Q1 The temperature at 11000ft AMSL is forecast to be –5°C: compared to the International Standard Atmosphere (ISA) this is:

A - ISA –1°C.

B - IISA +2°C.

C - IISA –3°C.

D - IISA +4°C.

Q2 The International Standard Atmosphere specifies:

A - values of actual conditions of temperature, pressure and density that exist at all levels of the atmosphere.

B - sea level conditions of atmospheric temperature, pressure and density.

C - ambient conditions of atmospheric temperature, pressure and density for all altitudes.

D - standardised atmospheric values of temperature, pressure and density for all altitudes.

Q3 The variable physical properties of the atmosphere that affect aircraft performance are:

A - temperature, pressure and humidity.

B - pressure, humidity and oxygen content.

C - temperature, pressure, density and humidity.

D - pressure, humidity, temperature and specific gravity.

Q4 The International Standard Atmosphere assumes that the ambient temperature:

A - will decrease with height only if an inversion layer is present.

B - decreases with increase in height above the Earth.

C - increases with increase in height above the Earth.

D - increases with decrease in height above the Earth.

Q5 Air density which is integral to airframe and engine performance, is proportional to:

A - temperature, and inversely proportional to pressure.

B - pressure, and inversely proportional to temperature.

C - humidity and temperature.

D - pressure and temperature.

Q6 The two major constituents of the earth's atmosphere are oxygen and nitrogen. The ratio of these two constituent gases by volume is:

	Nitrogen	Oxygen
A -	1	4
B -	1	5
C -	3	1
D -	4	1

Q7 The percentage oxygen content of the atmosphere at higher altitudes compared to that at lower altitudes:

A - falls, but since the quantity is adequate, the fall has little effect on the pilot at any altitude.

B - decreases due to the decreased air pressure.

C - remains constant, but the lower atmospheric pressure at altitude makes it more difficult for the body to absorb oxygen.

D - increases slightly up to the tropopause above which it remains constant.

Q8 A reduction of air pressure while humidity and temperature are maintained at constant levels will:

A - not affect the air density if the temperature remains constant.

B - cause the air density to increase.

C - cause the air density to decrease.

D - cause air density to fluctuate whilst pressure is changing due to adiabatic heating and cooling.

Q9 The principal constituent gases that make up the Earth's atmosphere are:

A - hydrogen, carbon dioxide, helium and oxygen.

B - nitrogen, oxygen and water vapour.

C - oxygen, carbon dioxide and water vapour.

D - oxygen, carbon monoxide and water vapour.

AIRCRAFT GENERAL (AEROPLANES)

The actual examination paper consists of fifty questions with a multiple choice of four answers A, B, C or D. The candidate should indicate the chosen answer by placing a cross in the appropriate box on the answer paper provided.

Time allowed 1hour 30 minutes.

The pass mark is 75%, so the minimum number of questions that must be answered correctly to obtain a pass is thirty eight. Marks are not deducted for incorrect answers.

The explanation section follows the question section and each explanation is prefixed TEC (Technical Explanation).

Q10 When compared with perfectly dry air at the same temperature and pressure, very moist or saturated air will have:

A - a greater density.

B - a similar density.

C - an imbeure density.

D - a lower density.

Q11 Air density reduces with altitude because:

A - of the fall in water vapour content.

B - the pressure falls.

C - he temperature falls.

D - of adiabatic cooling.

Q12 If air is maintained at a constant temperature and volume while its pressure is increased, its density will:

A - increase.

B - decrease.

C - remain constant because the volume is constant.

D - vary only with changes in the environmental temperature.

Q13 If the pressure of a given mass of dry air is increased whilst the temperature remains constant, its density will:

A - decrease

B - increase.

C - remain the same.

D - none of the above answers are correct.

Q14 The definition of relative humidity is:

A - the amount of water vapour present in the air compared to the maximum amount of water vapour the air could hold at the same temperature. This is expressed as a percentage.

B - the percentage of water in a measured volume of air irrespective of temperature.

C - the relative amount of water vapour in the air at any time.

D - the water vapour density at any temperature compared with its density at saturation temperature.

Q15 A monocoque structure my be described as:

A - containing no openings and no internal support structure where all self and imposed loads are carried by the skin.

B - containing some openings which are structurally reinforced to maintain the integrity the load bearing skin.

C - containing a load bearing structure that transmits self and imposed loads proportionately to the integral load bearing skin.

D - containing no openings where all imposed loads are transferred to an internal load bearing structure.

Q16 If air is maintained at a constant temperature and volume while its pressure is decreased, its density will:

A - increase.

B - decrease.

C - remain constant because the volume is constant.

D - remain constant because pressure will have no effect on density at a constant volume and temperature.

Q17 The onset of a stall is characterised by:

A - a nose pitch up and aircraft sink.

B - airspeed decay and wing drop.

C - airspeed stagnation and incipient spin.

D - a nose pitch down and aircraft sink.

Q18 The pressure of air flowing under a wing in straight and level flight when compared with the airflow over the wing will be:

A - higher.

B - lower.

C - the same.

D - the same at low airspeed but lower at high airspeed.

Q19 The bending of an aeroplane's wing spar in flight is the product of opposing forces - lift which bends the wing ....(**a**)........ and weight which bends the.......(**b**)...........

Select the answer which correctly completes this statement.

	(a)	(b)
A -	upwards	upwards
B -	downwards	downwards
C -	upwards	downwards
D -	downwards	upwards

Q20 An aircraft in straight and level flight is in equilibrium when:

A - the lift equals the drag and the thrust equals the weight.

B - the weight equals the drag and the lift equals the thrust.

C - the weight equals the lift couple and the drag equals the thrust couple.

D - the weight equals lift and the drag equals the thrust.

Q21 A coefficient of lift reaches its maximum value:

A - between 4° and 6° angle of attack in straight and level flight.

B - at or just prior to the stall.

C - at the minimum drag speed in the clean configuration.

D - at the normal operating speed (Vno) in the clean configuration.

Q22 The reason for 'washout' being designed into an aeroplane wing is to:

A - decrease the effectiveness of the ailerons.

B - cause the outboard section of the wing to stall first.

C - cause the inboard section of the wing to stall first.

D - prevent progressive wing stall and loss of control.

Q23 The speed scale of an airspeed indicator is colour coded. The green band is:

A - the normal operating range (Vno)

B - the flap extension range (Vfe)

C - the caution range (Vne)

D - the landing gear retraction range (Vlo)

Q24 A gyroscope when spinning, is said to have rigidity in space. Rigidity is a function of:

A - RPM, rotor mass, and position of its centre of gravity..

B - RPM and position of its centre of gravity.

C - RPM and rotor mass.

D - Centre of gravity position and rotor mass.

Q25 Deviation from the maintenance schedule specified in the Certificate of Airworthiness (C of A):

A - will require the issue of a new C of A if the specified maintenance is not completed within 50 flying hours.

B - will not affect the C of A but invalidates any subsequent Certificate of Release to Service.

C - invalidates the C of A but not any subsequent Certificate of Release to Service.

D - renders the C of A invalid until the specified maintenance is carried out.

Q26 Ferrous objects in close proximity to a magnetic compass will:

A - induce significant errors in the magnetic heading indication.

B - not affect the magnetic compass as its housing is screened from magnetic field distortion.

C - not affect flight operations provided the heading indicator is synchronised with the magnetic compass before the ferrous items are brought on board.

D - induce some small errors in the magnetic compass due to changes in flux density.

Q27 Complete the following statement.

The .....**X**..... wake turbulence is generated by a .....**Y**..... aircraft flying at .....**Z**..... airspeed.

	X	Y	Z
A -	greatest	light	high
B -	greatest	heavy	slow
C -	least	heavy	slow
D -	least	light	high

Q28 An aircraft that has been over stressed:

A - must be inspected by a qualified engineer before the next flight.

B - must be inspected by the pilot in command and if no defect is found, s/he will not be required to make an appropriate entry in the aircraft technical log.

C - must be inspected by at least two pilots licenced on the type, one of whom must be the pilot in command.

D - must be subjected to a duplicate inspected by two engineers before the next flight.

Q29 An increase in aircraft weight amongst other things will:

A - cause an increase in the stalling speed.

B - not effect the stalling speed.

C - cause a decrease in the stalling speed.

D - cause an increase in the flapless stalling speed but decrease in the clean stalling speed.

Q30 If an aircraft is maintaining a constant angle of attack but increases its airspeed, this will cause:

A - a decrease in lift but an increase in drag.

B - no change in lift generated by the wing, but an increase in airframe drag.

C - an increase of both lift and drag.

D - an increase in lift but a decrease in drag.

Q31 The valve which allows oil to either flow through or bye-pass a serviceable engine oil cooler is:

A - pressure activated

B - manually activated.

C - pneumatically activated.

D - temperature activated

Q32 The speed at which a particular aircraft stalls whilst in straight and level flight is 80kt. The approximate stalling speed of the same aircraft in a 60° bank turn would be:

A - 121kt.

B - 105kt.

C - 112kt.

D - 118kt.

Q33 Study the diagram below. The total pressure entering the the pitot tube represented by the arrow is:

A - pitot pressure + dynamic pressure.

