternator output and some others are protected by a “pull-off” type circuit breaker to allow for voluntary isolation in case of a malfunction.
Electrical circuits which are not protected by circuit breakers are the battery contactor closing (external power) circuit, clock circuit, and flight hour recorder circuit.
These circuits are protected by fuses mounted adjacent to the battery and are sometimes termed “hot wired or hot bus” connections.

The master switch controls the operation of the battery and alternation system.
The switch is an interlocking split rocker type with the battery mode on the right hand side and the alternator mode on the left hand side. This arrangement allows the battery to be on line without the alternator, however, operation of the alternator without the battery on the line is not possible.
The switch is labeled BAT and ALT and is located on the left-hand side of the instrument panel.
Continued operation with the alternator switch OFF will reduce battery power low enough to open the battery contactor, remove power from the alternator field, and prevent the alternator restart. This is important to remember if you are starting an aeroplane by other means because of a flat battery.

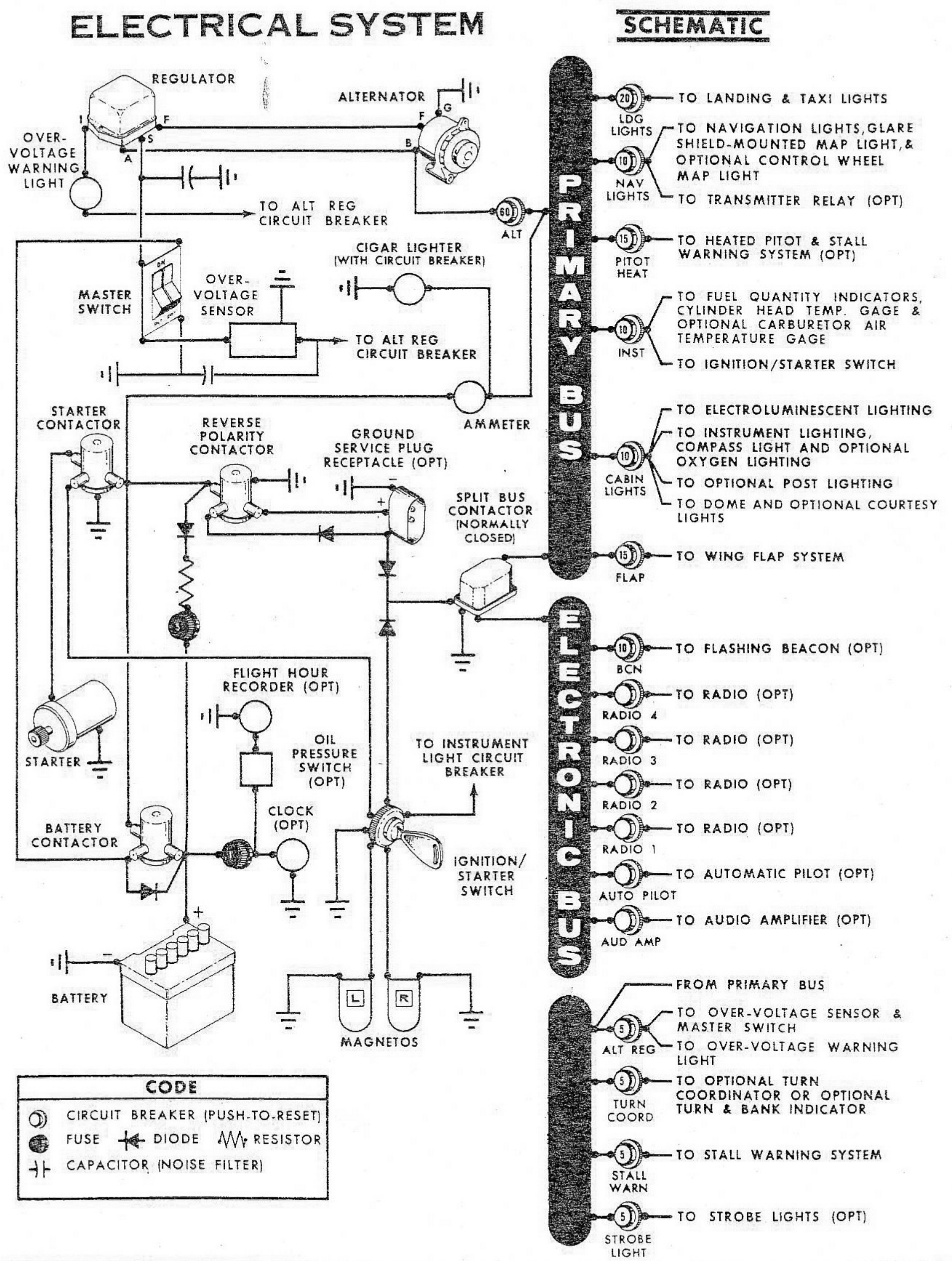
The ammeter, located on the upper right side of the instrument panel, indicates the flow of current, in amperes, from the alternator to the battery or from the battery to the aircraft electrical system.

The ammeter may be a rate of charge type or zero reading type. Rate of charge will read the amount of amps being supplied and should be indicating a normal rate (ie not zero or full scale but somewhere mid scale depending on the demands). Zero indicating gauges indicate the rate of charge or discharge to the battery. These will indicate zero for all normal operations, a charge may be indicated after start when the battery is depleted from a long start or if there is a fault in the regulating system, and a discharge if there is a loss of charge supplied from the alternator.

The aircraft is equipped with an automatic over-voltage protection system consisting of an over-voltage sensor behind the instrument panel and a red warning light near the ammeter, labeled “LOW VOLTAGE”.
In the event an over-voltage condition occurs, the over-voltage sensor automatically removes the alternator field current and shuts down the alternator. The red warning light will then turn on, indicating to the pilot that the battery is supplying all electrical power and can be checked on the ammeter.
The over-voltage sensor may be reset by turning the alternator (ALT portion) or the master switch (both sides) OFF and back ON again.
If the light does illuminate again, a malfunction has occurred, and the flight should be terminated as soon as practical, bearing in mind the consequences of an electrical supply from battery source only.
The over-voltage warning light may be tested by momentarily turning OFF the ALT portion of the master switch. Illumination of the low-voltage light may occur during low rpm conditions with an electrical load on the system, such as during the taxi at low rpm. Under these conditions, the light will go out at higher rpm, and the master switch need not be recycled since an over-voltage condition has not occurred to de-activate the alternator.

Electric System Schematic

Below a schematic of the electrical system can be seen.



Flight Instruments and Associated Systems

The aircraft is equipped with the following standard flight instruments:

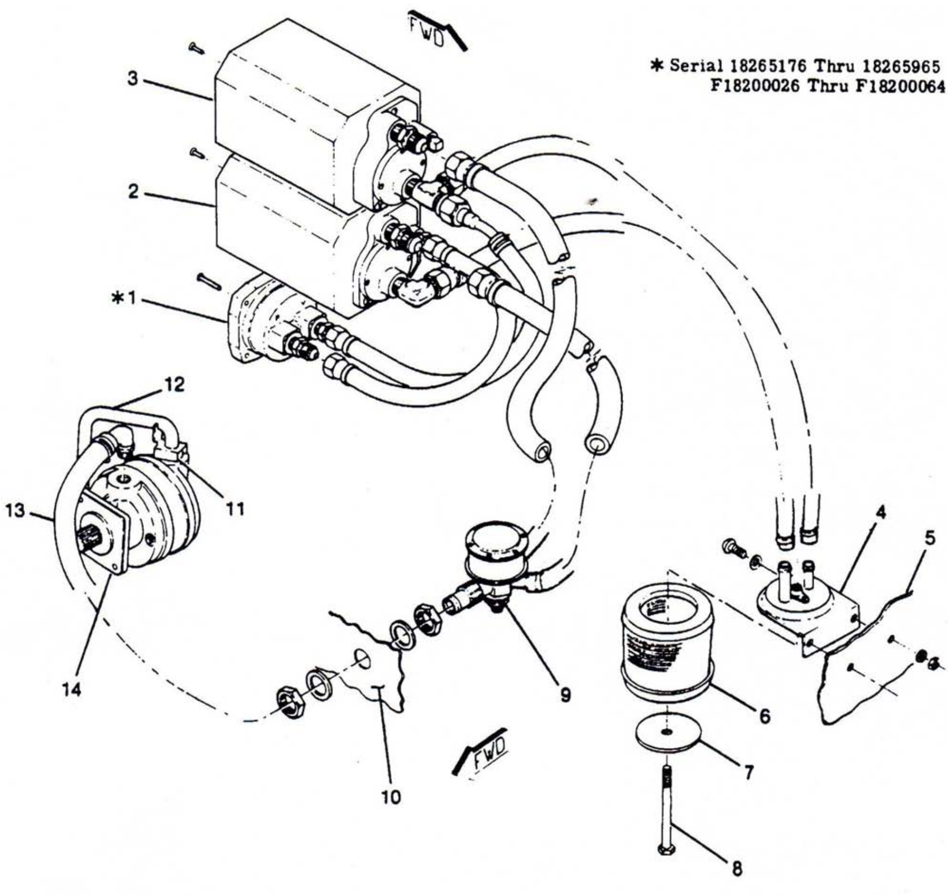
- ✈ **Attitude Indicator** requires vacuum system for operation and it gives a visual indication of flight attitude. A knob at the bottom of the instrument is provided for in-flight adjustment of the miniature aeroplane to the horizon bar;
- ✈ **Directional Indicator** requires vacuum system for operation and it displays aeroplane heading on a compass card. A knob on the lower left edge of the instrument is used to adjust the compass card to correct for any precession;
- ✈ **Airspeed Indicator** requires dynamic and static pressure and is calibrated in knots or miles per hour. The instrument has colour coded limitation marking in form of white (flap limit), green (normal), and yellow (caution) arcs and a red line (never exceed);
- ✈ **Altimeter** requires static pressure and depicts aeroplane altitude in feet. A knob near the lower left edge of the instrument provides adjustment of the barometric scale to the current altimeter setting – QNH/QNE/QFE;
- ✈ **Vertical Speed Indicator** requires static pressure and it depicts aeroplane rate of climb or descent in feet per minute;
- ✈ **Turn and Slip Indicator** requires electric power for rate of turn indication, gravity for slip indication.

Vacuum System

Suction is necessary to operate the main gyro instruments, consisting of the attitude indicator and directional indicator.
Suction is provided by a dry-type, engine-driven, vacuum pump. A suction relief valve, to control system pressure, is connected between the pump inlet and the instruments.
A suction gauge is fitted on the instrument panel and indicates suction at the gyros.
A suction range of 3 to 5 inches of mercury below atmospheric pressure is acceptable. If the vacuum pressure is too low, the airflow will be reduced, the gyro's rotor will not run at the required speed, and the gyro instruments will be unreliable.
If the pressure is too high, the gyro rotors speed will be too fast and the gyro may be damaged.

A diagram of a typical system installation is shown on the following page.

Vacuum System Diagram



SERIAL 18265176 THRU 18267715
F18200026 THRU F18200169

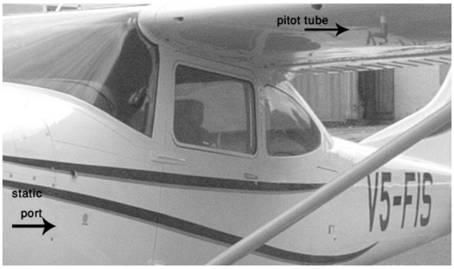
1. Suction Gage
2. Directional Gyro
3. Gyro Horizon
4. Bracket
5. Cabin Skin
6. Filter
7. Washer
8. Bolt
9. Suction Relief Valve
10. Firewall
11. Tube Locator
12. Overboard Line
13. Hose
14. Vacuum Pump

Pitot-Static System

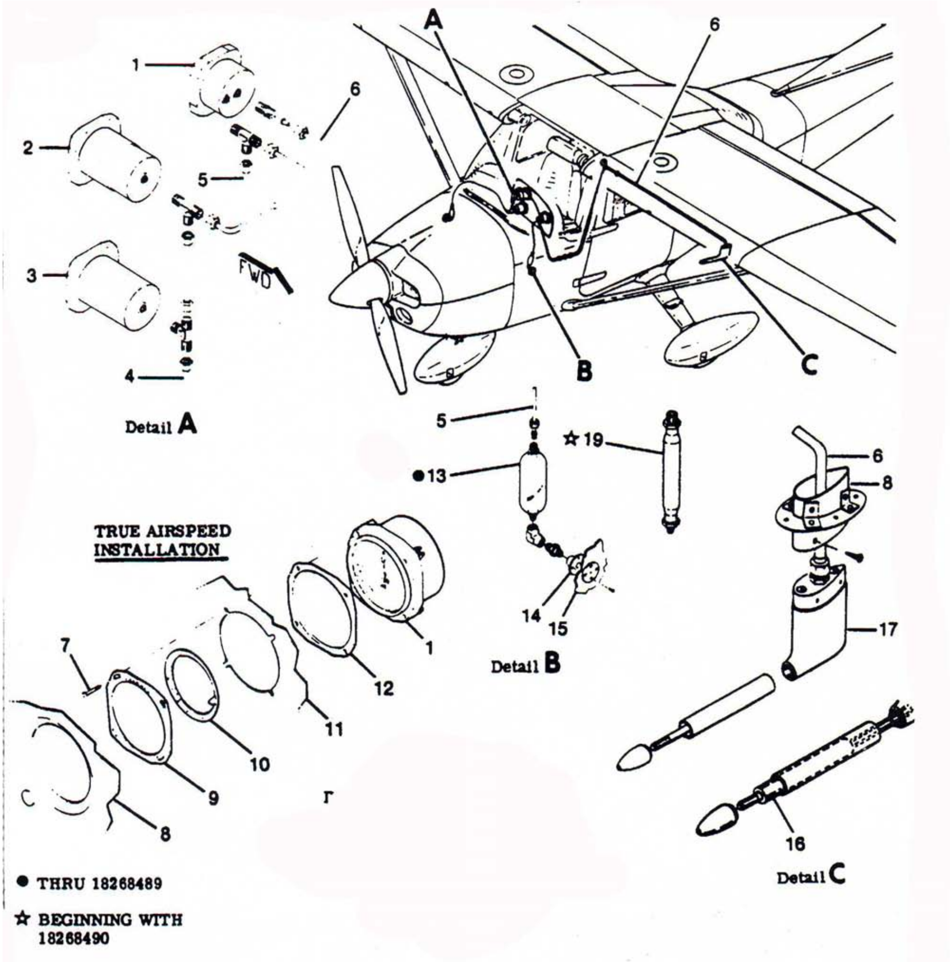
The pitot-static system supplies dynamic air pressure to the airspeed indicator and static air pressure to the airspeed indicator, vertical speed indicator and altimeter.
The system is composed of a pitot tube mounted on the lower surface of the left wing, two external static ports on the lower left and right side of the forward fuselage, and associated plumbing necessary to connect the instruments to the ports.

The heated pitot system consists of a heating element in the pitot tube, and a switch labeled PITOT HT on the lower left side of the instrument panel.
When the pitot heat switch is turned ON, the element in the pitot tube is heated electrically to avoid ice building on the pitot tube in possible icing conditions.

The pitot tube and static vent should not be damaged or obstructed, otherwise false reading from the relevant flight instruments could degrade the safety of the flight.
They should be carefully checked in the preflight inspection.
The pitot cover is used to prevent water or insects accumulating in the tube during parking. The pitot tube and static vent should not be tested by blowing in them, since very sensitive instruments are involved.



Pitot Static System Diagram



1. Airspeed Indicator
2. Altimeter
3. Vertical Speed Indicator
4. Static Line (To Right Sump)
5. Static Line (To Left Sump)
6. Pitot Line (To Pitot Tube)
7. Mounting Screw
8. Decorative Cover
9. Retainer
10. True Airspeed Ring
11. Instrument Panel
12. Spacer
13. Sump - Plastic
14. Static Port
15. Fuselage Skin
16. Heater, Element (Heated Pitot Only)
17. Mast Body
18. Connector
19. Sump - Metal

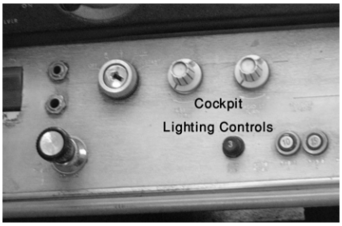
Stall Warning System

The aeroplane is equipped with a pneumatic-type stall warning system consisting of an inlet in the leading edge of the left wing, and an air-operated horn near the upper left corner of the windshield.
As the aeroplane approaches a stall, the low pressure of the upper surface of the wings moves forward around the leading edge of the wings. This low pressure creates a differential pressure in the stall warning system which draws air through the warning horn, resulting in an audible warning at approximately 5 to 10 knots above stall in all flight conditions.
The system can be checked during the preflight inspection by applying suction over the vent opening. A sound from the warning horn will confirm that the system is operative.

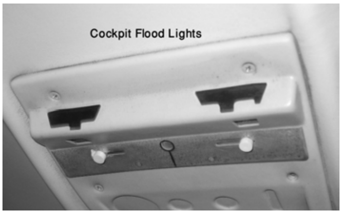
Ancillary Systems

Lighting System

Instrument and control panel lighting is provided by flood lighting, and integral lighting (internally lit equipment) and, optional post lights (individual lights above the instruments).



Two rheostat control knobs on the lower left side of the control panel, labelled PANEL LT and RADIO LT, control intensity of the lighting.
A slide-type switch on the overhead console, labelled PANEL LIGHTS, is used to select flood lighting in the FLOOD position. Flood lighting consists of a single red flood light in the forward part of the overhead console. To use the flood lighting, rotate the PANEL LT rheostat control knob clockwise to the desired intensity.



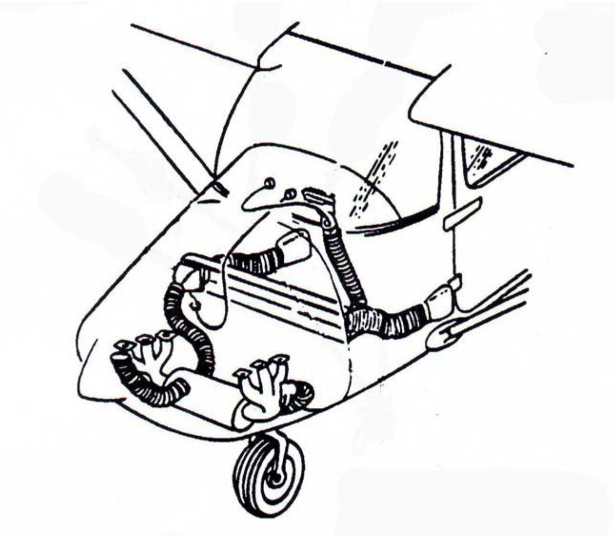
The external lighting system consists of:
- ✈ navigational lights on the wing tips and top of the rudder
- ✈ single or dual landing/taxi light mounted in the front cowling nose cap
- ✈ a flashing beacon located on top of the vertical fin
- ✈ strobe lights installed on each wing tip

All lights are controlled by switches on the lower left side of the instrument panel.
The switches are ON in the up position and OFF in the down position.

Cabin Heating and Ventilating System

Heated air and outside air are blended in a cabin manifold just aft of the firewall by adjustment of the heat and air controls.
The temperature and volume of airflow into the cabin is controlled by the push-pull CABIN HT and CABIN AIR control knobs.
(Note, As cabin controls are firewall vents, they need to be closed for engine startup and shutdown).
The air is vented into the cabin from outlets in the cabin manifold near the pilot's feet. Windshield defrost air is also supplied by a duct leading from the manifold to the outlets below the windshield.
For cabin ventilation, pull the CABIN AIR knob out.
To raise the air temperature, pull the CABIN HT knob partially or fully out as required. Additional direct ventilation may be obtained by opening the adjustable ventilators near the upper left and right corners of the windshield.
The cabin heating system uses warm air from around the engine exhaust as shown in the diagram below. Any leaks in the exhaust system can allow carbon monoxide to enter the cabin.
To minimize the effect of engine fumes, fresh air should always be used in conjunction with cabin heat.
Carbon monoxide is odourless and poisoning will seriously impair human performance, and if not remedied, could be fatal. Personal CO detectors are inexpensive and available at most pilot shops.

Cabin Heating System Diagram



Avionics Systems

The minimum standard fitting is a single VHF radio with hand mike and single jack point, however most trainers have a dual place intercom with PTT. Many aircraft have upgrades on the avionics systems so an overview of general operation is included.

Audio Selector

Before operation of any radio installation the audio selector panel should be checked. The audio selector selects the position of the transmitter and receiver for the radio equipment on board.

The common audio selector panel positions are:

Transmitter: Transmit on one, two... etc
Receiver: Listen to Com One/Two, Nav One/Two....etc
Listen to each channel on speaker, head phone or select off

Intercom

The intercom sometimes incorporated in the audio select panel contains at least a volume and squelch control. The volume control is for crew volume and squelch for intensity of crew voice activation.

VHF Radio Operations

Once the audio panel has been set, the crew communication established, if required, and the radio switched on, correct operation should be confirmed prior to transmitting. All VHF radio installations will have a squelch selection to check volume and for increased reception when required. This is either in the form of a pull to test button or a rheostat, turned, until activation is heard. Thereafter initial contact should be established if on a manned frequency. Most modern radio installations have an indicator to confirm the transmit button is active. This should be monitored on the first transmission and frequently during initiating radio transmission thereafter.

Transponder

Wherever installed transponders should be switched to standby after start to allow for warm up time. When entering an active runway for departure, until leaving the active runway at the end of the flight, the selector should be in ALT if available or ON.
Many commercial aircraft now contain TCAS and can observe other transponder equipped targets for traffic separation purposes.

The following international transponder codes are useful to remember:

No specified code	2000
Emergencies	7700
Radio failure	7600
Unlawful Interference	7500

FLIGHT OPERATIONS

This a generic training manual for the C182 range of aircraft. Information is adequate for training, reference and most normal operations. It is reminded again that speeds have been rounded UP in all cases to the nearest 5kts, and may differ slightly between models.

Operational and performance data has bee rounded to the safer side. Limitations provided will not be strictly true for all C182 models. This information should be used in conjunction with the AFM of the aircraft you are flying.

Note on C182 POH

The C182 was developed and nearly perfected in the days prior to public liability suits, meaning the lawyers left us and the ever vigilant watch-bodies to determine the safety margins. This relates to a number of curious facts in the early C182 POH's.

Early model flight manuals will not conform to the present standard layout, detailed in the beginning of this book and so will be more difficult to navigate and they do not have as much in depth explanation as the later manuals.

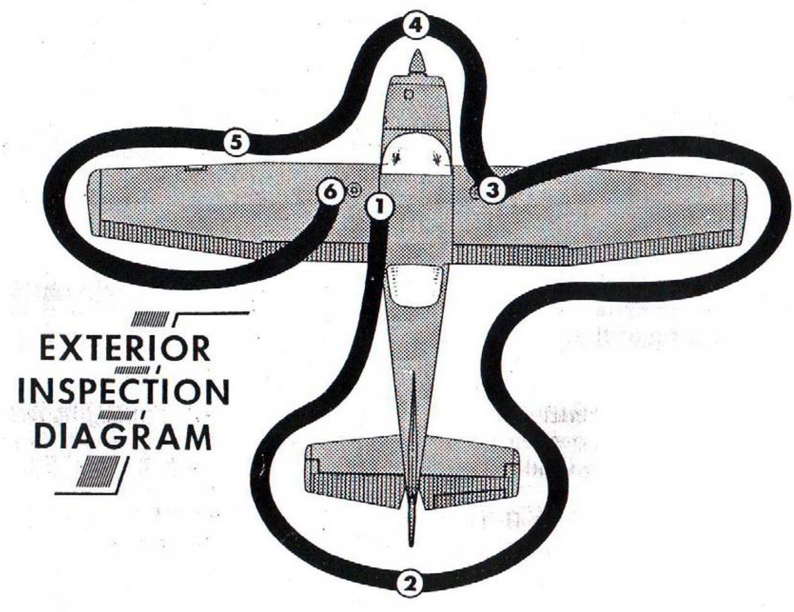
Information now considered essential is often missing in early manuals, for example maximum demonstrated crosswind component, and some margins do not conform to the present accepted minimums, for example takeoff and landing safety speeds. It is thus essential to apply modern safety practices to operations dictated by the POH in such cases.

More on these issues is explained under the relevant sub headings in this section.

NORMAL PROCEDURES

Pre-Flight Check

The preflight inspection should be done in anticlockwise direction as indicated in the flight manual, beginning with the interior inspection.



(1) Cabin

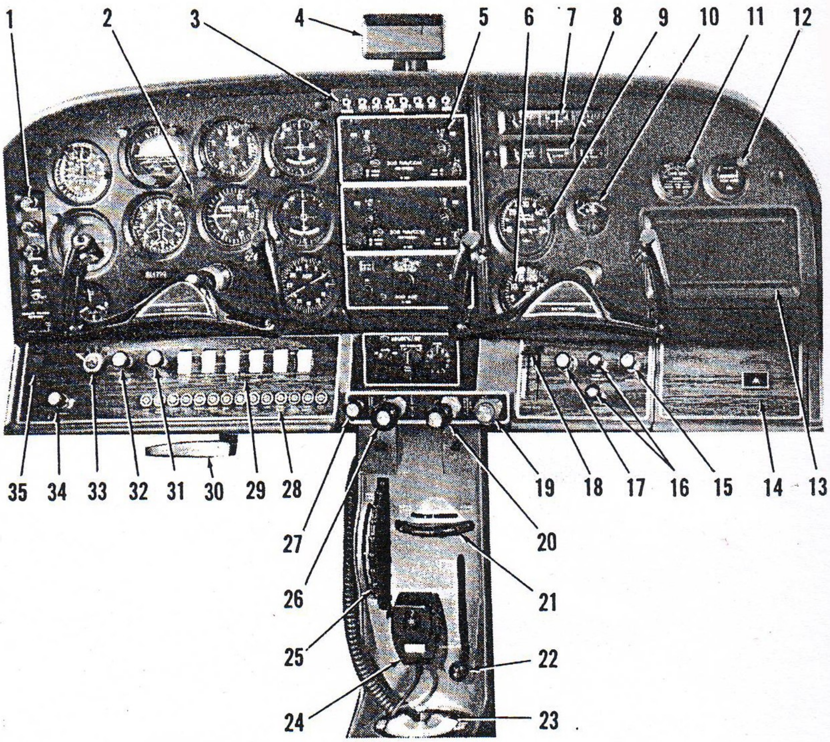
Ensure the required documents (certificate of airworthiness, maintenance release, radio license, weight and balance, flight folio, flight manual, and any other flight specific) are on board and valid. Perform a visual inspection of the panel from right to left to ensure all instruments and equipment are in order.
If night flight is planned ensure internal lights are operational.