B - static pressure + dynamic pressure.

C - adiabatic + pitot pressure.

D - pitot + adiabatic pressure.

Q34 An aeroplane wing will stall at a given:

A - angle of incidence

B - angle of lift

C - dihedral angle

D - angle of attack

Q35 A stalling angle of attack is increased by 'slots' because:

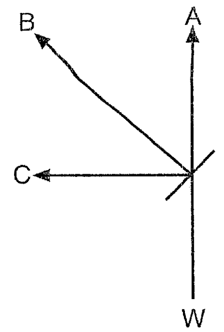
A - they delay the break up of the smooth airflow over the wing.

B - they dump positive pressure airflow from under the wing.

C - they increase the effective wing area at the leading edge.

D - they decrease the ineffective wing area at the leading edge.

Q36 Study the vector diagram below representing the forces in a turn.



Which of the following represents total lift?

A - A
B - B
C - C
D - W

Q37 The consequence of an aircraft with its centre of gravity positioned at or very close to its designed aft limit could be:

A - an increased stalling speed.
B - an increased applied elevator force during rotation.
C - an increased applied rudder force during rotation.
D - greatly reduced applied elevator force during the flare.

Q38 As an aeroplane's True Air Speed (TAS) increases:

A - parasite drag decreases and induced drag increases.
B - induced drag decreases and parasite drag increases.
C - induced drag increases and parasite drag increases.
D - induced drag decreases and parasite drag decreases.

Q39 Induced drag:

A - is not a factor of airspeed.
B - is reduced as airspeed increases.
C - is increased as airspeed increases.
D - is reduced as airspeed reduces.

Q40 A fixed trim tab such as those commonly found on ailerons should:

A - not be adjusted once set by the manufacturer.
B - be adjusted on the ground after a test flight to achieve longitudinally level flight.
C - be adjusted on the ground after a flight test to achieve laterally level flight.
D - only be adjusted after receipt of written approval from the Authority.

Q41 The purpose of a control surface anti-balance tab is to:

A - ensure the centre of pressure is maintained forward of the hinge line.
B - assist the pilot in moving the control surface.
C - ensure that the pilot's physical control load decreases with increase of control surface deflection.
D - ensure that the pilot's physical control load increases with increase of control surface deflection.

Q42 A flying control surface is fitted with a simple trim tab. Once the trim tab is set in flight, any movement of the flying control surface will result in the:

A - trim tab position remaining constant relative to the control surface.
B - trim tab moving to a new position and will have to be re-set.
C - trim tab position remaining constant relative to the airflow.
D - trim tab moving in the opposite direction to the main flying control surface.

Q43 A factor that determines an aeroplane's stalling speed for a given weight is:

A - the square of the wing area.
B - the square root of the load factor.
C - the square root of the weight.
D - the square root of the airspeed.

Q44 The angle of attack of an aerofoil may be defined as:

A - the angle subtended by the aerofoil chord line and the longitudinal axis.

B - the angle subtended by the aerofoil chord line and the relative airflow.

C - the angle subtended by the aerofoil mean chord line and the horizontal.

D - the angle subtended by the aerofoil mean chord line and the rigging angle.

Q45 In straight and level flight, the air flow over the wing's upper surface compared with the air flow unaffected by the wing will have:

A - the same velocity.

B - a reduced velocity.

C - a greater velocity.

D - a relative velocity.

Q46 Select the answer that correctly completes the following statement.

The stalling angle of attack will be ....with trailing edge flaps extended, if measured between the relative airflow and the aerofoil chord line with flaps retracted:

A - the same.

B - greater.

C - less.

D - inverted.

Q47 Which of the following gives an aeroplane directional stability?

A - The rudder.

B - The rudder trim tab.

C - The dorsal fin or keel area.

D - The fin.

Q48 The movement of an aeroplane about its normal (vertical) axis is known as:

A - side slipping.

B - roll.

C - pitch.

D - yaw.

Q49 An aircraft is fitted with a balance tab controlled rudder, when viewed from the rear, forward movement of the rudder bar to the left to yaw the aircraft to the left will move the balance tab to the:

A - right and the rudder to the left.

B - left and the rudder to the right.

C - right and rudder to the right.

D - left and rudder to the left.

Q50 Control surface mass balance:

A - balances the extra weight of the servo tab on the trailing edge.

B - makes the control easier for the pilot to move.

C - makes the control more difficult for the pilot to move.

D - prevents flutter of that control in the higher speed range.

Q51 High speed flying control flutter is eliminated by fitting:

A - servo tabs to the trailing edge.

B - balance tabs to the leading edge.

C - mass balance forward of the control surface hinge.

D - balance tabs to the trailing edge.

Q52 A flying control surface that is aerodynamically balanced:

A - has an area of the control surface forward of the hinge line.

B - has been modified with a trim tab.

C - uses a balance weight forward of the hinge line.

D - uses a balance weight aft of the hinge line.

Q53 Differential aileron where the up-going aileron moves further than the down-going aileron is a design feature that helps to counteract:

A - aircraft inertia.

B - *adverse aileron drag.*

C - lateral positive stability.

D - lateral instability.

Q54 The secondary effects of rudder and aileron are:

	rudder	aileron
A -	turn	roll and spiral dive
B -	pitch	bank and spin
C -	roll	yaw and spiral dive
D -	yaw	turn and spin

Q55 When an aeroplane is disturbed from its established flight path, for instance when entering turbulent air, it is said to have positive stability if it consequently:

A - remains in the new flight path.

B - becomes further displaced from its original flight path.

C - re-establishes its original flight path without any pilot input.

D - oscillates about its original flight path.

Q56 When an aeroplane is disturbed from its trimmed attitude, for instance when entering turbulent air, it is said to have neutral stability if it consequently:

A - remains in the new attitude.

B - oscillates about its original attitude before eventually settling in its original attitude.

C - immediately re-establishes its original attitude.

D - departs further from its original attitude.

Q57 The centre of pressure by design is behind the aircraft centre of gravity which is balanced in straight and level flight by:

A - the tailplane producing a downward force.

B - the tailplane producing an upward force.

C - neither an upward nor downward tailplane force as the aircraft will be in equilibrium.

D - neither an upward or downward tailplane force as the aircraft will not be in equilibrium.

Q58 A flying control lock:

A - locks controls in flight to neutralise aerodynamic loads and ease the physical load on the pilot.

B - locks the trim tabs once straight and level cruise is established.

C - locks the nose wheel steering once airborne to prevent disruption of the stabilising longitudinal keel effect.

D - locks controls on the ground to prevent damage in windy conditions.

Q59 One effect of the centre of gravity being at or close to its permitted forward limit will be:

A - dangerously low elevator forces being required during the flare prior to touch-down.

B - high elevator forces being required during the flare prior to touch-down.

C - a reduction in the basic stalling speed.

D - a significant increase in the basic stalling speed with possible loss of control close to the stall.

Q60 At what power setting is serious carburettor icing likely to occur if operating at an ambient temperature of +25°C and a relative humidity of 50%?

A - climb power.

B - cruise power.

C - descent power.

D - maximum continuous.

Q61 It is important to carry out regular checks for water in the fuel system as the presence of water will cause:

A - intake and carburettor venturi icing.

B - the fuel to freeze..

C - fuel system contamination resulting in the loss of engine power.

D - incomplete combustion.

Q62 The crankshaft in a four stroke piston engine:

A - controls the clearance of the valves.

B - converts rotary motion into reciprocating movement.

C - converts linear motion into reciprocating movement.

D - converts reciprocating movement into rotary motion.

Q63 How many times will each valve open and close during one complete cycle (Otto cycle) of a four-stroke internal combustion piston engine?

A - once.

B - twice.

C - three times.

D - four times.

Q64 After starting a cold engine, if the oil pressure gauge does not indicate within approximately 30 seconds:

A - the engine RPM should be increased and the oil pressure re-checked.

B - this may be ignored if the oil temperature is still low and the oil level was checked before start-up.

C - the engine must be stopped immediately.

D - refer to the Pilot's Operating Handbook (PoH) for the appropriate action.

Q65 If the starter warning light remains on after the starter button (starter switch) has been released:

A - the alternator output level should be checked.

B - the engine should be immediately stopped.

C - the engine RPM should be increased as it is too low for starter auto disconnect.

D - manually disengage the starter.

Q66 Information regarding aircraft that may legally be fuelled with MOGAS may be found in:

A - Notams

B - AICs

C - The Pilot's ~Operating Handbook (PoH).

D - CAA Airworthiness Notices.

Q67 When refuelling, to ensure that the correct type of fuel is used, both the fuel itself and tank labels are colour coded. The primary colour for all labels relating to 100LL is ......(i)...... and the colour of the fuel itself should be ......(ii)......

	(i)	(ii)
A -	red	blue
B -	black	red
C -	blue	straw
D -	red	straw

Q68 The normal location of an electrically driven fuel boost pump is:

A - the lowest part of a fuel tank.

B - upstream of the engine driven pump.

C - the tank to tank fuel transfer line.

D - forward of the engine fire wall bulkhead.

Q69 When a fuel priming pump is used before starting an engine, the fuel is normally delivered directly to:

A - the carburettor float chamber.

B - the combustion chamber.