Control lock – REMOVE
Ignition switch – OFF
Lights - OFF except beacon

Master switch – ON
Fuel quantity – CHECK
Flaps lever – DOWN
Master switch – OFF
Fuel shutoff valve – ON

Instrument Panel Diagram

INSTRUMENT PANEL

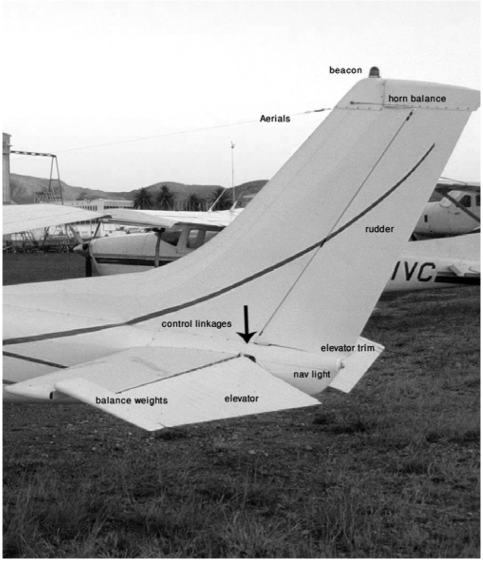


1. Marker Beacon Indicator Lights and Switches (Opt)
2. Flight Instrument Group
3. Radio Selector Switches (Opt)
4. Rear View Mirror (Opt)
5. Radios (Opt)
6. Tachometer
7. Fuel Quantity Indicators and Ammeter
8. Cylinder Head Temperature Gage, Oil Temperature Gage, and Oil Pressure Gage
9. Manifold Pressure Gage
10. Exhaust Gas Temperature Gage (Opt)
11. Carburetor Air Temperature Gage (Opt)
12. Flight Hour Recorder (Opt)
13. Optional Radio Space
14. Map Compartment
15. Defroster Control Knob
16. Cabin Heat and Cabin Air Control Knobs
17. Cigar Lighter
18. Wing Flap Switch
19. Mixture Control Knob
20. Propeller Control Knob
21. Rudder Trim Control Wheel
22. Cowl Flap Control Handle
23. Fuel Selector Valve Handle
24. Microphone
25. Elevator Trim Control Wheel
26. Throttle
27. Carburetor Air Heat Knob
28. Circuit Breakers
29. Electrical Switches
30. Parking Brake Handle
31. Radio Dial Lights Rheostat
32. Instrument Lights Rheostat
33. Ignition Switch
34. Primer
35. Master Switch

Exterior Inspection

Visually check the aircraft for general condition during the walk-around inspection, ensuring all surfaces are sound and no signs of structural damage, worked rivets, missing screws, lock wires or loose connections.

If night flight is planned ensure all required lights are operational and crew torch is carried by each crew member.



(2) Tail Section

Check top, bottom, and side surfaces for any damage, balance weights secure.

Rudder, elevator, and elevator trim secure and undamaged, linkages free, full and free movement of control.

Linkage and turnbuckles secure, free of obstruction, lock wires in place.

Elevator and horn balance weights secure.

Beacon, aerials and rear navigation light undamaged and secure.

(3) Right Wing

Check top, bottom, and side surfaces for any damage. Aerials undamaged and secure.

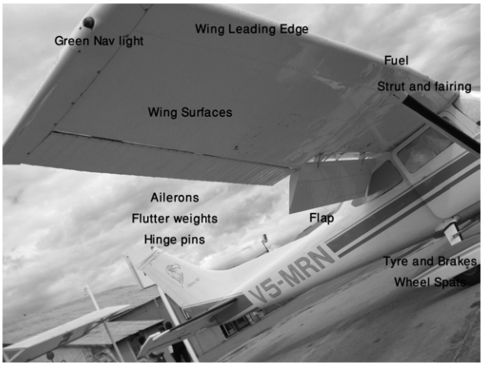
Ensure flap does not retract if pushed, flap rollers allow small amount of play in down position.

Check for damage to surface and flap tracks, free of operating linkage and security of all nuts.

Check for damage to surface and security of all hinges and flutter weights.

Condition, security and colour of navigation light.

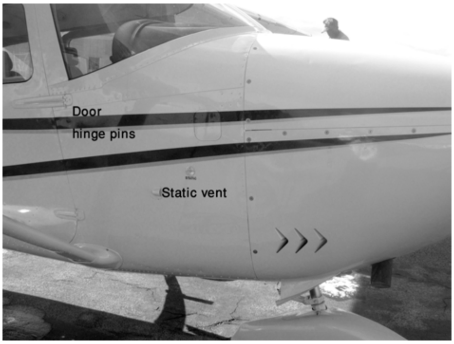
Condition and security of fairing and strut.



Cleanliness of static vent (dual fitted)

Check for security, condition of strut and tyre. Check tyre for wear, cuts, bruises, and slippage. Recommended tyre pressure should be maintained. Remember, that any drop in temperature of air inside a tyre causes a corresponding drop in air pressure.

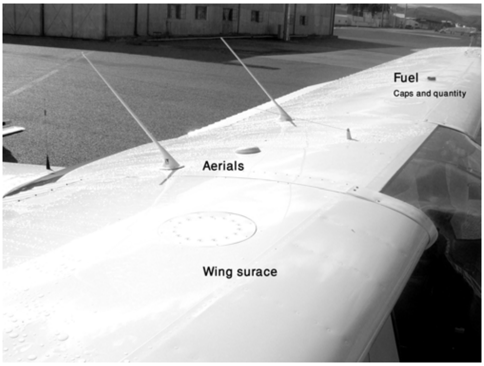
Check for security, condition of hydraulic lines, disc brake and all nuts.

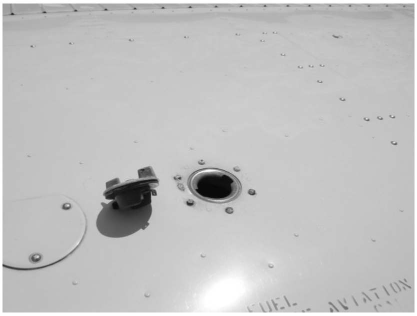


Use sampler cup and drain a small quantity of fuel from tank sump quick-drain valve to check for water, sediment and proper fuel grade.

Check top and bottom wing surfaces for any damage or accumulations on wing. *Ice or excessive dirt must be removed before flight.*

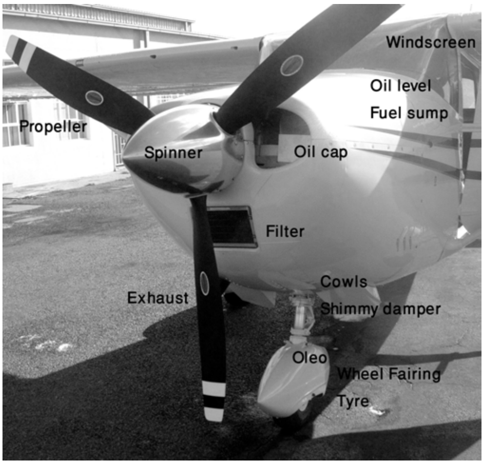
Ensure all aerials are secure and undamaged.





Check visually for desired fuel level using a suitable calibrated dipstick.

After checking the fuel. Ensure that fuel cap is secure. For the type illustrated the ridge should be parallel to the axis of flight.



(4) **Nose**

Check propeller and spinner for nicks and security. Ensure propeller blades and spinner cover is secure. When engine is cold the propeller may be turned through to assist with pre-start lubrication. *Always treat the propeller as live.*

Condition and cleanliness of landing light (on some models may be on left wing).

Condition and security of air filter, air filter should be clear of any dust or other foreign matter.

Visually check exhaust for signs of wear, on first flight or is engine is cool check exhaust is secure.

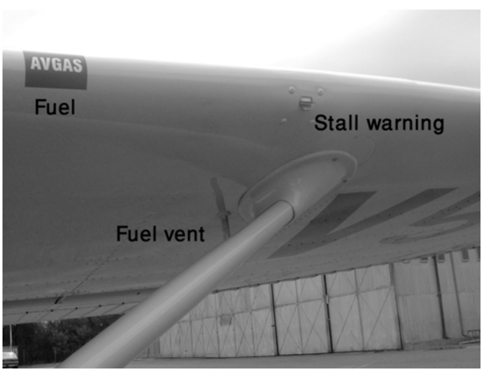
Freedom of operating linkage, and security and state of shimmy damper.
Cowl flaps rigidity and operation

Security of nuts and split pins, state and inflation of tyre, state of wheel fairing

Open inspection cover, check oil level. Minimum oil 9 quarts (see oil system).
Check oil cap secure through nose cowl opening.

Before first flight of the day and after each refueling, pull out fuel strainer to check the fuel sample. Check strainer drain closed.

Check security and condition of engine cowling.



(5) Differences on the Left Side

Security and cleanliness of static vent.

Remove the pitot tube cover, and check the pitot tube for cleanliness, security and clear opening passage.

Check the fuel tank vent for security and clear opening passage.

(6) Final Inspection

Check all chocks and covers are removed and the aircraft is in a position to safely taxi without excessive manoeuvring or power application.

Starting and Warm-up.

Before Start

Before engine start or priming, all controls should be set in the appropriate positions, the instrument panel set up and pre-start check completed. The panel setup should be a flow through in a logical order to ensure all equipment is set up correctly, serviceable and accessible.

The throttle should be advanced approximately ¼ inch to provide the correct setting for starting. If the throttle is advanced too much flooding may occur.

To provide sufficient fuel for starting the mixture should be full rich at all altitudes. It must be remembered, above approximately 3000ft field elevations the mixture should be leaned after successful starting, to prevent spark plug fouling during low power operations.

Priming

If the engine is cold, it will need to be primed before starting. *Note*, if no heat was felt from the engine area during the preflight, the engine is cold. One to three strokes of the primer will be required depending on the ambient and engine temperature. Even in warm outside temperatures a little priming will improve starting characteristics. Warm engines (i.e. an engine that has been recently running) do not normally require priming.

Priming before start using the throttle should be avoided as the carburettor is located at the bottom of the engine and by advancing the throttle, fuel is primed from carburettor into the engine. As no suction is available from the engine, all fuel is collected in the carburettor. After igniting the engine, this excess fuel may explode in the carburettor and/or begin burning in the intake, damaging the engine.

If over priming occurs, engine clearing, turning the engine over with the mixture at idle cut-off, may be needed. This may be combined with a flooded start procedure. Ensure starter limits, not more than 30 seconds without cooling, are observed.

Start

The engine is started by turned ignition keys into START position. Before engaging the starter ensure the area is clear, be looking outside and keep one hand on the throttle for adjustment during starting or as the engine fires, and feet on the brakes (light aircraft park brakes are not always self adjusting and may have become weak with brake wear).

Do not crank the engine continuously if the engine fails to start. The starter motor should not be operated continuously for more than 30 seconds. Additionally, if the engine fails to start, typically it is either under or over primed, or you have omitted an important step, eg placing the fuel selector on.

The recommended start procedure for a carburettor engine is as follows:

STARTING ENGINE (With Battery) -

1. Throttle – OPENING ¼ INCH
2. Propeller – HIGH RPM
3. Mixture – RICH
4. Prime – 1-3 AS REQUIRED
4. Propeller Area – CLEAR
5. Master Switch – ON
6.Ignition Switch – START (release when engine starts)

Starting the C182S and T

The latest model Cessna 182, with the larger fuel injected Lycoming engine, is more sensitive to over-priming. Because of this Cessna recommends starting with the Mixture Idle Cut Off, then advancing as the engine is fires, as detailed below. Priming is carried out using the fuel pump, and only when the engine is cold.

STARTING ENGINE (With Battery) – C182S,T

1. Throttle – OPENING ¼ INCH
2. Propeller – HIGH RPM
3. Mixture – IDLE CUT OFF
4. Propeller Area – CLEAR
5. Master Switch – ON
6. Auxiliary Fuel Pump Switch – ON
7. Mixture – ADVANCE to obtain 3 to 4 seconds fuel flow, then
return to IDLE CUT OFF position

NOTE: If engine is warm, omit priming procedure of step 7 above

8. Ignition Switch – START (release when engine starts)
9. Mixture – ADVANCE smoothly to RICH when engine fires

As engine starts, the ignition switch should be moved into BOTH position and the throttle adjusted to 1000 engine rpm or less. In no circumstances should the engine be allowed to overrun on start up. After starting, if the oil gauge does not begin to show pressure within 30 seconds, the engine should be stopped and reported to the maintenance. Lack of oil pressure can cause serious engine damage.

After Start

After start checks are completed to ensure all the critical items are completed prior to taxi. This will include leaning the mixture if the airfield is above 3000ft density altitude, to prevent spark plug fouling during taxi.

A "live mag" check may be done at this point, by selection of the left and right positions to confirm both are live. This confirms both magnetos are operational, it is not an integrity check as the engine is still cold. The purpose of the check is to prevent unnecessary taxiing to the run-up point should one magneto have failed completely.

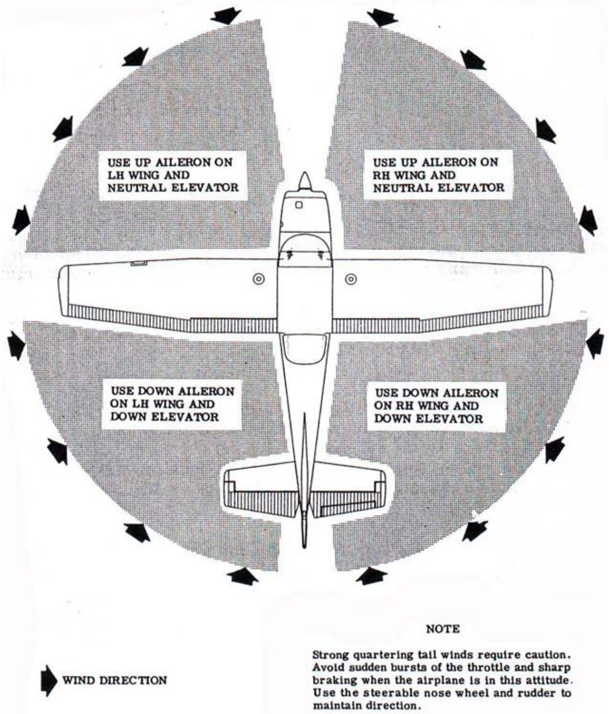
Most of the engine warm-up is conducted during taxi. If the engine is cold, for example on first flight of the day, or when it is anticipated that high power may be needed during taxi, time should be allowed for the engine to warm up prior to taxi. Ideally this warm up period should be sufficient to allow the CHT to increase into the green range before taxi. The cowl flaps should

not be closed for this warm up as this will provide uneven temperature distribution which may damage the engine.
If the flight is being taken from an airfield where no taxi is possible (or only very short taxi) additional warm-up time should be allowed before take-off .

Taxi

Taxi speed should be limited to a brisk walk, the aircraft is is its most unstable condition on the ground, especially with strong winds that may reach minimum flying speeds.
Brake use should be kept to a minimum by anticipation of slowing down or stopping followed by reduction of power to idle prior to applying brakes.

Controls should be held to prevent buffeting by the wind. Elevators should be held fully aft when taxiing over rough surfaces, bumps or gravel to reduce loads on the nose wheel and propeller damage. In all other cases the diagram below illustrates positions of controls in consideration of wind for the best aerodynamic effects during taxi.



The following phrase may be helpful as a memory aid:

CLIMB INTO wind, DIVE AWAY from the wind

Engine Run-up

The engine run-up checks are usually performed on the holding point or on a concrete “run-up” pad. For Gravel operations stationery run-ups should not be completed unless there is no alternative as this causes excessive wear on the propeller and can introduce dust and debris into the engine.

Although the engine and pre-take off checks are often combined in the manufacturers checklist it is considered better to separate them. So that following thee engine checks each items is confirmed set in the correct place prior to takeoff.

Advance the engine to 1700rpm and perform the following checks prior to take-off (note: some operators may require additional checks):

- ✈ Prior to take-off from fields above 3000ft density altitude, the mixture should be leaned. As the air pressure decreases with altitude the air density also decreases and so the engine receives less mass of air. If the mixture is left in the full rich position, the air/fuel ratio will not be correct (too much fuel or the mixture too rich). The correct air/fuel ratio is required for engine to produce maximum available power.
- ✈ The following procedure may be used for leaning the mixture prior to takeoff: lean the mixture by rotating the mixture knob anticlockwise till peak rpm, then enrich the mixture for about 3 rotations. This procedure is similar to that carried out enroute for leaning. This check may also be performed at lower altitudes to check correct operation and setting of the mixture, however the mixture should be returned to full rich before takeoff;
- ✈ Carburettor heat should be checked by pulling and pushing the carburettor heat control knob for a brief period of time. The engine rpm should drop about 100 rpm during the carburettor heat operation. Don’t operate the system for prolonged period of time, because when the knob is pulled out to heat position, air entering the engine is not filtered;
- ✈ Propeller CSU should be checked to confirm correct operation and to ensure proper lubrication throughout the system.
  - Select the pitch control to full course, permitting a rpm drop of not more than +/-300rpm, then return to fine and note:
    - rpm drop,
    - manifold pressure increase,
    - oil pressure drop, and return
  - If the engine is cold or to allow checking of each item individually, repeat the process until the rpm drops smoothly and rapidly and correct operation is confirmed, up to three cycles.
- ✈ Magnetos check should be done as follows.
  - Move ignition switch first to L and note rpm.
  - Next move the switch back to BOTH to clear the other set of plugs and regain the reference rpm.
  - Then move the switch to R position, note rpm and return the switch to BOTH position.
  - Rpm drop in either L or R position should not exceed 125 rpm and show no greater than 50 rpm differential between magnetos;
- ✈ Verify proper operation of alternator, alternator control, suction system; and correct indications (in the green) of all engine control gauges

- ✈ DI may be set to compass at this point as engine interference and suction operation is more indicative at 1700rpm
- ✈ Reduce the engine rpm to idle to confirm idle operation on warm engine at the correct mixture settings (approximately 500-700rpm)
- ✈ Return to 1000 rpm for pre-takeoff checks

Pre Takeoff Vital Actions

The flight manual provides the “minimum required actions” before takeoff, generally there are some additional operational items to check. Many flight schools or operators will have their own check lists and/or acronyms for the pre take-off checks. Acronyms are highly recommended for single pilot operations. One of the most popular acronyms for pre-takeoff checks is as follows:

Too	Test controls and trims
Many	Mixture set for takeoff, Magnetos on both
Pilots	Pitch full fine,
Go	Gills (cowl flaps) open and Gyros uncaged and set (as applicable)
Fly	Fuel contents checked on correct tank, primer locked, fuel pump as required, Flaps set for takeoff
In	Instruments, panel check from right to left, DI aligned with compass, time check
Heaven	Hatches and harnesses secure
Early	Electrics circuit breakers checked, lights, switches correct position, systems (Autopilot/GPS/Fuel management) set

Takeoff

Takeoff is always carried out under full power with the heels on the floor to avoid accidentally using the toe brakes. Unless on gravel or with traffic around, it is always good airmanship to line up straight on the runway centreline, stop and complete final line up checks.

The following items should be selected and checked on line up, (these also have a helpful acronym):

REmember	Runway clear from obstruction, Engine parameters checked
What	Windsock aligned, controls into wind
To	Transponder on ALT
Do	DI aligned with compass and indicating runway direction
Last	Lights strobe and landing lights

It is important to check full-throttle engine operation early in the takeoff run. Although setting the power too quickly will result in possible rich cut, rough running, overrun of the rpm red line while the CSU reacts and piston damage due to rapid acceleration. When the runway surface is clear static or partial static power applications may be made.

Any sign of rough engine operation or sluggish engine acceleration or less than expected takeoff power is cause to discontinue the takeoff.

The engine should run smoothly and with constant static rpm of 2600 and manifold indicating within 1-2 inches of ambient pressure.

When taking off from gravel runways, a rolling takeoff should be used, as the gravel will be blown back of the propeller rather than pulled into it. The throttle should be advanced slowly, allowing the aeroplane to start rolling before high rpm is developed to minimize damage to the propeller and engine.

After full throttle is applied, adjust the throttle friction lock clockwise to prevent the throttle from creeping back. Keep one hand on the throttle when possible until reaching a safe altitude of 500-1000ft AGL

Wing Flaps Setting for Takeoff

Takeoff may be made with 0, 10, or 20 degrees of flap. Using the flaps for takeoff will shorten ground roll but will reduce climb performance of aircraft.
During testing, it is established which flap settings will be most favourable and the associated performance is tabulated.

Using 20º wing flaps on C182 reduces the total takeoff distance to 50ft obstacle clearance considerable, however if there is rising terrain after the 50ft point climb performance should be considered.
Use of flap on soft or rough surfaces will assist with reducing the frictional drag considerably.
Flap deflections greater than 20º are not approved for takeoff.

If flaps are used for takeoff, they should not be retracted below 300ft AGL and not before a safe flap retraction speed has been reached. On flap retraction the aircraft loses lift and with insufficient speed may sink down. The AFM does not specify a flap retraction speed, 80mph is recommended.

Short Field Takeoff

For the minimum takeoff distance to clear a 50ft obstacle the AFM Recommended short field take off procedure specifies:

- ✈ Wing flaps 20 degrees
- ✈ Apply full throttle against brakes*, 2600rpm
- ✈ Elevator should be slightly low, lift off early
- ✈ Maintain 55kts / 65**mph until obstacles are cleared
- ✈ Retract flaps once obstacles are cleared (*and after safe retraction speed is reached)*

* If power is applied after brake release increase distance by the distance taken to apply full power.

***Note on takeoff safety speeds*
Vt/o or V2 the takeoff target speed at 50ft according to international recommendation should not be less than 1.2 Vs, or 1.2 x the indicated stall speed in the applicable configuration.

The indicated stall speed is marked by the bottom of the green or white arc depending on the configuration. These are 67 and 60mph respectively.
Taking 60mph stall speed with full flap, 60x1.2 = 72mph, however the recommended short field speed for takeoff in the POH of many models is 61mph with 20 degrees flap.

It can be assumed from the calibrated airspeed tables that due to errors from the angle and configuration this speed is safely achievable if we require maximum performance, however we know better in aviation than to assume.
It is advised to add a 5kt margin to the recommended speed, but not less than the bottom of the green arc as a minimum target speed for takeoff to compensate for wind, turbulence and performance deviations.
Performance requiring more accuracy than this is probably operating without adequate safety margins on field length and should not be considered for normal operations.

Performance Graphs

Consult the performance graphs for the correct figure for your model and weight, see more on short field take off performance in the Performance and Flight Planning section.
These figures are those prescribed in the flight manual for the performance figures given at max weight.
Any deviation from the recommended procedure should be expected to give a decrease in performance.

Soft Field Takeoff

Soft field takeoffs are performed with the maximum flap setting permitted for takeoff. This provides maximum additional lift to aid in reducing frictional drag. If this setting is more than optimum for a short field or if there are significant obstacles on takeoff, field length and climb out performance must also be considered.

In the C182 soft or rough field takeoffs are performed with 20º wing flaps, lifting the aeroplane off the ground as soon as practical in a slightly tail-low attitude.

After takeoff the aeroplane should be levelled off to accelerate to a safe climb out speed.

If no obstacles are ahead, the aeroplane should be accelerated to Vy (75-80kts, 85-90mph) for best initial climb performance. If there are obstacles, the aircraft should be accelerated to Vx (55kts, 60mph) and this speed should be used for the climb till all obstacles are cleared.

The AFM typically does not provide information on the effect of surface conditions on takeoff rolls. Factors are provided for paved and dry grass fields only. It must be remembered that frictional drag caused by rough or soft surfaces including the effects of recent rain are extremely detrimental to your performance.

Crosswind Component

Most C182 aircraft do not have a maximum demonstrated crosswind component. In later models a maximum demonstrated crosswind component of 15 knots was introduced.

This is the highest value for which the aeroplane has been tested during takeoff and landings, but is not considered to be the limiting crosswind velocity.

It is good operating practice to not exceed this limitation during normal operations, and it is also vital that an inexperienced pilot should reduce this value even further.

Although good preflight planning should prevent it, situations may arise where a landing with strong crosswind is unavoidable. Thorough dual practice during conversion training in strong crosswinds should be carried out whenever possible.

During a crosswind takeoff, as the aircraft becomes airborne, it will tend to move sideways with the air mass and sink back onto ground with strong sideways movement which may damage the undercarriage.
Therefore, the recommended technique is to hold the aeroplane firmly on the ground to slightly higher lift-off speed and then positively lift-off with a backward movement of the control column. Once airborne the aircraft nose is turned, using a coordinated turn, into wind to prevent drift, commonly termed ‘crabbing into wind’.
The minimum flap setting for takeoff will improve crosswind control. This provides a higher lift off speed and better lateral control.

Climb

The normal climb with or without flap, is made at 23” manifold pressure and 2450 rpm.

If a maximum rate of climb is desired an airspeed of:
- ✈ 80kts / 90mph at sea level reduced to
- ✈ 75kts / 85mph at 10,000ft (approx reduction 2kts/5000ft)

should be maintained, and for maximum performance with maximum power (full throttle and 2600rpm).

The Maximum Rate of Climb speed or Vy is used to reach cruise altitude as quickly as possible, as it gains the greatest altitude in a given time. Normally this speed is only used until safely away from the ground, between 500 and 1500ft AGL.

Takeoff power is not time limited , but for engine handling considerations maximum power should only be used when needed, reducing thereafter to normal climb power.

When required an obstacle clearance climb is required, a maximum angle climb - Vx is used. Best angle of climb gains the greatest altitude for a given horizontal distance.
Maximum angle of climb does not change significantly with altitude and is:
- ✈ 65kts/70mph flap up or
- ✈ 55kts/65mph flap 20

Because the slow airspeed results in reduced cooling and higher engine temperatures, and reduces the margin above the stall, it should be used only when necessary or for practice during dual training.

If sufficient performance allows, a cruise climb at lower altitudes may be achieved by lowering the nose to maintain a rate of climb of 500ft/min. This should provide a speed between 90 to 110kts, or 100 to 120mph. This provides better engine cooling and forward visibility, added passenger comfort and also reduces trip times.

Leaning during extended climbs may be required to maintain performance. Leaning is generally only required when the altitude change exceeds 3000ft by a reasonable amount. For example when climbing from the coastal areas inland to clear the escarpment continuous climbs of more than 7000ft are often made, and intermediate leaning will be necessary. Leaning during the climb should be made in a similar to the procedure for richening during descent, around one turn per 1000ft leaner whilst monitoring engine temperatures, EGT and for injected engines fuel flow/

Cruise

Optimum cruise is achieved at the recommended cruise power settings provided in the performance section (see ground planning and performance).

Normal cruise power may be selected at pilot discretion between
2200 - 2450 rpm and 15-23" of manifold pressure. A good rule of thumb with prop and manifold pressure is always to keep the manifold pressure equal to or less than the rpm.

As altitude increases the manifold pressure will continue to drop until and must be increased until "full throttle height" is reached.

To achieve the best fuel consumption, the mixture should be leaned during the cruise. The recommended method is to lean until a loss of manifold pressure and rough running is experienced, there after return to slightly rich of peak. With an accurate EGT the temperature should be returned to 50 degrees rich of peak. Operation at peak or lean of peak may cause excessive engine wear through detonation and high operating temperatures. Operation excessively rich will lead to spark plug fouling and excessive fuel consumption.

Carburettor ice can be experienced during low rpm operation and can be evidenced by a sudden rpm drop. Carburettor ice can be removed by application of the Carburettor heat system by pulling the Carb heat knob. Since the heated air causes a richer air/fuel mixture, the mixture setting should be readjusted when the carburettor heat is used in cruise flight. The use of the carburettor heat is also recommended during flight in very heavy rain to avoid the possibility of engine stoppage due to excessive water ingestion.

Approach and Landing

Landings should be made on the main wheels ***first***, for aerodynamic and structural reasons to prevent damaging the aircraft. After touchdown the nose wheel should be lowered ***gently,*** controls placed into wind and brakes applied as necessary.

The speeds specified in the AFM for a normal approach is between 70 and 80kts (80-90mph) with flap up, reducing to 65-70kts (70-80mph) with full flap.

Normal approaches should be made somewhere in the mid range of the recommended approach speeds. This Provides adequate margin for safety and control without excessively increasing landing distance or float in the flare.