C - the delivery shroud of the fuel injector manifold.

D - the induction manifold or inlet valve port.

Q70 A piston engine fuel/ air mixture ratio, ideally should be in the region of:

A - 1:7 by weight.

B - 1:9 by volume.

C - 1:12 by weight.

D - 1:15 by volume.

Q71 What is the function of an idle cut off valve in a piston engined aeroplane?

A - It controls engine slow-running via the carburettor idle jet.

B - changes fuel flow to the main jet from the idle jet when power is increased.

C - it shuts down the engine automatically if the cylinder head temperature rises due to long periods at idle on the ground.

D - It inhibits fuel flow from a discharge nozzle in the carburettor when selected.

Q72 When leaning the fuel/ air mixture at altitude, to achieve the most efficient mixture, the control is first moved towards the LEAN position until the engine RPM:

A - decreases. The mixture control is then moved slightly to the RICH side of peak RPM.

B - increases. The mixture control is then left in that position.

C - increases by approximately 50 RPM. The mixture control is then moved slightly more towards the LEAN position.

D - decreases by approximately 50 RPM. The mixture control is then moved slightly more towards the LEAN position.

Q73 The restrictive throat of a carburettor venturi changes the characteristics of the air that passes through it. These are:

A - a dynamic pressure increase and a velocity decrease.

B - a dynamic pressure decrease and a velocity increase.

C - a drop in ambient pressure and velocity increase.

D - a dynamic pressure increase and ambient pressure increase.

Q74 Which of the following prevents excessive engine oil pressures?

A - An oil pressure relief valve.

B - A vernier therm.

C - A filter by-pass valve.

D - A non return valve (NRV).

Q75 The valve that allows oil to by-pass a blocked engine oil cooler is:

A - pressure activated.

B - temperature activated.

C - manually activated.

D - density activated.

Q76 For every crankshaft rotation in a piston engine, the camshaft rotates:

A - twice, because the camshaft operates at twice engine speed.

B - four times, because the camshaft operates at twice engine speed.

C - four times, because the camshaft operates at half engine speed.

D - one half of one revolution because the camshaft operates at half engine speed.

Q77 Elemental to one complete Otto Cycle is that each piston moves:

A - up once and down once.

B - up twice and down twice.

C - up four times and down four time.

D - up twice and down once.

Q78 The compression ratio of a piston engine is defined as the ratio of:

A - the cylinder volume when the piston is at bottom dead centre to the total cylinder volume.

B - total cylinder volume to the volume remaining above the piston when it is at top dead centre.

C - cylinder volume with the piston at bottom dead centre (BDC) to cylinder volume with the piston at top dead centre (TDC).

D - total cylinder volume to the volume remaining below the piston when it is at top dead centre.

Q79 At sea level, the power developed by a four-stroke piston engine:

A - increases proportional to RPM to about 60% throttle setting, then decreases.

B - increases along with RPM.

C - increases proportional to RPM to about 60% throttle setting, then remains constant.

D - increases proportional to RPM to about 60% throttle setting, then increases.

Q80 In respect of a low wing aircraft, failure to close a fuel strainer drain valve prior to flight:

A - will cause a lean mixture to be produced by the carburettor.

B - may cause fuel starvation if the electric pump is not used.

C - may result in an inability to start the engine due to the formation of a vapour lock in the tank.

D - will cause over ventilation of the fuel tank and excessively rich mixture entering the combustion chamber.

Q113 Which of the following apply to a magnetic compass?

1 A magnetic heading is the sum of the compass heading and compass deviation.

2 A magnetic heading is the sum of the compass heading and local variation.

3 The aircraft rotates about the compass.

4 The magnet assembly is emersed in and supported by a low viscous fluid which decreases friction and dampens oscillations.

5 It doesn't suffer from either acceleration or turning errors.

6 The compass card summarises variation errors.

A - 1,2,4 and 6

B - 1,3,5 and 6

C - 1,2 and 4

D - 1,3,and 4

Q114 A DI or heading indicator is susceptible to apparent drift which is a function of:

A - rotor speed instability

B - internal friction

C - inherent rigidity in space.

D - Earth rotation about its own axis.

Q115 If an un-pressurised aircraft is fitted with an alternative static source that is within the cockpit, when compared to the outside static source the alternate static pressure will be:

A - less.

B - greater.

C - the same.

D - variable as it will be susceptible to temperature difference.

Q116 Tyre creep may be monitored by:

A - alignment marks painted on and across the tyre wall and wheel flange.

B - two diametrically opposed yellow arrows painted on the tyre side wall.

C - stretch marks on the tyre wall and possible tyre deflation.

D - position and condition of the inflation valve.

Q117 The operation of a mechanically steered nose wheel is normally accomplished by:

A - cables connected to the aileron control wheel.

B - the use of differential braking technique.

C - push-pull control rods and/ or cables operated by the rudder pedals.

D - a single hydraulic actuator and two way sequence valve.

Q118 Carbon monoxide gas is highly toxic. Should a leak occur in the exhaust/ air heat exchanger allowing carbon monoxide to enter the aircraft cabin:

A - it may be identified by its strong smell.

B - it may be identified because of its grey colour.

C - it cannot be detected because it is both odourless and colourless.

D - it can only be detected by acetate odour.

Q119 Toxic carbon monoxide fumes that may enter a cockpit in the event of a heat exchanger malfunction:

A - may be identified by their smoke-like appearance.

B - may be identified by their strong pungent smell.

C - are not easily detected by either smell or sight, as carbon monoxide is both odourless and colourless.

D - are easily detected as they make you hyper active in a confined space.

Q120 Water based fire extinguishers are most effective when extinguishing burning:

A - fossil fuels and oils.

B - electrical equipment and acids.

C - plastics and fibre glass based materials.

D - paper and furnishing fabrics.

Q121 The safest extinguishant to use on a wheel assembly fire is:

A - dry powder.

B - carbon dioxide (CO_2).

C - water based CTC.

D - ammonia based BCF.

Q122 The use of take-off flap will result in:

A - greater acceleration.

B - increased rate of climb to transition altitude.

C - increased angle of climb after rotation.

D - a shorter take-off run.

Q123 A BCF fire extinguisher that is used in an enclosed cockpit:

A - gives off highly toxic fumes and must never be used in an enclosed cockpit.

B - may not extinguish wood and fabric fires and may not be suitable for all aircraft.

C - is quite safe to use provided the cockpit is subsequently ventilated.

D - should only be used as a last resort.

Q124 If the appropriate manual or check list is not available to deal with an engine fire during flight, you should:

A - make a May Day call, slip the aircraft to keep the fumes away from the cabin, then attempt to put the fire out using the cabin fire extinguisher.

B - close the throttle, turn the fuel off and close the cabin air intake.

C - close the throttle, switch off the ignition, then set up for a forced landing.

D - try and keep the engine running to suck the fire into the induction manifold.

Q125 Take-off Safety Speed may be defined as a target air speed that provides a safe speed margin in excess of the stalling speed where the margin is never less than:

A - 43% of the stall speed.

B - 15% of the stall speed.

C - 20% of the stall speed.

D - 33% of the stall speed.

Q126 The recommended practice in respect of life jackets for flight in light aircraft over extensive areas of water is that they should be:

A - stowed under individual seats.

B - worn un-inflated.

C - worn inflated at all times.

D - worn only in the event of ditching as such garments can impede cockpit management.

Q127 If the direction indicator and artificial horizon appear to be functioning correctly but the vacuum gauge indicates zero, the most probable cause would be:

A - blockage to the filter on the inlet side of the engine driven vacuum pump.

B - failure of the vacuum gauge.

C - failure of the DC electrical supply from the instrument bus bar.

D - failure of the AC electrical supply from the instrument bus bar.

Q128 The type of gas that is stored in a small cylinder attached to a life jacket and used to inflate the life jackets is:

A - air.

B - helium.

C - carbon monoxide.

D - carbon dioxide.

Q129 A Certificate of Airworthiness (C of A) in any category:

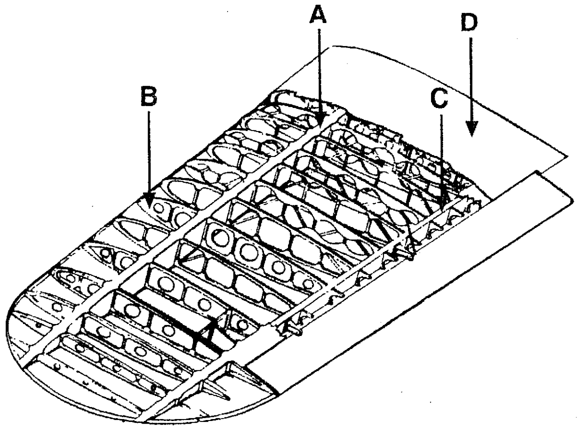
A - will only expire if the aircraft is removed from the British Register.

B - remains valid at all times if the aeroplane is continually maintained in accordance with the approved Schedule of Maintenance and British Civil Airworthiness Requirements (BCARs).

C - will only expire if the aircraft is modified or it is desired to change the C of A category.

D - expires on the date stated on the Certificate of Airworthiness document.