Carburettor heat should be applied for low power operation on approach, and selected cold, on short final for possible go around or ground operations.

Short Field Landing

For a short field operation, an approach should be made at 65kts* (70mph) with 40° flaps. Positive control of the approach speed and descent should be made to ensure accuracy of the touchdown point.

The landing should be positive, nose high and as close as possible to the stall.

Unless maximum performance requires the use of minimum figures, approach speeds may be increased by 5 knots to provide a safe margin above the stall. Where maximum performance is required consult the performance graphs in your aircraft flight manual.

In windy/gusty conditions, a wind correction factor should also be applied providing a safety margin to allow for wind shear.

The rule for application of the wind and gust factor is:
- ½ HWC and all of the gust

eg. for a wind of 20kts gusting 30 at 60 degrees to the centerline, the HWC is 10kts and the gust is 10kts so the wind should be increased by 20kts.

Although this sounds like a large increase in speed the following must be remembered, only head wind component must be considered and as only half is taken there is still a reduction in distance from the reduced ground speed, as landing calculations must generally be made in still wind.
Headwind component can be calculated from graphs, trigonometry or on request from ATC.
When the wind is gusting there is generally a significant headwind factor so even if all gust is taken landing distance may not be significantly affected, and whenever the wind is reported gusting, particularly at altitude we need to have all the resources available to deal with unknown influence of windshear.
The rule however is a starting point and may be modified as required for conditions and field length.

**Note on Landing reference speed*
As detailed in the short field takeoff section, present International Standards recommend a landing reference speed (Vref) or the short field barrier speed of not less than 1.3 x the indicated stall speed in the landing configuration (Vso). From an indicated stall speed of 60mph (52kts) this would follow that the minimum safe speed on final approach should not be less than 78 mph (68kts). Some manuals provide a speed of 69mph or 60kts. As with the advice for takeoff reference speeds it is recommended to add a margin for external factors and piloting technique, and normally not less than the bottom of the green arc. As with takeoff, operations into fields requiring more accuracy would not have sufficient margins for variations in conditions applied.

Crosswind Landing

When approaching to land with a crosswind the aircraft flight manual discusses crabbed, slipping or combination method.

To prevent drift on finals the aircraft should be crabbed into wind as detailed above.
For landing, the aircraft nose should be brought in line with the runway. In doing so the aircraft will begin to drift, and the 'into wind' wing will need to be lowered just enough to keep the aircraft on the runway centre line. The 'into wind' wheel will therefore make contact first, thereafter the remaining main wheel and then the nose wheel should be positively placed on the ground, and ailerons placed into wind to prevent aerodynamic side forces.

The question of differing techniques is therefore only a question of where to transition from the 'crabbed' approach to the landing configuration.
This is ideally achieved in the round out, however it may be commenced earlier to assist the student with learning the degree of, control input, to apply.
In a strong crosswind a slightly higher approach speed may be required to maintain more effective control against the wind factor. A slightly higher touchdown speed is also recommended to prevent drift in the transition between effective aerodynamic control and effective nose wheel steering.

Reduction in flap setting improves lateral stability for added crosswind control should the student meet conditions he/she feels beyond his/her capabilities.
It should be noted the C182 is controllable with full flap in excess of the maximum demonstrated crosswind, and is a good exercise to practice with an instructor.

Flapless Landing

Two items of importance should be considered for a flapless landing.
1. Lack of drag to assist with the descent and approach.
2. The increased stall speed compared to the normal landing configuration.

To assist with overcoming these items a slightly lower power setting and higher approach speed should be used. If necessary the downwind may be extended slightly. Due to these factors the approach and round out will be flatter than for a normal approach.

The increase in approach speed need not be more than either the recommended approach speed without flap, or the normal approach speed adjusted by the amount of the increase in stall speed. Where field length is not a consideration, the pilot may elect to use a higher margin, however it must be remembered there will be an increased tendency to 'float' during the round out.

The recommended flapless approach speed for the C182 is 70-75 kts.

Balked Landing

The wing flaps should be reduced to 20º immediately after full power is applied.
Upon reaching a safe airspeed and altitude, the flaps should be retracted in stages to the full UP position.

Circuit Pattern

The circuit pattern may differ from airport to airport. Ask your instructor, the briefing office or consult the relevant aeronautical information publication for the pattern on your airfield.

The standard circuit pattern, unless published otherwise, is the left circuit pattern at 1000ft above ground for piston engine aeroplanes.

The following provides guidelines for circuit operations:

✈ Taxi towards the runway and position the aircraft clear of the runway to carry out the **engine run-up** and pre takeoff checks. When positioning the aircraft, ensure that:
   - The slipstream will not affect other aircraft;

- A brake failure will not cause you to run into other aircraft or obstacles;
- Loose stones will not damage the propeller.

✈ Where possible the aircraft is parked into wind, or in calm conditions facing the approach path.

✈ Set the park brake and complete the **Engine Run-up and Pre Takeoff Vital Actions:**

✈ Consider air traffic control and radio procedures before lining up on the runway. Line up and ensure that the nose wheel is straight (make full use of the runway length available) and perform **line-up check (REmember What To Do Last):**

- Runway heading aligned with
- Engine Parameters checked
- Windsock check (confirm with ATC wind), control column positioned for wind;
- Transponder ALT.
- DI aligned with runway direction and reading correct;
- **Landing light and Transponder – ON;:**

✈ Takeoff and climb maintaining runway alignment. Keep straight with rudder (will require right ruder due to the slipstream and torque effects). Protect the nose-wheel by holding the weight of it.

✈ Upon reaching a safe altitude (300' above airfield elevation) raise the flaps (if used) and perform **after takeoff check (BUMPFFL)**:

- **Brakes** – ON and OFF;
- **Power / Mixture** – Set;
- **Flaps** – Up;
- **Fuel valve** – ON;
- **Engine's Temperature & Pressure** – Check;
- **Landing light** – OFF.

✈ At a minimum of 500' scan the area into which you will be turning and then turn onto crosswind leg using a normal climbing turn (bank 15ºor Rate 1 maximum).

✈ Reaching circuit height, level-off, allow the speed to settle, set downwind power, approximately 2300rpm, and 20" manifold to prevent speed increasing beyond flap arcs, select cowl flaps to half

✈ Trim the aeroplane for straight-and-level flight

✈ Scan the area into which you will be turning and turn onto downwind leg, selecting a reference point well ahead on which to parallel the runway

✈ Select first ten degrees of flap if below Vfe for first stage of flap (140kts/100kts) and re-trim for level flight

✈ Circuit width should be approximately 1½ to 2 miles from the runway.

✈ When abeam the runway, make ATC call and perform **downwind check (BUMPFFEL)**:

- **Brakes** – ON check pressure and ensure OFF;
- **Undercarriage** - fixed
- **Mixture / Pitch / Power** – Set;
- **Flaps** – 10 degrees;
- **Fuel valve** – On BOTH;
- **Engine's Temperature & Pressure** – Check;
- **Landing light** – ON.

✈ Approaching late down wind reduce power to approx 15-17" depending on speed,

- ✈ Approaching base leg (45º to the runway) check that the speed is within the white arc and lower flap to 20º.
- ✈ After scanning for traffic on Base and Final, select a reference point on the wing tip and turn onto base leg performing standard medium turn.
- ✈ After levelling the wings, select Carb. Heat on, reduce power to 12-15 inches (while keeping the nose up for the approach speed), and trim for the descent, ensure speed is not more than around 10kts above desired final approach speed.
- ✈ Trim the aeroplane to maintain approximately 65-70kts and use power to maintain the desired approach angle.
- ✈ Visually check the final approach clear of traffic and anticipate the turn to final so as to roll out with the aircraft aligned with the direction of the landing runway, (remember radius of turn is dependant on your base speed) and no less then 500'.
- ✈ Once on final select the flaps to landing position, normally 40 degrees or less if desired for conditions, re-trim for selected final approach speed and complete **before landing checks (CCUMP)**:
    - **Cowl flaps -** open
    - **Carburettor Heat** – cold;
    - **Undercarriage** - fixed
    - **Mixture** – set;
    - **Pitch** - fully fine

- ✈ Execute the appropriate landing procedure.
- ✈ Maintain the centre line during the landing run by using rudder and wings kept level with aileron. Brakes may be used once the nose-wheel is on the ground.
- ✈ Once clear of the runway, stop the aeroplane, set 1000 RPM and complete **after landing checks**:
    - **Wing flaps** – up;
    - **Cowl flaps** – confirm open
    - **Carburettor heat** – cold;
    - **Strobe and landing light** - off.
    - **Transponder** - Standby

Engine Handling

All engine operations should be made with consideration of the piston engine heating and cooling principles, and with thought to the requirements of the systems fitted (for example the carburettor and CSU).

Before startup ensure the aircraft is positioned so that minimum power is required for the initial taxi manoeuvring, and the propeller area is clear from loose dirt or stones.

After start care should be taken not to allow the rpm to increase from idle until the oil system is fully lubricated. Caution throttle setting on light up, ensure that as the engine fires power is brought back to the minimum to sustain engine operation until the oil pressure is indicating in the green range. The time will depend on the viscosity and capacity of the oil, however if approaching 30 seconds, the manufacturers limits, the engine must be shut down.

Significant power application for taxi should only be made after CHT temperatures are in the normal operating range.

Throttle application during the takeoff run must be made to avoid exceeding the limitations of the carburettor or the CSU.

During climb temperatures should be monitored. Variation of speed and interim levels may be considered in prolonged climbs.

Selection of cowl flaps at top of climb and during cruise should be made with consideration of the operating temperatures.

Rapid changes of power should be avoided in all situations except emergencies.

Anticipation of deceleration during descent should be made to avoid large changes late in the joining procedure.

Power changes during the circuit need not be more than 2-3” of manifold pressure at one time. Each power change should be allowed to take effect before the next change is made, thus avoiding excessive thermal cycles. Once practised required power for conditions (excluding windshear) will be more easily anticipated and not only better engine handling but more stabilised approaches and smoother safer flying will result.

After landing or on go round, engine mixture setting should be adjusted and cowl flaps opened if not completed during final approach checks.

Minimum power should be applied during the final taxi manoeuvre to ensure stable temperatures and reduce thermal spikes prior to shutdown. Rather expend a small amount of physical energy pushing the aircraft than a large amount of financial energy replacing pistons!

Note on Checklists

Present standard and recommended operating practice on a single-pilot aeroplane dictate use of a checklist AFTER completion of vital actions in a flow pattern on each critical stage of the flight, such as before and after takeoff, on downwind and final leg.
The acronyms above therefore provide a memory aid to allow for completion of the checks prior to reading the checklist.

Acronyms are strongly recommended for single pilot operations, and ideally should be as generic as possible. Any convenient acronym is acceptable providing the minimum required items are catered for.

The above checks and procedures are based on standard training practices, including all the relevant items from C182 P.O.H., and may be modified to suit a specific operation.

Checks for emergencies and must be memorized and are sometimes followed up by a “do-list” accomplished in a read and do manner. See next section on emergencies in the C182.

The Aircraft Flight Manual provides a checklist of minimum items which must be adhered to, it is often good practice to include a number of additional items, a checklist can then be developed to assist with completion of mandatory and critical items. Any suitable checklist may be used providing it does not omit any required items from the AFM, although it is always best to have a checklist specifically written for the applicable aircraft, specific to the type, model and serial number and inclusive of any equipment, engine or airframe modifications.

ABNORMAL AND EMERGENCY PROCEDURES

General

The main consideration in any emergency should be given to flying the aircraft.
Primary attention should be given to altitude and airspeed control and thereafter to the emergency solution.
Rapid and proper handling of an emergency will be useless if the aircraft is stalled and impacts with the ground due to loss of control. This is most critical during takeoff, approach and landing.
The check lists in this section should be used as a guide only. The emergency checklist and procedures for your particular aircraft model specified in the aircraft Pilots Operating Handbook should be consulted for operational purposes.

Emergency During Takeoff

Any emergency or abnormality during takeoff calls for the takeoff to be aborted.
The most important thing is to stop the aeroplane safely on the remaining runway.

After the aircraft is airborne, re-landing should be considered only if sufficient runway is available for this purpose. As a general rule, the runway is sufficient, if the end of the runway can be seen in front of the aircraft. Where no sufficient runway is available, the engine failure after takeoff procedure should be followed.

Engine Failure after Takeoff

In the event of an engine failure after takeoff first fly the aircraft:
Promptly lower the nose and establish a glide attitude to maintain 70kts.
Landing should be planned straight ahead and within ±30° to either side.
The turn, if required, should be made with no more than 15° of bank.
If adequate time exists secure the fuel and ignition system prior to touchdown to reduce the possibility of fire after touchdown, in accordance with the procedure below.

Any attempt to restart the engine depends on altitude available.
A controlled descent and crash landing on an unprepared surface is more preferable to uncontrolled impact with the ground in the attempted engine start.

After engine failure:

- **Airspeed** – 70kts

  This speed gives the best gliding distance with a propeller windmilling and flaps in up position.

Before landing:

- **Mixture** – IDLE CUT-OFF
- **Fuel selector** – OFF;

  This will ensure that the engine will be cut-off from the fuel system and thus minimise fire possibility after an impact.
- **Ignition switch**- OFF;
- **Master switch** – OFF

  The master switch should be switched off after the flaps being set in the desired position, to minimize the chance of a fire after touchdown.

- **Doors** - UNLOCKED
The doors should be unlocked in aid of rapid evacuation after the touchdown.

After landing:
- Stop the aeroplane;
- Check that fuel, ignition and electronics are OFF;
- Evacuate as soon as possible.

Gliding and Forced Landing

For a forced landing without engine power a gliding speed of 70kts should be used, however if maximum distance is not required a higher speed may be maintained to allow for turbulence and wind penetration.

The first priority is to establish glide speed and turn toward the suitable landing area.

While gliding toward the area, the cause of the failure should be established.
An engine restart should be attempted as shown in the checklist below.
If the attempts to restart the engine fail, secure the engine and focus on completing the forced landing (further attempts to restart distract the pilot from performing the forced landing procedure).