Q130 The **A**, **B**, and **C** component parts of the wing structure illustrated below are:



	A	B	C
A -	primary spar	framer	secondary spar
B -	primary spar	former	rear spar
C -	front spar	rib	rear spar
D -	main spar	rib	tertiary spar

Q131 A VSI is a rate instrument that senses....**X**.....pressure which it then converts to a rate of change of .....**Y**.... pressure, to indicate....**Z**.....speed.

	X	Y	Z
A -	static	pitot	vectorial
B -	pitot	pitot	vertical
C -	static	static	vertical
D -	pitot	static	vertical

Q132 An altimeter:

A - contains an aneroid capsule that contracts during a descent. Capsule movement is transmitted via a mechanical linkage to dials on the instrument face.

B - contains a barometric capsule that is connected to the static source. During a climb, capsule movement is transmitted via a mechanical linkage to dials on the instrument face.

C - contains a partially evacuated capsule connected to the aircraft static system. During a descent, the capsule expands and capsule movement is transmitted via a mechanical linkage to dials on the instrument face.

D - contains an open capsule, the surrounding chamber of which is connected to the aircraft static system. During a descent, the capsule expands and capsule movement is transmitted via a mechanical linkage to dials on the instrument face.

Q133 CAA flight manual supplements that specify additional operational restrictions:

A - may contain limitations not considered by the CAA at the time of granting a Board of Trade licence to build the aircraft.

B - only applicable during Certificate of Airworthiness flight testing.

C - must be observed even if in conflict with the manufacturer's manual.

D - only applicable if an elemental of The Certificate of Airworthiness.

Q134 Minor aircraft maintenance which a private pilot is legally permitted to carry out:

A - must be entered in a log book and certified by the pilot concerned.

B - is not required to be recorded.

C - must be entered in a log book and certified by a licensed engineer.

D - must not be entered in a log book or certified by the pilot unless that pilot is also a licenced engineer.

Q135 A control system which has undergone a minor adjustment legally requires a duplicate inspection. If this adjustment is made away from base then the second part of the inspection may be:

A - carried out only by a type licensed engineer.

B - carried out by an unlicensed engineer with a minimum of two years experience on the type.

C - carried out by a pilot qualified on category or type.

D - carried out by a pilot. qualified on the aircraft type who holds a commercial pilot's licence.

Q136 Aircraft maintenance carried out that does not concur with the maintenance schedule quoted in the Certificate of Airworthiness (C of A) will:

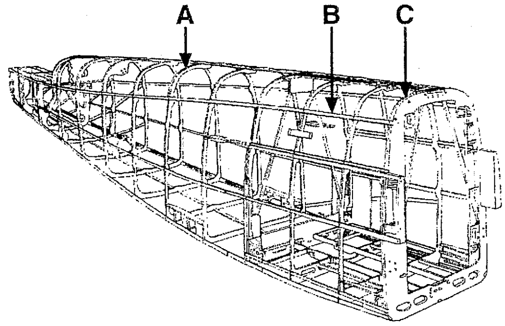
A - not affect the validity of the C of A.

B - *invalidate the C of A until the required maintenance is completed.*

C - require a C of A renewal after the required maintenance has been completed and before the aeroplane is flown again.

D - invalidate the previous Certificate of Release to Service as the maintenance schedule will not have been complied with.

Q137 Identify the fuselage components **A**,**B** and **C** illustrated below.



	A	B	C
A -	longeron	former	rib
B -	former	longeron	bulkhead
C -	former	stringer	framer
D -	stringer	bulkhead	rib

Q138 The function of a flying control stop is to:

A - inhibit excessive control surface movement and prevent damage during gusty conditions.

B - inhibit excessive deflection of the flying control surface by the pilot

C - constrain the control column to its design limits so as not to over stress the airframe during normal operations.

D - inhibit the control column during turbulent flight conditions..

Q139 Wheel spats that have become heavily contaminated with soil and grass:

A - are designed to be cleared by wheel rotation.

B - must be discarded before the next flight.

C - are designed with a specific volume that will not inhibit normal operations if contaminated.

D - must be removed, cleaned and freed of all contamination and re-fitted before the next flight.

Q140 Amongst other things, nose wheel shimmy could be caused by either insufficient pressure in the shimmy damper or:

A - too low a pressure in the nose wheel tyre.

B - failure of the torque link.

C - excessive tyre creep.

D - nose wheel tyre flat spots caused by excessive braking.

Q141 Pre-flight inspection of the landing gear includes tyre creep, oleo leaks and correct tyre inflation but should also include an awareness of:

A - tyre flat spots due to aqua planing or skidding and side wall condition.

B - matching tread patterns of main landing gear tyres.

C - wire locking of schreider inflation valve.

D - wheel freedom of rotation.

Q142 High cylinder head temperatures can be reduced in flight by:

A - increasing power and airspeed to augment the cooling airflow around the engine..

B - closing the cowl flaps which will increase the cooling airflow over the engine.

C - enriching the fuel/ air mixture to reduce combustion chamber temperature.

D - climbing into colder air thus augmenting the cooling airflow over the engine.

Q143 Baffles are fitted to the inside of engine cowlings to:

A - brace and stiffen the cowling, the skin which has large unsupported areas.

B - duct air overboard.

C - generally direct the cooling airflow uniformly around the cylinder heads.

D - control the amount of cooling airflow entering the engine nacelle.

Q144 What design feature increases the cooling efficiency of an air cooled piston engine?

A - incorporating fins into the individual cylinder heads.

B - an inverted engine because cooler air will subside to cool the cylinder heads.

C - cylinders arranged as a V which permits the air flow between the cylinders.

D - a square or short stroke format.

Q145 What should your immediate action be If during the cruise, you noticed excessive oil streaks over the engine cowl or any other engine oil system related problem?

A - Make a Pan call and land at the nearest available aerodrome.

B - Continue to your destination at reduced power provided the engine oil quantity indicated full before departure.

C - Land as soon as possible as the engine could fail due to oil loss.

D - Select a suitable site for a forced landing, make a Pan call to alert the emergency services and land.

Q146 In icing conditions, if a static vent became blocked during level flight, during a subsequent climb, how would **(i)** the ALTIMETER, **(ii)** the VSI and **(iii)** the ASI be affected.

Select the correct response.

	(i) ALTIMETER	**(ii)** VSI	**(iii)** ASI
A -	remain static	remain static	under read
B -	remain static	under read	over read
C -	under read	remain static	over read
D -	over read	under read	under read

Q147 All aircraft have prescribed positive and negative 'G' load limits which form part of the Certificate of Airworthiness. If it is suspected that the positive load factor has been exceeded if only for a short period and by a small amount:

A - no action is necessary as the maximum certificated loading limits are by design 20% below the value of structural failure.

B - the aircraft commander should carry out a walk round inspection on landing and if satisfied with the structural integrity of the aircraft, take no further action.

C - Action is only necessary if the cèrtificated loading limits are exceeded by 20%.

D - primary structural damage or failure could have occurred and the aircraft must not be flown again until inspected by a qualified engineer.

Q148 The most probable cause of vacuum driven gyroscopic instruments that are slow to respond to changes in aircraft attitude would be.

A - engine driven vacuum pump failure.

B - failure of the vacuum pressure relief valve causing excessive system vacuum pressure.

C - high friction in the gyro bearings.

D - a partial system leak or a partial blockage of the vacuum system air filter.

Q149 An aircraft piston engine designed with a dry sump lubricating system:

A - employs a scavenge pump that returns the oil from the sump to a storage tank.

B - employs a pressure pump that tops up the oil in the sump from the storage tank.

C - does not employ a storage tank.

D - is gravity fed from a storage tank.

Q150 In either a wet or dry sump piston engine, the oil pressure sensor is located:

A - on the inlet side off the scavenge pump.

B - on the outlet side of the pressure pump.

C - on the outlet side of the scavenge pump.

D - on the inlet side of the pressure pump.

Q151 During flight operations, it is noticed during a cruise check that the engine oil pressure is fluctuating and the oil temperature is rising. You should:

A - continue the flight to the planned destination at reduced power.

B - land as soon as is practically possible.

C - enrich the fuel/ air mixture to lower the cylinder head temperature.

D - declare an emergency, move the mixture control to idle cut-off and make a forced landing.

Q152 A wet sump engine:

A - stores all of the oil in a sump which usually forms part of the crank case.

B - employs a scavenge pump that returns some of the oil from the sump to a storage tank.

C - employs a small storage tank as it is a legal requirement for a reserve oil quantity to be carried.

D - scavenges all of the oil to the wet sump where it is filtered and pumped to the storage tank and re-circulated.

Q153 The definition of a monocoque structure is:

A - an integral stressed skin with no apertures and no supporting internal structure..

B - a stressed skin with structurally supported apertures.

C - a stressed skin containing a light internal structural framework.

D - an integral stressed skin with no apertures containing a light internal structural framework.

Q154 The definition of a semi-monocoque structure is:

A - an integral stressed skin with no apertures.

B - a stressed skin with supported apertures containing an internal structural framework.

C - a stressed skin with apertures.

D - an integral stressed skin with no apertures and a light internal supporting framework.

Q155 An aircraft certificated in the normal or utility category will have both positive and negative load factor limits that are .... an aircraft certificated in the aerobatic category.

A - the same as.

B - 15% greater than.

C - less than.

D - 20% greater than.

Q156 An object placed on the ground at rest exerts a force vertically downward on the ground by virtue of its own weight and remains stationary because a reaction equal to the down force acts:

A - vertically downward.

B - vertically upwards through the object.

C - radially outward from the centre of the object in the horizontal plane.

D - radially inward from the outside of the object in the vertical plane.

Q157 Aircraft engines are fitted with cowlings:

A - to protect persons in the vicinity of a live engine.

B - to contain damage in the event of an engine failure.

C - to ensure a smooth airflow meets the wing root leading edge at an optimal angle of attack.

D - to allow air to be ducted around the cylinder heads for cooling purposes and to reduce drag.

Q158 The static pressure in a carburettor venturi compared to the ambient pressure in the float chamber will be:

A - higher

B - the same.

C - higher or lower as it will be dependent upon the density of the fuel air mixture.

D - lower.

Q159 As altitude is increased, an adjustment has to made to the fuel/ air mixture because atmospheric:

A - density increases and the fuel/ air mixture is enriched.

B - density decreases and the fuel/ air mixture is enriched.

C - density decreases and the fuel/ air mixture becomes leaner.

D - density increases and the fuel/ air mixture becomes leaner.

Q160 The function of an accelerator pump fitted to a carburettor is to deliver sufficient fuel to the engine when the throttle is rapidly advanced. An accelerator pump is usually:

A - a plunger immersed in the float chamber and connected to the throttle via a mechanical linkage.

B - ancillary to the main fuel pump which opens via a valve connected to the throttle linkage and delivers neat fuel directly to the inlet manifold.

C - manually operated by the pilot to prevent a lean cut when rapidly advancing the throttle.

D - a plunger immersed in the float chamber and connected to the mixture control via a mechanical linkage.

Q161 With increased altitude, the fuel mixture entering the combustion chamber becomes ....(i)....... as air density ....(ii)........

Select one of the four responses below that will correctly complete the above sentence.

	(i)	(ii)
A -	enriched	reduces.
B -	enriched	increases.
C -	weaker	reduces.
D -	weaker	increases.

Q162 The function of an idling jet within a carburettor is:

A - to supply sufficient fuel to the engine to prevent a dead cut during inverted flight.

B - to compensate for air density changes as the aeroplane climbs and descends.

C - to stabilise the fuel air mixture at high power settings.

D - to meter a preset amount of fuel to maintain the engine running at a low RPM or idle.

Q163 An enriched mixture at high power settings is desirable because:

A - the air is denser at high power settings.

B - fuel is a cooling agent.

C - extra power can be generated particularly with prevailing high pressure systems and higher than normal air density.

D - insufficient fuel at high power settings could result in excessively hot lubricating oil being washed from the cylinder walls.

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AIRCRAFT GENERAL (AEROPLANES)
PRACTICE ANSWER SHEET

	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

	A	B	C	D
21				
22				
23				
24				
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27				
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30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				

	A	B	C	D
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				

	A	B	C	D
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62				
63				
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66				
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72				
73				
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75				
76				
77				
78				
79				
80				

AIRCRAFT GENERAL (AEROPLANES)
PRACTICE ANSWER SHEET

	A	B	C	D
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
100				

	A	B	C	D
101				
102				
103				
104				
105				
106				
107				
108				
109				
110				
111				
112				
113				
114				
115				
116				
117				
118				
119				
120				
121				

	A	B	C	D
122				
123				
124				
125				
126				
127				
128				
129				
130				
131				
132				
133				
134				
135				
136				
137				
138				
139				
140				
141				
142				

	A	B	C	D
143				
144				
145				
146				
147				
148				
149				
150				
151				
152				
153				
154				
155				
156				
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159				
160				
161				
162				
163				

AIRCRAFT GENERAL (AEROPLANES)
ANSWER SHEET

	A	B	C	D
1		X		
2				X
3			X	
4		X		
5		X		
6				X
7			X	
8			X	
9		X		
10				X
11		X		
12	X			
13		X		
14	X			
15	X			
16		X		
17				X
18	X			
19			X	
20				X

	A	B	C	D
21		X		
22			X	
23	X			
24	X			
25				X
26	X			
27		X		
28	X			
29	X			
30			X	
31				X
32			X	
33		X		
34				X
35	X			
36		X		
37				X
38		X		
39		X		
40			X	

	A	B	C	D
41				X
42	X			
43		X		
44		X		
45			X	
46			X	
47				X
48				X
49		X		
50				X
51			X	
52	X			
53		X		
54			X	
55			X	
56	X			
57	X			
58				X
59		X		
60			X	

	A	B	C	D
61			X	
62				X
63	X			
64			X	
65		X		
66				X
67	X			
68	X			
69				X
70			X	
71				X
72	X			
73			X	
74	X			
75	X			
76				X
77		X		
78			X	
79		X		
80		X		

AIRCRAFT GENERAL (AEROPLANES)
ANSWER SHEET

	A	B	C	D
81				X
82				X
83		X		
84			X	
85			X	
86	X			
87			X	
88				X
89	X			
90	X			
91		X		
92		X		
93		X		
94				X
95				X
96				X
97			X	
98	X			
99			X	
100		X		

	A	B	C	D
101	X			
102	X			
103		X		
104	X			
105			X	
106				X
107		X		
108		X		
109			X	
110			X	
111			X	
112				X
113				X
114				X
115	X			
116	X			
117			X	
118			X	
119			X	
120				X
121	X			

	A	B	C	D
122				X
123			X	
124		X		
125			X	
126		X		
127		X		
128				X
129				X
130			X	
131			X	
132	X			
133			X	
134	X			
135			X	
136		X		
137		X		
138		X		
139				X
140		X		
141	X			
142			X	

	A	B	C	D
143			X	
144	X			
145			X	
146	X			
147				X
148				X
149	X			
150		X		
151		X		
152	X			
153	X			
154		X		
155			X	
156		X		
157				X
158				X
159		X		
160	X			
161	X			
162				X
163		X		

TEC1(B)

See fig T1

The ISA Lapse Rate of 1.98°C/1000ft is an arbitrary standard rounded up to 2°C/1000ft for the practical purpose of calculating the temperature aloft, or determining how the actual temperature aloft differs from ISA.

ISA at 11000ft	=	+15°C – (2°C x 11)
ISA at 11000ft	=	+15°C – 22°C = –7°C
OAT at 11000ft	=	–5°C which is 2°C warmer than ISA
OAT at 11000ft	=	ISA + 2°C.

TEC2(D)

The International Standard Atmosphere (ISA) is an arbitrary standard established to provide universal values of temperature, pressure, density, and lapse rate at all altitudes for the purpose of measuring aircraft performance and calibrating aircraft instruments whose sources are barometric. See fig T1.

ISA mean sea level values are:

Pressure: 1013.25hPa.

Density: 1225 grammes per cubic metre.

Temperature: +15°C.

Lapse Rate: temperature reducing with altitude at a rate of 1.98°C per 1000 feet to –56.5°C at 36090ft (Tropopause) above which it remains constant.

TEC4(B)

See TEC2, lapse rate.

TEC5(B)

Atmospheric density is proportional to ambient pressure and inversely proportional to temperature. See TEC3.

TEC6(D)

The constituents of the Earth's atmosphere for dry air are:

- Oxygen approximately 21%
- Nitrogen approximately 78%
- Other gases approximately 1%

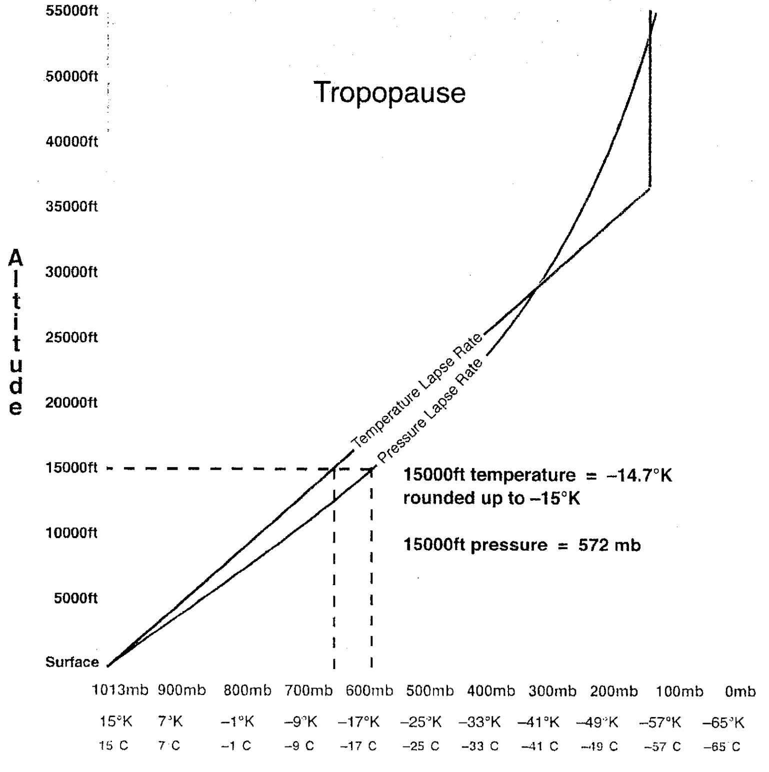
Approximately 4 parts nitrogen to 1 of oxygen.