If the cause of engine failure is a mechanical failure or fire, the engine should be secured immediately and no restart should be attempted.
If the failure is partial, resulting in reduced or intermittent running, it is recommended to use the partial power till arrival overhead the intended area of landing. Thereafter the engine should be secured when the forced landing procedure is initiated. If a partial power setting is used and power is lost or suddenly regained during the forced landing circuit, this may change the gliding ability of the aircraft so dramatically, that it will be impossible to reach the intended landing area safely.

Forced landing procedure:
- Trim for 70kts
- Carb. heat on
- Select a field, plan the approach

Finding the fault:
Fault finding after the exclusion of mechanical failures has a limited number of possibilities. It may waste critical time to complete panel scans, when each specific cause can be then checked quickly and accurately.

For most piston aircraft these elements do not change, and the order of importance is not relevant, in remembering during times of pressure it is especially useful to have an effective acronym, for example the following uses “MAFIT”.

- **Mixture** – FULLY RICH (or as required)*;
- **Air - Carb. Heat** – PULL ON**, Alternate air if applicable select;
- **Fuel** – CHECK, CONTENTS SUFFICIENT, TANK SELECTOR CHECK/CHANGE; Primer – IN AND LOCKED, PUMPS AS APPLICABLE
- **Ignition** – CHECK BOTH/Left and Right check;

- **Throttle** – ADVANCE SMOTHLY TO FULL FORWARD;

* Mixture is recommended to be set rich in the pilots operating handbook, however if it is suspected the cut is from too rich setting at altitude, leaning can be opted for.
** One of the causes of an engine failure can be carburettor ice. By applying the Carb. heat, the problem can be eliminated. This check is included additionally as part of the initial memory items, as delay may lose heat from the exhaust to the extent it is ineffective.

Securing the engine:
Securing the engine is completed in a similar order to those items checked for engine restart operations.

- **Mixture** – IDLE CUT-OFF
- **Fuel selector** – OFF;

This will ensure that the engine will be cut-off from the fuel system and thus minimise fire possibility after an impact.
- **Throttle** – FULLY FORWARD;

By opening the throttle all the fuel left in the carburettor will be sucked out, and the fire possibility will be minimised.
- **Ignition switch**- OFF;
- **Master switch** – OFF

The master switch should be switched off after the flaps being set in the desired position, and is done to minimize an electrical fire.
- **Doors** - UNLOCKED

The doors should be unlatched in anticipation of a quick evacuation after the touchdown. After landing the same procedure as detailed for an engine failure after takeoff above, should be initiated.

After landing:
- Stop the aeroplane;
- Check that fuel, ignition and electronics are OFF;
- Evacuate as soon as possible.

Simulated Forced Landing

In case of simulated forced landing training, the carburettor heat should be selected before closing the throttle. During an extended glide, select a partial power for a brief period every 500-1000ft to provide engine warming and to ensure power is available.

Engine Fire

In case of fire on the ground, the engine should be shut down immediately and fire must be controlled as quickly as possible.
In flight such emergency calls for execution of a forced landing. Do not attempt to restart the engine.
A sideslip may be initiated to keep the flame away from the occupants, this procedure can be also used to extinguish the fire.
If required, the emergency descent may be initiated to land as soon as possible. Opening the window or door may produce a low pressure in the cabin and thus draw the fire into the cockpit.

Therefore, all doors and windows should be kept closed till short final, where the door should be open in anticipation of a quick evacuation after the landing.

An engine fire is usually caused by fuel leak, an electrical short, or exhaust leak.
If an engine fire occurs, the first step is to shut-off the fuel supply to the engine by putting the mixture to idle cut off and fuel valve to the off position.
The ignition switch should be left on and throttle fully open in order for the engine to use the remaining fuel in the lines and carburettor.
The following check list should be used in quick and proper manner.

During an engine start on ground:

- **Cranking** – CONTINUE FOR A FEW MINUTES

  This will suck the flames and burning fuel through the carburettor into the engine. The fire may burn out of exhaust for a few minutes and extinguish if continue cranking.
- **If engine starts - power** – 1700 rpm FOR A FEW MINUTES;
- **Mixture** – IDLE CUT OFF
- **Fuel valve** – CLOSED
- **Ignition switch** – OFF
- **Master switch** - OFF

  Use the fire extinguisher if the fire persists. Do not restart and call for maintenance for the engine inspection.

In flight:

- **Mixture** – IDLE CUT-OFF
- **Fuel valve** – OFF;
- **Throttle** – FULLY OPEN;
- **Master switch** – OFF;
- **Cabin Heat and Air** – OFF (To prevent the fire to be drawn into the cockpit
- **Airspeed** – 85kts If the fire is not extinguished, increase to a glide speed which may extinguish the fire.
- **Forced landing** – EXECUTE

Electrical Fire

The indication of an electrical fire is usually the distinct odour of burning insulation. Once an electrical fire is detected, attempt to identify the effected circuit and equipment. If the affected circuit cannot be identified or isolated, switch the master switch off, thus removing the possible source of the fire.
If the affected circuit or equipment is identified, isolate the circuit by pulling out the applicable circuit breaker and switching the equipment off.

Smoke may be removed by opening the windows and the cabin air control. However, if the fire or smoke increases, the windows and cabin air control should be closed.
The fire extinguisher may be used, if required.
Ventilate the cockpit after that to remove the gases.
Landing should be initiated as soon as practical on the first suitable airfield.
If the fire cannot be extinguished, land as soon as possible.

Landing Gear Emergencies (RG model)

Landing gear malfunctions may be viewed as non normal situations where time is not as critical as it may be with emergencies. Therefore, landing gear emergencies should not be addresses in the circuit, but rather somewhere away from conflicting traffic and while maintaining a safe altitude.

Normal landing gear extension time is approximately 5 seconds. If the landing gear will not extend normally, the general checks of circuit breakers and master switch shall be performed and the normal extension procedures at a reduced airspeed of 100KIAS repeated. The landing gear lever must be in the down position with the detent engaged. If efforts to extend and lock the gear through the normal landing gear system fail, providing there is still hydraulic system fluid in the system, the gear can be manually extended by use of the emergency hand pump. The hand pump is located between the front seats.

The manual gear extension procedure should be completed while using the checklist from the Pilots Operating Handbook, as it is a non-normal procedure, to ensure all steps are completed correctly. An example is provided below.

If gear motor operation is audible after a period of one minute following gear lever extension actuation, the GEAR PUMP circuit breaker must be pulled out to prevent the electric motor from overheating. In this event, remember to re-engage the circuit breaker just prior to landing.

LANDING GEAR MALFUNCTION PROCEDURES

LANDING GEAR FAILS TO RETRACT

1. Master Switch -- ON.
2. Landing Gear Lever -- CHECK (lever full up).
3. Landing Gear and Gear Pump Circuit Breakers -- IN.
4. Gear Up Light -- CHECK.
5. Landing Gear Lever -- RECYCLE.
6. Gear Motor -- CHECK operation (ammeter and noise).

LANDING GEAR FAILS TO EXTEND

1. Master Switch .-- ON.
2. Landing Gear Lever -- DOWN.
3. Landing Gear and Gear Pump Circuit Breakers -- IN.
4. Emergency Hand Pump--EXTEND HANDLE, and PUMP (perpen dicular to handle until resistance becomes heavy -- about 35 cycles).
5. Gear Down Light -- ON.
6. Pump Handle - - STOW.

GEAR UP LANDING

1. Landing Gear Lever -- UP.
2. Landing Gear and Gear Pump Circuit Breakers -- IN.
3. Runway -- SELECT longest hard surface or smooth sod runway available.
4. Wing Flaps - - 300 (on final approach).
5. Airspeed -- 65 KIAS.
6. Doors -- UNLATCH PRIOR TO TOUCHDOWN.
7. Avionics Power and Master Switches -- OFF when landing is assured.
8. Touchdown -- SLIGHTLY TAIL LOW.
9. Mixture -- IDLE CUT-OFF.
10. Ignition Switch -- OFF.
11. Fuel Selector Valve -- OFF.
12. Airplane -- EVACUATE.

LANDING WITHOUT POSITIVE INDICATION OF GEAR LOCKING

1. Before Landing Check -- COMPLETE.
2. Approach -- NORMAL (full flap).
3. Landing Gear and Gear Pump Circuit Breakers -- IN.
4. Landing -- TAIL LOW as smoothly as possible.
5. Braking -- MINIMUM necessary.
6. Taxi -- SLOWLY.
7. Engine -- SHUTDOWN before inspecting gear.

Stalling and Spinning

There is no pronounced aerodynamic stall warning (buffet). The stall warning is provided by a steady audible signal approximately 10kts before the actual stall is reached, which remains on until the flight attitude is changed. The stall characteristics are conventional for flaps retracted and extended. Slight elevator buffeting may occur just before the stall with flaps down.

A positive wing drop may occur if the aircraft is unbalanced or can be induced by the use of partial power or flap at the entry.

Spinning is prohibited. If an inadvertent spin is entered recovery is standard, as follows:

Spin recovery:

- Confirm throttle closed;
- Confirm direction of spin;
- Simultaneously apply opposite rudder to break spin and forward elevator input to break stall;
- Once spinning has stopped neutralize rudder and ease out of the dive;
- To minimize height loss once airspeed is decreasing apply full power.

PERFORMANCE SPECIFICATIONS AND LIMITATIONS

Performance figures given at MAUW and speeds in KIAS unless specified otherwise. Figures provided are averages and rounded to the safer side, they may not correspond to the exact figures for your particular model.

Structural Limitations

Gross weight (take-off and landing)	2500lbs - 3100lbs
Maximum landing weight	2500lbs -2950lbs
Standard empty weight	1620lbs-1880lbs
Max Baggage allowance in aft compartment	120lbs
Flight load factor (flaps up)	+3.8g – 1.52g
Flight load factor (flaps down)	+3.5g – 0

Engine Specifications

Engine (Lycoming O-470 series) power	230 BHP at 2600 rpm
Oil capacity	12Qts maximum, 9Qts minimum, 10 for normal operations*

**Engineers recommendation to operate on the low side of the minimum oil requirements.*

Fuel

Usable fuel	Standard tanks	56 USG (225 litres)
	Long range tanks	75 USG (300 litres)
	Wet Wing	88 USG (300 litres)

Tyre Pressures

Main wheel tyre pressure	42 psi
Nose wheel tyre pressure	49 psi

Maximum Speeds

Never Exceed Speed, (Vne)	167kts (193mph)	(top red line)
Maximum structural cruise speed (Vno)*	140kts , (160mph)	(speed, top of green arc)
Maximum demonstrated crosswind component**		15kts
Maximum maneuvering speed (Va)		111kts (128mph)

**May not be exceeded unless in smooth air conditions*
***Late models only*

Flap limitation speeds:

Early models	0-40 95kts (110MPH)	
Later models	0-10 140kts (160MPH)	(top of green arc)
	10-40 95kts (110MPH)	(top of white arc)

Stall Speeds

Stall speed, clean (Vs)	58kts (67mph)	(bottom of green arc)
Stall speed, landing config. (Vso)	52kts (60mph)	(bottom of white arc)

Speeds for normal operation

Normal take-off, flaps up	Raise nose at 55kts (60mph), Accelerate 90mph once obstacle cleared	
Normal climb out speed	90-105kts (100-120mph)	
Short field take off, Flaps 20º	lift off 60kts (65mph)*, accelerate Vy when obstacles clear, retract flaps	
Best rate of climb speed	Sea level	75kts (90mph)
	10,000ft	75ks (85mph)
Normal approach flaps 40º	65-70kts, (70-80mph)	
Normal approach flaps up	70-80kts, (80-90mph)	
Short field landing	65kts, (70mph)	

** See notes on short field performance and speeds*

Speeds for emergency operation

Engine Failure after take-off	70kts (80mph)
Forced landing	70kts (80mph) flap up
	65kts (75mph) flap up
Precautionary landing	70kts (80mph) flap up,
	65kts (75mph) full flap

Cruise Performance*

(Continental O470 series 230hp engines, C182 Skylane)

Cruise at 2500ft pressure altitude	2450 rpm 23"mp, 137KTAS, 14.2gph/ 54lts
Cruise at 10,000ft pressure altitude	2450rpm, 19"mp 156KTAS, 11.9gph/ 45lts
Block cruises, recommended performance	2400rpm, 23" or available MP 125kts, 55lt/hr

**Cruise figures provided from the pilots operating handbook should be used with a contingency factor, block cruises speed and fuel flow allow for contingency and for climb and descent, and are normally applied for planing purposes.*

Performance Graphs

The performance section of the POH provides graphs or tables to assist with performance figures.

The performance graphs for normal operations include takeoff, climb, cruise, and landing.

Non normal operations include glide performance, stall speeds for different flap settings and bank angles, and airspeed calibration.

Additional graphs provided to assist with extracting information may include crosswind components, standard temperature an pressure conversions and deviation from ISA conditions.

More details on the use of performance graphs and tables is provided in the ground planning section.

Weight and Balance

The maximum weight throughout the life of the C182 varies from 2500lbs to 3100lbs.
The unladen standard empty weight is approximately 1670lbs (757kg) and includes full oil and usable fuel. This provides a payload of approximately 1200lbs.

The actual weight of the aircraft you are flying should always be used for weight and balance calculations. Refer to the relevant weight and balance certificate (which should be not older then 5 years) carried on board the aircraft for exact weight for each aircraft.

Weight and balance documentation is not normally required for private flights, however it is still the pilot in command's responsibility to ensure that the aircraft is properly loaded and within limits. It is vital for safety and performance considerations to know your exact operating weight and condition before each take-off.
Aeroplane balance is maintained by controlling the position of the Centre of Gravity. Overloading, or mis-loading, may not result in obvious structural damage, but can cause fatigue on internal structural components or produce hazardous aeroplane handling characteristics.
An overweight aircraft will have increased takeoff distance, climb rates, cruise speeds and landing distance.
An aeroplane loaded past the rear limit of its permissible Centre of Gravity range will have an increased tendency for over-rotation, loss of elevator control on landing and, although a lower stall speed, a more unstable stall spin tendency.
Aircraft loaded past the forward limit will result in a higher stall speed, and wheel-barrowing on takeoff or landing.