The air in most regions of the world contains some water vapour (which is a gas), which can vary from as much as 5% in warm tropical regions to almost none in very cold polar regions.

TEC7(C)

With altitude increase, the amount of all constituent gases decreases as pressure decreases but proportionally, the amounts relative to one another remain constant.

The reduced partial pressure of oxygen at altitude makes its absorption into the blood stream more difficult.



Surface to 15000ft % temperature reduction =

$$\left(\frac{+15°K \; - \; -15°K}{273°K}\right) \times \frac{100}{1}$$

$$= \left(\frac{30}{273}\right) \times \frac{100}{1} = 10.41\%$$

Surface to 15000ft % pressure reduction =

$$\left(\frac{1013mb \; - \; 572mb}{1013mb}\right) \times \frac{100}{1}$$

$$= \left(\frac{441}{1013}\right) \times \frac{100}{1} = 43.53\%$$

fig T1

TEC3(C)

Temperature, humidity, and ambient pressure are physically interrelated to affect density and subsequently aircraft performance.

The amount of lift generated, engine power and propeller thrust developed, all depend on air density. The greater the density the greater the values of lift, power and thrust.

(i) Ambient pressure is proportional to density.

(ii) Temperature is inversely proportional to density.

(iii) Humidity is inversely proportional to density as water vapour (which is a gas) is lighter than air.

TEC8(C)

If the ambient pressure of a parcel of air is reduced, density will reduce proportionally. Looking at it another way, if air expands to occupy a greater volume (which reduces its pressure), then its density will reduce. In such circumstances, the maintenance of temperature and humidity levels will not have a dominant affect on air density. See TEC3.

TEC9(B)

See TEC6.

TEC10(D)

Water vapour is lighter (less dense) than air, so a parcel of air containing the maximum amount of water vapour will itself be lighter (less dense) than dry air at the same temperature and pressure.

TEC11(B)

Pressure is directly proportional to density. If atmospheric pressure is reduced, density will decrease. See TEC5 and TEC8.

TEC12(A)

If the volume remains constant, more air must be added to that volume for pressure to increase, so density will also increase. See TEC15.

TEC13(B)

Temperature, humidity, and ambient pressure are physically interrelated to affect density.

(i) Ambient pressure is proportional to density.

(ii) Temperature is inversely proportional to density.

(iii) Pressure is proportional to temperature.

(iv) Humidity is inversely proportional to density as water vapour (which is a gas) is lighter than air.

The only way pressure can be increased is to:

1 - add more air (increase the mass) whilst the volume is maintained constant or

2 - reduce the volume of the given mass.

In both instances density must be increased.

TEC14(A)

Relative humidity is the amount of water vapour contained by a parcel of air at a given temperature compared with the maximum amount of water vapour that parcel of air could hold at the same temperature. Relative humidity is expressed as a percentage.

$$\frac{\text{Water vapour content at a given temperature}}{\text{maximum water vapour content at the same temperature}} \times \frac{100}{1} = \%$$

TEC15(A)

An egg is a perfect example of a monocoque structure having no internal structure where all imposed stress is distributed by the shell.

Aircraft designers in pursuit of minimising structural weight and improving performance aim to design airframes where the stressed metal skin carries the majority of self weight and imposed aerodynamic loads.

Unfortunately, most skin materials are incapable on their own of carrying the loads imposed during flight and require some form of internal structure. Also, apertures for maintenance access and for persons to enter and leave the aircraft are required. These have to be reinforced to maintain the structural integrity of the stressed skin but with all of the aeroplane doors closed and access panels fitted, an aeroplane alludes to a monocoque structure. Such design is referred to as semi-monocoque.

TEC16(B)

The Relationships between Temperature, Pressure, and Density. See fig T1.

At the surface, a parcel of air when heated from below initially acts like a bubble attached to the surface so analogy with a hot air balloon is useful. When heat is applied to inside the canopy, both air temperature and pressure are increased so the canopy expands but density reduces due to expansion. Expansion occurs because pressure inside the balloon seeks to equalise with that of its surrounding environment so in reality when heat is added, pressure remains constant and appears not to affect density.

A **temperature increase** corresponds to a **density decrease** so temperature appears to have the dominant affect on density when heat is added. To summarise:

At the surface: temperature increase - density decrease - pressure constant - volume increase.

Above the surface. When density is sufficiently reduced at the surface, our expanded balloon or parcel of heated air will detach and rise above the surface. At this point, heat is no longer added and any temperature modification is purely adiabatic under the influence of expansion due to reducing atmospheric pressure. As the balloon rises it will continually expand as canopy pressure seeks to equalise with its falling environment pressure. Because of expansion, temperature, pressure and density inside the canopy all decrease producing an apparent reversal in the relationship between temperature and density occurring at the surface. A temperature decrease now corresponds to a density decrease so the affect on our three atmospheric parameters due to adiabatic cooling may be summarised as:

Above the surface: temperature decrease - density decrease - Pressure decrease - volume increase.

At the surface, heat is added producing a temperature increase, together with expansion and density decrease. This correctly defines the inverse relationship between temperature and density. However, this relationship above the surface is masked by the dominant affect of pressure on density where a pressure reduction acts in the opposite sense to decrease density.

With increased altitude, pressure reduces at a much greater rate than temperature as may be seen in fig T1. The Kelvin temperature scale is used which is the same as the Celsius scale except the Kelvin scale datum (-273°K or absolute zero) is the coldest temperature a substance can potentially be reduced to.

Given a surface temperature of +15°K, the temperature range considered must be from +15°K to −273°K = −288°K. The pressure range is from 1013hPa down to 0hPa. From the surface to 15000ft the temperature and pressure lapse rates are almost linear but the temperature reduction of 30°K equates to a temperature reduction of only 10.41%.

The pressure fall from 1013hPa to 572hPa = 441hPa equates to a percentage reduction of 41.53%. which is approximately 4 times greater than that of temperature. Hence the dominant effect of pressure on the value of density.

Pressure is proportional to Temperature

Pressure is proportional to Density

Temperature is inversely proportional to Density

TEC17(D)

The angle of attack at which the laminar flow over the wing is severely disrupted always occurs at the same angle of attack.

At the stall, the centre of pressure moves rapidly towards the wing trailing edge. This, together with weight or the Centre of Gravity being forward of the centre pressure will create a large C of G to C of P moment causing the nose to pitch down. The aeroplane will sink because weight will be greater than lift.

TEC18(A)

Refer to fig T2 X & Y.

Air does not flow over an aerofoil, an aerofoil divides the air as it passes though it creating different paths above and below. In fig T2 **X**, the aerofoil is illustrated at a 4° angle of attack, about normal for level flight. Because the linear distance **A-B** above the aerofoil, is greater than that below, the air above has to travel faster to meet the air below at **B**.

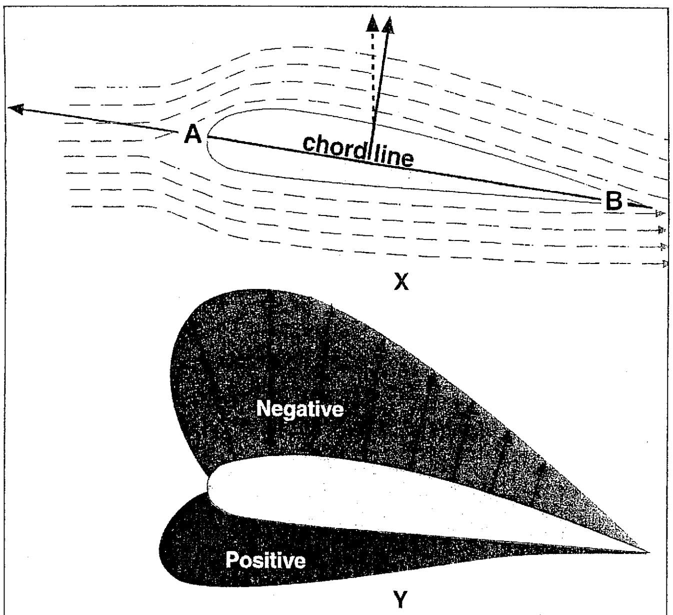


fig T2

Given that pressure is inversely proportional to velocity, the static pressure of the faster moving air above the aerofoil is markedly decreased whilst below, there is a relatively small increase due to downward deflection. See aerofoil **Y**.

The resultant is a reaction acting upwards at 90° to the chord line, its vertical component being that element of lift which opposes weight.