Loading moments may be calculated using the moment arms, which provides the most accurate method, or with graphs or sometimes tables provided in the POH.
The total moment limitation is determined by numerical limitations or more commonly by a graph of C of G or moment against weight, as variation of moment with weight is often non linear.

More information on weight and balance calculations and loading graphs is detailed in the following section on ground planning.

GROUND PLANNING

Provided below is an example for completion of your pre-flight planning. Weight and balance and performance tables are found in the C182 POH, and other forms for use in planning should be available at your flying school.

In this example, the airplane needs to carry two pilots, 20 pounds of baggage, and sufficient fuel to fly 1.5 hours en route at 8000ft on a private flight under visual flight rules.

Navigation Planning

The first step in any flight planning is to determine the route, this is normally carried out on a *navigation worksheet*, then transferred to the *flight log* for use in flight.

An example of a navigation worksheet is shown below.

FM	TO	Alt	Temp	W/V	IAS	TAS	Trk T	V	Trk M	G/S	Dist	EET
TOTALS												

Note: a flight log will only contain the information needed in flight, typically magnetic track, distance, elapsed time, wind velocity and altitude.

Cruise Performance

The next step in ground planning after completion of the navigation log or determination of the flight time, is to calculate the fuel required. How much load you can carry is dependent on the required fuel.

On the following page page you will find example of CRUISE PERFORMANCE table you will find in the C182 POH (Figure 5-4). The table is a sample only and should be not used for flight planing.

For the flight we will use an outside temperature of 20ºC above standard temperature, or -1 degrees Celsius at 7500ft. At 65% power setting, using 2300rpm and 21”manifold pressure, we should obtain 135kts (156mph) and a fuel consumption of 12.2 gallons per hour. Using the conversion factors given in the beginning of this manual 1USG = 3.785Lt, we will in theory achieve 46 litres per hour fuel consumption. This figure is however in ideal conditions with the engine and airframe producing exactly the performance it achieved during testing.

To allow for power variations in climb and provide a more conservative approach a "block" figure of 55 litres per hour and 125kts may be used for planning purposes. Using this figure for a 1.5 hour of flight we will require 82.5 litres of fuel.

CRUISE PERFORMANCE

LEAN MIXTURE

Standard Conditions — Zero Wind — Gross Weight- 2800 Pounds

RPM	MP	% BHP	GAL/ HOUR	TAS MPH	60 GAL (NO RESERVE) ENDR. HOURS	60 GAL (NO RESERVE) RANGE MILES	79 GAL (NO RESERVE) ENDR. HOURS	79 GAL (NO RESERVE) RANGE MILES
7500 FEET								
2450	21	71	13.1	161	4.6	730	6.0	960
	20	67	12.4	157	4.8	760	6.4	1005
	19	62	11.7	152	5.1	780	6.8	1025
	18	58	11.0	147	5.5	805	7.2	1055
2300	21	66	12.2	156	4.9	760	6.5	1005
	20	62	11.6	151	5.2	780	6.8	1025
	19	58	11.0	147	5.5	800	7.2	1050
	18	54	10.5	142	5.7	810	7.5	1065
2200	21	62	11.4	152	5.3	805	6.9	1055
	20	58	10.7	148	5.6	830	7.4	1090
	19	54	10.2	143	5.9	840	7.7	1105
	18	51	9.7	138	6.2	860	8.1	1130
2000 MAXIMUM RANGE SETTINGS	19	47	8.7	131	6.9	900	9.1	1185
	18	43	8.1	123	7.4	910	9.8	1200
	17	39	7.6	116	7.9	920	10.4	1210
	16	36	7.0	107	8.6	920	11.3	1210
10,000 FEET								
2450	19	63	11.9	156	5.0	785	6.6	1035
	18	60	11.2	152	5.3	810	7.1	1065
	17	55	10.6	146	5.7	830	7.5	1090
	16	51	10.0	141	6.0	840	7.9	1105
2300	19	60	11.1	152	5.4	820	7.1	1080
	18	56	10.5	147	5.7	840	7.5	1105
	17	51	9.8	141	6.1	860	8.1	1130
	16	47	9.2	134	6.5	870	8.6	1145
2200	19	56	10.4	148	5.7	850	7.6	1120
	18	52	9.8	142	6.1	875	8.1	1155
	17	49	9.3	136	6.5	880	8.5	1160
	16	45	8.7	129	6.9	895	9.1	1175
2000 MAXIMUM RANGE SETTINGS	18	44	8.4	128	7.1	910	9.4	1200
	17	40	7.8	120	7.7	925	10.1	1215
	16	38	7.4	114	8.1	925	10.7	1215
	15	35	6.9	105	8.7	910	11.4	1200

Figure 5-4 (Sheet 2 of 3).

Fill in the fuel planning sheet as follows:

- On the first line enter the calculated trip fuel in the fuel planning table as en route fuel
- On the second line enter 10% of this amount as contingency fuel (82.5x0.1 = 8.3lt)
- Enter 45 minutes at the block consumption of 55lt/hr for VFR reserve (55x0.75 = 41.25)

Note; all figures are rounded up to the nearest litre for simplicity and added safety.

Adding together all of the above, we find the minimum fuel required for the flight is 138 litres.

The fuel in the tanks should be checked to ensure more than the minimum required, if more the actual dipped fuel must be used, if less the aircraft must be fueled to the minimum required, or weight permitting you may decide to add extra fuel.

To use fuel quantity in weight and balance calculation, we shall convert fuel volume into the weight. Using the formula in the table, we will find 70litres dipped is equivalent to 100 pounds of usable fuel (unusable fuel is allowed for in the aircraft weight.

Fuel Planning Worksheet

Date: / / **Reg.**

Cessna 182

		LITRES	Lbs
			X1.584
ENROUTE TIME @ 55 LITRES / HOUR		83	131
10 % CONTINGENCY FUEL		9	
RESERVE (45 MINS) @ 55 LITRES / HOUR		42	
TAXI / TAKEOFF	*(estimated)*	5	
UNUSABLE FUEL		19	
	MIN FUEL REQUIRED	141	
	TOTAL FUEL DIPPED	160	
	Extra fuel		
LESS UNUSABLE FUEL	(Included in aircraft empty weight)	-16	
		144	228

TOTAL FUEL WEIGHT TO WEIGHT AND BALANCE SHEET **TRIP FUEL WEIGHT TO WEIGHT AND BALANCE**	228lbs 131lbs

Weight and Balance Calculation

When the weight of the minimum fuel required is known, the weight and balance requirements may be calculated.

Begin with entering the Aircraft Empty Weight. This may be obtained from the aircraft flight manual or documents folder and is different for every aeroplane. In the example we used the C182A standard figures and limits.

The Basic Empty Weight is 1670lbs at a Moment of 59,400 lbs-ins.

Enter the actual weights or standard weights for the crew and passenger. If weights are not known standard weights must be used for all occupants.

Then enter the fuel and baggage weights.

Add all the figures together to obtain the total takeoff weight. This must be less than the maximum allowable take off weight, 2950lbs.

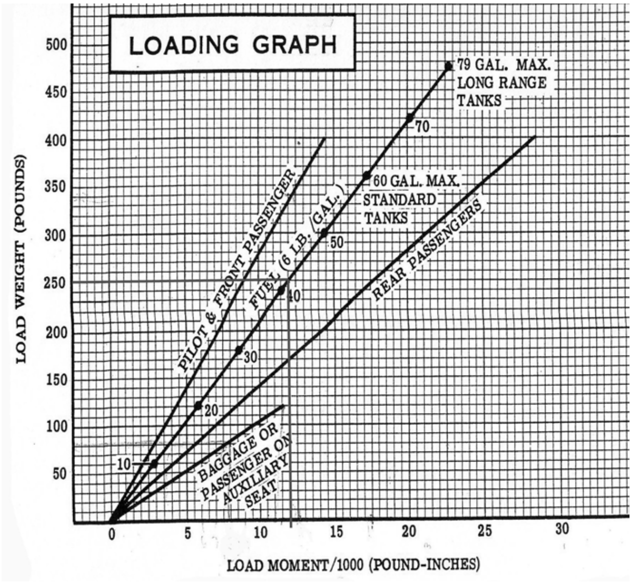
Should it be higher, weight must be removed until it is below the maximum. Baggage or passengers may be offloaded, or a shorter flight planned with a lower fuel requirement.

If the actual weight is below the maximum, additional fuel may be taken to allow for contingency or unplanned weather. By subtracting the figure obtained from the maximum weight, the maximum additional fuel in pounds can be obtained, and then converted to litres.

Moments may then be calculated by multiplying the weight (mass in lbs) by the moment arm (inches from the datum), to obtain the moment in lbs/inches.

Alternatively using tables of graphs the appropriate weight is found then against the line or column applicable (fuel, row 1, 2 baggage etc.) the moment can be extracted. In tables some interpolation may be required.

The graphical example can be seen easily in the picture below. In the example 250lbs of fuel is used to provide a moment of 12000 lb-in, or 12 lb-in/1000.



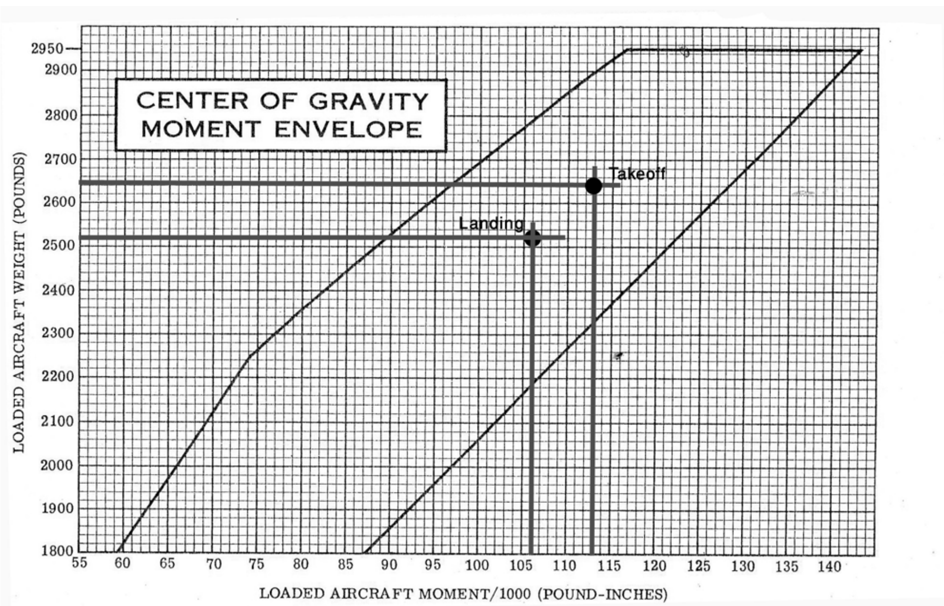
All weights and arms used in weight and balance calculation should be in the same units. Moments are divided by 1000 for more easily workable numbers, and this is also the format used in the Pilot's Operating Handbook.

Loading Worksheet

ITEM	WEIGHT				ARM	MOMENT / 1000								
Aircraft Empty Weight (Flt. Man)	1	6	7	0	35.5					5	9	.	3	0
Pilot, front passenger		3	4	0	35.9					1	2	.	2	0
Rear Passenger		3	4	0	70.9					2	4	.	1	0
Baggage Area 1 (Max 120 lbs)			6	5	97						6	.	3	0
Fuel Weight (Max 475 lbs)		2	3	0	48.1					1	1	.	1	0
Takeoff Weight (Max 2950 lbs)	**2**	**6**	**4**	**5**	**42.72**				**1**	**1**	**3**	**.**	**0**	**0**
Adjustments														
NEW TAKEOFF WEIGHT														
Less Fuel Burn		1	3	1	48.1						6	.	3	0
Landing Weight (Max 2800 lbs)	2	5	1	4	**42.44**				1	0	6	.	7	0

Weight x Arm = Moment. Final C. of G. = Total moments ÷ Total weights

The centre of gravity of the aeroplane in its takeoff condition can be determined by dividing Takeoff Moment by Takeoff Weight. In our case the centre of gravity for takeoff will be 42.72 inches aft of the datum.



To determine that the C. of G. is within the approved envelope, enter takeoff weight and Takeoff Moment in the Centre of Gravity Limits graph found in the POH, as shown in the example on the previous page. Some graphs may show weight against Centre of Gravity.

If Centre of Gravity is located outside the envelope, the baggage should be shifted or removed and the Weight and Balance must be computed again to insure the aircraft centre of gravity located within the limit.

The landing condition may then be determined in similar manner, resulting in a C of G at 42.44 inches aft of the datum.

Note, it sometimes may be necessary to calculate how far we can fly with the load on board then plan fuel stops in the required distance, in this case the calculation must be reversed.

Takeoff and Landing Performance Planning

Once we know what the actual weight will be for takeoff and landing, the takeoff and landing performance can be checked to ensure the field length is adequate. For this the tables TAKEOFF DISTANCE and LANDING DISTANCE from the C-182 POH (figures 5-3 & 5-5) must be used, these have been reproduced in the examples below.

In our example we will use the following conditions: 30°C ambient temperature, QNH 1023 and 5570' airfield elevation. No wind is considered, as an into wind runway should normally be chosen, increasing the performance and providing a safety buffer over the distance calculated. On one-way strips a tailwind if prevalent must be considered, up to the maximum limit of 10kts. Maximum crosswind, although not limiting should be taken into consideration for pilot experience levels.

The pressure altitude was calculated using the standard formulas provided in the front of this manual. Remember all figures should be rounded up for safety margins, and make sure that all factors, such as runway slope and grass runway surface have been considered and applied correctly in the distances calculation.

In the case of takeoff performance below a factor of 20% was used for the increase in temperature (10% per 25 deg. Fahrenheit above standard, corrected to Celsius and rounded up to the nearest 10%). Temperature is not considered in landing graphs as it has less of an effect on the performance since power is not used.

Climb data may be referred to if the departures airfields has significant obstacles on the takeoff path, or if climb performance affects your flight in any way (eg climbing from sea level to high altitude airfields).

When reviewing the runway distance available, ensure length is considered in the correct units, if needed convert from feet to meters.
It must be remembered that figures provided in the POH are under ideal conditions and using test pilots. Deviation from the airspeed figures specified, the engine and airframe condition when new, and variations in piloting technique will result in longer distances.

The runway length available should always be greater than Takeoff or Landing distance required. It is considered good practice to apply the margins required for commercial planning of 1.3 for takeoff and 1.43 for landing.

Departure Performance

DEPARTURE AIRFIELD		FYWE, WINDHOEK EROS	
VARIATION	14 DEG WEST	AIRFIELD ELEVATION	5570FT
I.S.A.	1013		
LESS QNH	-1030	TAKEOFF WEIGHT	2645LBS
DIFFERENCE	-17	AMBIENT TEMPERATURE	30 ºC
	x 30 feet	STANDARD TEMPERATURE	4 ºC
	+/-510	DIFF FROM STANDARD	26ºC
PLUS ELEVATION	5570FT	SURFACE	PAVED
PRESSURE ALTITUDE	5060ft	CORRECTION APPLIED	20.00%
WIND ºTRUE	+/- VARIATION	14 = WIND ºMAG	
		RUNWAY HEADING	10
		ANGULAR DIFFERENCE	
CROSS WIND COMPONENT	N/A	HEADWIND COMPONENT	N/A
MAX DEMONSTRATED	15kts	CROSSWIND COMPONENT	N/A
		SLOPE	NIL SIG
		TAKE OFF ROLL REQUIRED	**1074FT**
		TOTAL TAKEOFF DISTANCE REQUIRED	**2034FT**
		COMMERCIAL MARGIN	**2644FT**
		TAKEOFF DISTANCE AVAILABLE	**6000FT**

Takeoff Performance Table

TAKE-OFF DATA

TAKE-OFF DISTANCE WITH 20° FLAPS FROM HARD SURFACE RUNWAY.

GROSS WEIGHT LBS.	IAS @ 50' MPH	HEAD WIND MPH	AT SEA LEVEL & 59°F.		AT 2500 FT. & 50°F.		AT 5000 FT. & 41°F.		AT 7500 FT. & 32° F.	
			GROUND RUN	TOTAL TO CLEAR 50' OBS	GROUND RUN	TOTAL TO CLEAR 50' OBS	GROUND RUN	TOTAL TO CLEAR 50' OBS	GROUND RUN	TOTAL TO CLEAR 50' OBS
2800	61	0	625	1205	745	1420	895	1695	1095	2090
		15	380	830	460	990	565	1200	700	1505
		30	190	515	240	630	305	780	390	1000
2400	57	0	440	895	525	1035	630	1210	765	1460
		15	255	600	310	705	380	835	470	1020
		30	115	355	150	425	190	515	245	645
2000	52	0	295	655	350	745	415	855	500	1005
		15	160	425	195	490	235	570	290	680
		30	65	235	80	280	105	335	135	405

NOTES: 1. Increase distances 10% for each 25°F above standard temperature for particular altitude.
2. For operation on a dry, grass runway, increase distances (both "ground run" and "total to clear 50 ft. obstacle") by 7% of the "total to clear 50 ft. obstacle" figure.

Landing Performance

ARRIVAL AIRFIELD		FYWE, WINDHOEK EROS	
VARIATION	14 DEG WEST	AIRFIELD ELEVATION	5570FT
I.S.A.	1013		
LESS QNH	-1030	LANDING WEIGHT	2515LBS
DIFFERENCE	-17	AMBIENT TEMPERATURE	30ºC
	x 30 feet	STANDARD TEMPERATURE	4ºC
	+/-510	DIFF FROM STANDARD	26ºC
PLUS ELEVATION	5570FT	SURFACE	PAVED
PRESSURE ALTITUDE	5060ft	CORRECTION APPLIED	0.00%

WIND ºTRUE +/- VARIATION 14 = WIND ºMAG

		RUNWAY HEADING	10
		ANGULAR DIFFERENCE	
CROSS WIND COMPONENT	N/A	HEADWIND COMPONENT	N/A
MAX DEMONSTRATED	15 kts	CROSSWIND COMPONENT	N/A
		SLOPE	NIL SIG
		LANDING ROLL REQUIRED	**680FT**
		TOTAL LANDING DISTANCE REQUIRED	**1505FT**
		COMMERCIAL MARGIN	**2152FT**
		LANDING DISTANCE AVAILABLE	**6000FT**

LANDING DISTANCE TABLE

LANDING DISTANCE WITH 40° FLAPS ON HARD SURFACED RUNWAY

GROSS WEIGHT POUNDS	APPROACH IAS MPH	@ SEA LEVEL & 59° F		@ 2500 FEET & 50° F		@ 5000 FEET & 41° F		@ 7500 FEET & 32° F	
		GROUND ROLL	TOTAL TO CLEAR 50 FT. OBS.	GROUND ROLL	TOTAL TO CLEAR 50 FT. OBS.	GROUND ROLL	TOTAL TO CLEAR 50 FT. OBS.	GROUND ROLL	TOTAL TO CLEAR 50 FT. OBS.
2800	69	590	1350	640	1430	680	1505	740	1595

NOTES:
1. Distances shown are based on zero wind, power off and heavy braking.
2. Reduce landing distances 10% for each 6 MPH headwind.
3. For operation on a dry, grass runway, increase distances (both "ground roll" and "total to clear 50 ft. obstacle") by 20% of the "total to clear 50 ft. obstacle" figure.

REVIEW QUESTIONS

Engine and Ignition Systems

1. If the magneto selector is turned to OFF:
    a) there will be a drop in engine rpm
    b) the rpm will stay the same
    c) the engine will stop

2. Two separate ignition systems provide:
    a) more safety only
    b) more efficient burning only
    c) more safety and more efficient burning
    d) dual position key switching

3. Switching the ignition OFF connects the magneto system to ground:
    a) true
    b) false

4. If a magneto ground wire comes loose in flight, the engine:
    a) will stop
    b) will continue running with lower rpm
    c) will continue running

5. The spark plugs are provided with electrical supply from:
    a) battery at all times
    b) the magnetos
    c) the battery at start-up and then the magnetos

6. The most probable reason an engine continues to run after ignition switch has been turned off is:
    a) carbon deposit glowing on the spark plugs;
    b) a magneto ground wire is in contact with the engine casing;
    c) a broken magneto ground wire

7. The maximum drop and maximum differential on the magneto check for the C182 is :
    a) 150 drop, 50 difference
    b) 50 drop, 150 difference
    c) 125 drop, 75 difference

8. Cessna 182 engine has:
    a) fuel injection system
    b) carburettor located on the bottom of the engine
    c) carburettor located on the top of the engine

9. Cessna 182 engines are:
    a) sensitive to carburettor ice;
    b) not affected by carburettor ice;

10. Carb. heat is used to:
    a) prevent carburettor ice
    b) provide better fuel mixing in the carburettor as it evaporates quickly
    c) to heat the air/fuel mixture, so to provide better air/fuel mixture burning in the engine

11. The pilot controls the fuel/air ratio with the:
    a) throttle;
    b) carb. heat
    c) mixture

12. For takeoff at a sea level airport, the mixture control should be:
    a) in the leaned position for maximum rpm;
    b) in the full rich position;
    c) the engine is not affected by mixture setting below 3000ft.

13. What will occur if no leaning is made with the mixture control as the flight altitude increases:
    a) the volume of air entering the carburettor decreases and the amount of fuel decreases, resulting in a rich mixture;
    b) the density of air entering the carburettor decreases and the amount of fuel increases, resulting in a rich mixture;
    c) the density of air entering the carburettor decreases and the amount of fuel remains constant, resulting in a rich mixture.

14. The correct procedure to achieve the best fuel/air mixture when cruising at altitude is:
    a) to move the mixture control toward LEAN until engine rpm starts to drop;
    b) to move the mixture control toward LEAN until engine rpm reaches a peak value;
    c) to move the mixture control toward RICH until engine rpm starts to drop;
    d) to move the mixture control toward LEAN until engine rpm reaches a peak EGT and then toward RICH to get EGT 25-50ºF below the peak.

15. Extra fuel in a rich mixture causes:
    a) engine heating;
    b) engine cooling
    c) does not affect the heating or cooling of the engine

16. If after the mixture is properly adjusted while cruising at the altitude and pilot forgets to enrich the mixture during descent:
    a) the engine may cut-out due to too rich mixture;
    b) the engine may cut-out due to too lean mixture;
    c) a too rich mixture will create high cylinder head temperatures;
    d) a to lean mixture will create high cylinder head temperatures.

17. The remedy for suspected carburettor ice is to:
    a) enrichen the mixture;
    b) lean the mixture;
    c) apply carb. heat;
    d) increase power by advancing the throttle.

18. If carb. heat is applied:
    a) rpm will increase due to the leaner mixture;
    b) rpm will decrease due to the leaner mixture;
    c) rpm will decrease due to the richer mixture.

19. When the engine is primed for start-up, the fuel priming pump delivers fuel:
    a) through the carburettor to the induction manifold;
    b) through the carburettor to each cylinder;
    c) directly to the cylinders bypassing the carburettor.

20. The engine oil system is provided to:
    a) reduce friction between moving parts and ensure high engine temperatures;
    b) reduce friction between moving parts and prevent high engine temperatures;
    c) increase friction between moving parts and prevent high engine temperatures.

21. Oil grades:
    a) should not be mixed;
    b) may be mixed;
    c) may be mixed only when there is no viable alternative.

22. With too little oil, you may observe:
    a) high oil temperature and high oil pressure;
    b) high oil temperature and low oil pressure;
    c) low oil temperature and low oil pressure.

23. What action can a pilot take to aid in cooling an engine that is overheating during a climb:
    a) lean the mixture and increase airspeed;
    b) enrichen the mixture and increase airspeed;
    c) increase airspeed and reduce engine rpm.

24. The pilot should shut-down an engine after start if the oil pressure does not rise within:
    a) 30 seconds;
    b) 1 minutes;
    c) 10 seconds.

25. The aircraft is equipped with:
    a) a fixed pitch propeller;
    b) a constant speed propeller.

26. Engine power is monitored by the:
    a) manifold pressure gauge;
    b) engine rpm gauge.

27. The usual method of shutting an engine down is to:
    a) switch the magnetos off;
    b) move the mixture to idle cut-off;
    c) switch the master switch off.

28. The minimum oil quantity for start and normal flight is:
    a) 12 quarts;
    b) 7 quarts;
    c) 9 quarts.

29. Cowl flaps should be open:
    a) at all times
    b) for climb and ground operations and high engine operating temperatures
    c) whenever the engine temperature is too cool

30. Cowl flaps should be closed:
    a) at all times
    b) for climb and ground operations and high engine operating temperatures
    c) whenever the engine temperature is too cool

Fuel system

31. Fuel tanks is are located:
    a) in the aft cabin;
    b) beneath the pilot seats;
    c) in the wings

32. Water tends to collect at the:
    a) lowest point in the fuel system;
    b) highest point in the fuel system.

33. The average consumption rate of the C182 is
    a) 35 liters
    b) 75 liters
    c) 55 liters

34. The fuel cock selections are
    a) both only
    b) left, right and both, left and right can be used for level flight only
    c) left, right and both and all positions can be used in any phase of flight

Airframe, electrical and instruments

35. Normal in-flight electrical power is provided by an:
    a) alternator;
    b) battery;
    c) generator.

36. A distribution point for electrical power to various services is:
    a) circuit breaker;
    b) distributor;
    c) bus bar.

37. The battery master switch should be turned to OFF after the engine is stopped to avoid the battery discharging through:
    a) the magnetos;
    b) the generator;
    c) electrical services connected to it.

38. The suction (or vacuum gauge) shows the pressure:
    a) below atmospheric pressure;
    b) above atmospheric pressure.

39. The vacuum pump is:
    a) electrically-driven;
    b) engine-driven;
    c) hydraulically-driven.

40. The following instrument will be affected by a vacuum pump failure:
    a) artificial horizon and the direction indicator;
    b) turn and bank indicator;
    c) airspeed indicator.

41. The aircraft is equipped with:
    a) electrically operated elevator trim tab;
    b) manually-operated elevator trim;
    c) manually-operated elevator and rudder trim;

42. Frise type ailerons are used to:
    a) reduce airflow over the control surface to make the control lighter;
    b) reduce the adverse aileron yaw during bank;
    c) this aircraft does not have Frise type of ailerons;

43. The flaps are:
    a) hydraulically-operated;
    b) electrically-operated;
    c) manually-operated;

44. Flaps selections are:
    a) 10, 20 and 40 degrees
    b) take-off, approach and land
    c) 10, 20 and 30 degrees

45. Nose wheel steering is provided by:
    a) mechanical links with rudder pedals;
    b) differential braking;
    c) all of the above

Flight operations

46. The best glide speed is
    a) 80kts
    b) 70kts
    c) 70mph

47. The best rate of climb speed at sea level is:
    a) 88kts
    b) 78kts
    c) not applicable to this aeroplane

48. The recommended normal climb speed at sea level is:
    a) 90-105kts
    b) 100-120kts
    c) not specified

49. The recommended normal takeoff speed at sea level is:
    a) 90kts
    b) 100kts
    c) 80kts

50. The recommended normal landing speed at sea level is:
    a) 65-70kts with flap 40
    b) 70-80kts with flap 40
    c) any speed is OK as long as limitations are not exceeded