TEC19(C)

See fig T3

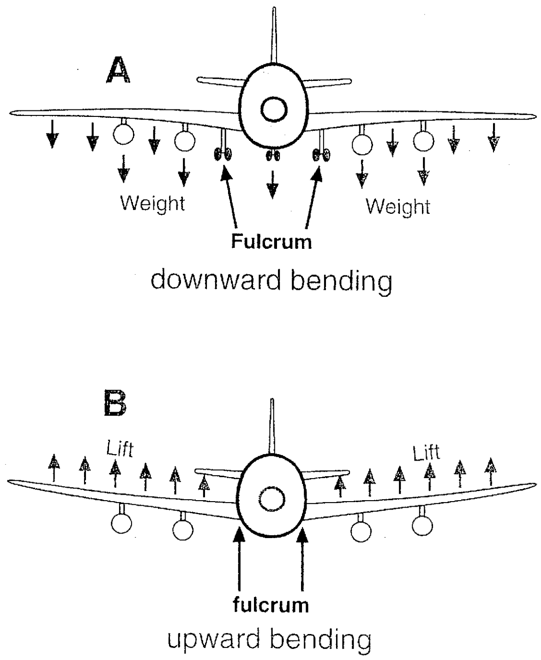


fig T3

Wing spars extend from the wing tip to the fuselage and during flight, wings generate the largest percentage of lift that opposes the aeroplane's self weight. When the aircraft is on the ground, its weight is supported by the landing gear. Each landing gear below a wing acts as a fulcrum, either side of which, the self weight of the wing produces a downward bending moment. See fig T3 '**A**'. In flight, the aircraft's self weight is supported by lift generated by the wings but now in the illustrated example, the wing root attachment to the fuselage becomes the fulcrum and lift produces an upward bending moment. See fig T3 '**B**'. Imprtant to note is that there are many types of wing designs and landing gear installations which affect fulcrum position but the principle of opposing weight and lift forces producing opposing bending moments holds good.

TEC20(D)

See fig T4.

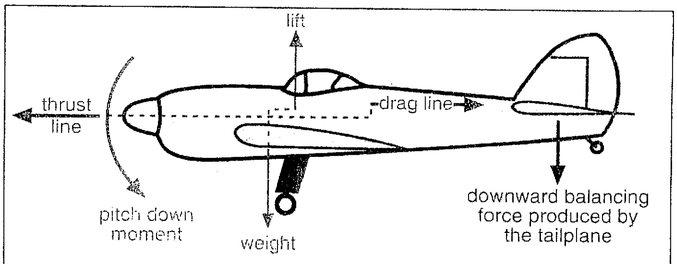


fig T4

For an aeroplane in flight to be in equilibrium, the opposing forces acting upon the aeroplane (lift-weight and thrust-drag) must be equal and opposite.

Any pitching moment resulting from the combined effect of the two couples is balanced by the tailplane.

Thrust: the forward reaction to air being accelerated backwards by a propeller.

Drag: the resistance to forward motion directly opposed to thrust.

Weight: the downward force due to gravity.

Lift: an upward force being the vertical component of lift generated by the wings that opposes weight.

The aircraft must neither climb nor descend and must maintain a constant airspeed. Therefore:

lift	=	weight
thrust	=	drag.

TEC21(B)

A coefficient of lift is the product of aerofoil design and angle of attack and is elemental to Bernoulli's theorem:

L	=	$C_L \frac{1}{2} \rho V^2 S$
L	=	**Lift**
C_L	=	**Coefficient of Lift, which is the product of aerofoil design and angle of attack**
ρ	=	**Air density**
V	=	**TAS**
S	=	**Wing area**

From the above formula, if **C_L** on the right hand side of the formula is increased, **Lift L** will also be increased.

C_L will continue to increase as angle of attack is increased up the the point of stall, at which, lift is severely disrupted.

TEC22(C)

See fig T5.

Angle of incidence is the angle subtended by the wing chord and the aircraft longitudinal axis.

Angle of attack is the angle subtended by the wing chord and the relative airflow.

Washout is the reduction of angle of incidence and consequently the angle of attack from the wing root towards the wing tip..

It is desirable that a wing stall is progressive, making the stall less violent and more manageable for the pilot.

An aerofoil (wing) always stalls at the same angle of attack, therefore if the angle of incidence is reduced from wing root to wing tip, the stall will be progressive with the wing root stalling first.

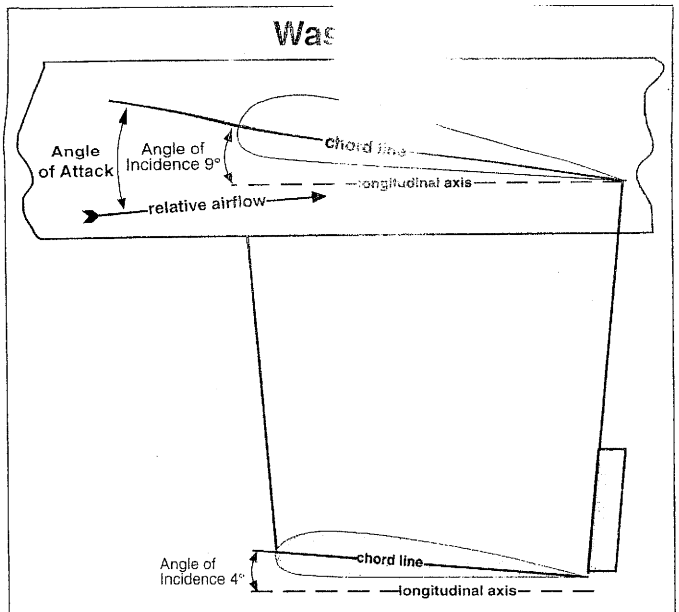


fig T05

As the ailerons control the aeroplane laterally about the longitudinal axis, they are placed towards the outboard section of the wing for maximum effect.

When a wing approaches the stall, aileron effectiveness and lateral control although greatly reduced can be maintained after the wing root has begun to stall. However, the use of aileron at the incipient stage of a stall could induce yaw and incipient spin.

TEC23(A)

See fig T6

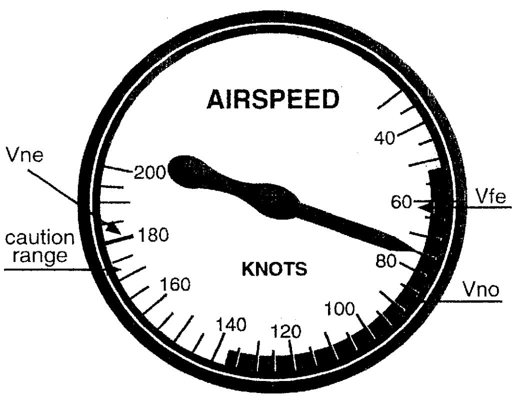


fig T6

Green is the standard aviation colour for a normal or safe operating range. In this case, green defines the indicated airspeed range for normal operation (Vno).

The yellow arc defining the caution range is from the top end of Vno to the red line denoting *velocity never exceed* (Vne).

The white arc denotes the *flap operating range* (Vfe) which is from the stall speed with full flap and the aircraft in the landing configuration up to the maximum speed with full flap extended.

TEC24(A)

Gyro rigidity is a function of:

(a) the gyro mass (weight)

(b) the radial position of its C of G from its spin axis.

(c) rotational velocity

Rigidity in space is a term that describes a gyro's ability to maintain its spin axis attitude irrespective of what goes on around it.

The greater the mass, the greater the inertia and rigidity.

The further the C of G is displaced radially from the spin axis, the greater the centrifugal force, inertia and rigidity.

The higher the rotational velocity the greater the inertia, centrifugal force and rigidity.

TEC25(D)

Renders the C of A invalid until such time as the prescribed maintenance is carried out and the aircraft is released to service.

TEC26(A)

Any ferrous object brought on board and placed in close proximity to the magnetic compass will concentrate the Earths magnetic field away from the magnetic compass. This will cause the magnetic compass to deviate from its alignment with magnetic north. The amount of deviation will depend upon the mass of the ferrous item and its proximity to the magnetic compass.

TEC27(B)

Wake turblulence is the product of induced drag and is greatest when generated by an aircraft at its maximum all up weight, flying at its slowest airspeed. This occurs at the point of rotation on take-off. Therefore, land well before the point of rotation of a large aircraft that has just departed from the same runway.

TEC28(A)

The over stressing of an aircraft during flight may not be immediately apparent from a walk round inspection. The stressing of rivets together with distortion or cracking of internal structure must be suspected and therefore the aeroplane must be inspected by a qualified engineer.

TEC29(A)

If weight is increased, the lift must increase proportionately to maintain the aeroplane airborne.

Given that an aerofoil will always stall at the same angle of attack and the lift generated is proportional to airspeed, (see TEC21 and TEC31 Bernoulli's Theorem) for a given angle of attack the airspeed must be increased to produce more lift to balance the increased aeroplane weight. Consequently, the speed at which the aeroplane stalls will be greater.

TEC30(C)

L	=	$C_L \frac{1}{2} \rho V^2 S$
L	=	**Lift**
C_L	=	**Coefficient of Lift, which is the product of aerofoil design and angle of attack**
ρ	=	**Air density**
V	=	**TAS**
S	=	**Wing area**

From the above formula (Bernoulli's Theorem), if **V** (TAS) on the right hand side of the formula is increased, the lift **L** on the left will also be increased.

The formula for DRAG is almost the same as that for LIFT. The difference being **D** and C_D.

D	=	$C_D \frac{1}{2} \rho V^2 S$
D	=	**Drag**
C_D	=	**Coefficient of Drag which is the product of aerofoil design and angle of attack**
ρ	=	**Air density**
V	=	**TAS**
S	=	**Wing area**

Therefore both Lift and Drag will increase as **V** (TAS) is increased.

TEC31(D)

Temperature activated

If an engine is operating at or below its normal operating temperature, the temperature actuated bye pass valve (vernier therm) will open, allowing oil to bye pass the oil cooler and achieve its normal temperature operating range. If the normal operating range is exceeded, for example during high ambient temperatures or during a prolonged climb, the valve will close allowing oil to route through the oil cooler.

TEC32(C)

See fig T7.

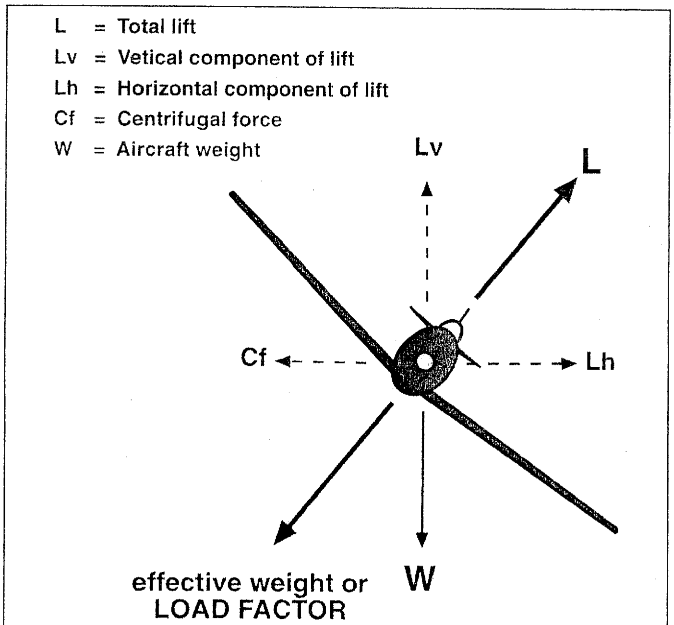


fig T7

In straight and level flight, the aeroplane's effective weight or **LOAD FACTOR** (**G**) is its own weight which = **1G**.

Represented vectorially, the **LOAD FACTOR** is the product of the aircraft weight (**W**) and centrifugal force (**Cf**) produced by the turn which acts outward. The total lift generated (**L**) acts at 90° to the aircraft lateral axes and is equal to **W** in straight and level flight. When banked, the wing produces both horizontal and vertical components of total lift being '**Lv**' and '**Lh**'.

The vertical component of lift (**Lv**) must be equal and oppose to '**W**' and the horizontal component of lift (**Lh**) must be equal and opposite to '**Cf**' to maintain a level balanced turn.

Any increase in angle of bank will cause the value of vector '**Lv**' to become smaller and the aeroplane to sink, so '**L**' must be increased to maintain the value of '**Lv**'.

'**L**' is increased by increasing the angle of attack which will increase drag causing the airspeed to decay unless power is increased. However, power is finite.

The additional total lift '**L**' required for a given bank angle is equal and opposite to that element of **LOAD FACTOR** that is greater than 1G.

Any load factor greater than 1G is effectively the same as increasing the aircraft weight.

In straight and level flight, any increase in aircraft weight will cause the stall speed to increase because an aerofoil always stalls at the same angle of attack. See TEC 27.

Any angle of bank will cause an increase in the aeroplane's effective weight, so, for any given angle of bank, the stall speed must increase proportionately.

For a given airspeed, the steeper the angle of bank:

(i) the greater the rate of turn.

(ii) the less the radius of turn.

(iii) the greater the load factor.

(iv) the greater the stalling speed.

The **LOAD FACTOR** is proportional to the bank angle = 60°.

Load Factor = Secant of the angle of bank

$$\text{Load Factor} = \frac{1}{\text{cosine } 60^\circ} = \frac{1}{0.5} = 2$$

Straight and level stall speed = 60kt

Stall speed in a 60° banked turn: =
square root of the Load Factor x normal stall speed.

$$= \sqrt{2} \times 80\text{kt} = 1.4 \times 80\text{kt}$$

$$= \mathbf{112kt}$$

TEC33(B)

See fig T8.

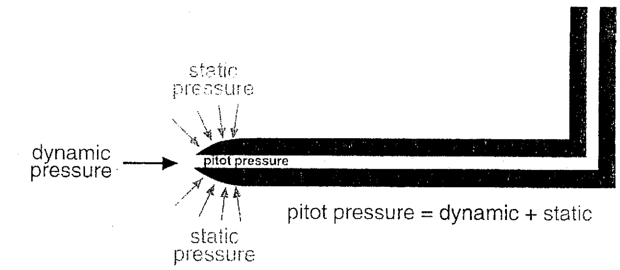


fig T8

Dynamic pressure is the product of aircraft forward motion but static pressure is omnipotent. Pitot pressure, also known as total pressure sensed by the pitot tube is the sum of dynamic + static pressures.

TEC34(D)

A wing will always stall at the same angle of attack but the stall speed will vary proportionately with aircraft weight.

TEC35(A)

See fig T9.

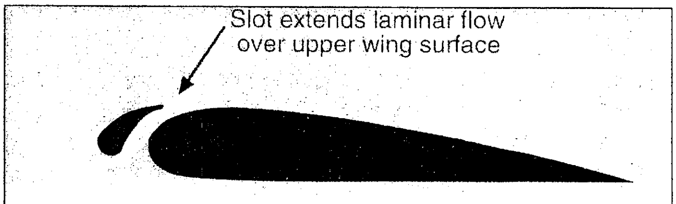


fig T9

Slots are passageways built into the wing a short distance aft of the leading edge. Their construction is such that at high angles of attack, air flows through the slot from the higher pressure area under the wing to the lower pressure area above.

The higher pressure air re-energises the low pressure air flowing over the upper surface, which maintains the laminar flow by smoothing out the turbulent eddies that result in a loss of lift and increased drag. A consequence is that the stalling angle of attack is increased.

TEC36(B)

See fig T7 and TEC30.

The forces in a turn diagram illustrated in the question is better understood if an aeroplane is superimposed. The total lift generated **B** is represented vectorially by components **A** and **C**, where **B** acts at 90° to the wing's lateral axis.

A is that component of lift opposing aircraft weight **W** and vec-

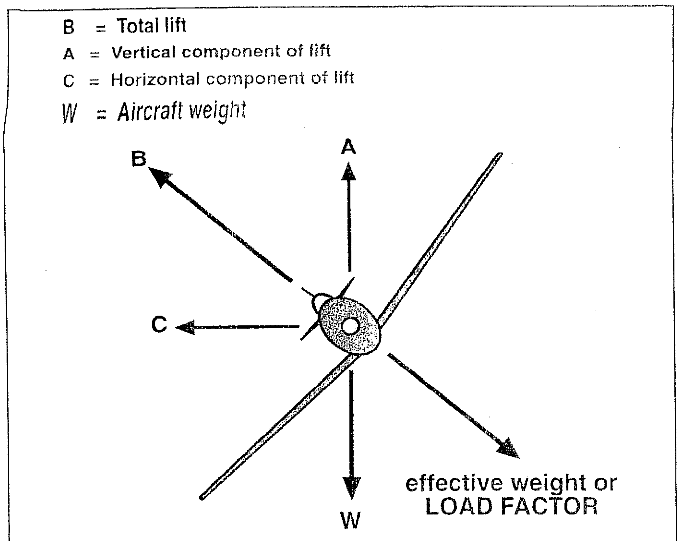


fig T10

tor **C** acts inward towards the centre of the turn opposing centrifugal force. The total lift **B** is equal and opposite to the **Load Factor** both of which are proportional to the angle of bank.

TEC37(D)

See fig T11.

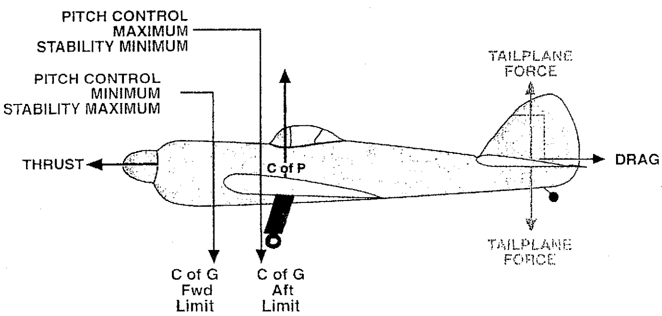


fig T11

If the C of G is aft of its design limit, the distance between the C of G and C of P will be reduced, producing a smaller lift/ weight couple and tendency towards a pitch attitude change because of reduced longitudinal stability.

Although this may be corrected by elevator movement, which becomes more sensitive as the moment arm is reduced, the aeroplane's longitudinal stability will be seriously impaired, causing a significant decrease in its ability to right itself after, for instance, a gust disturbance. In some situations, the aeroplane may be uncontrollable.

During the landing, the physical effort required to flare the aircraft will be greatly reduced with the possibility of over flaring, and stalling onto the runway.

TEC38(B)

Parasite drag may be divided into two components:

(i) **Form drag**, which is created by the form or shape of the airframe.

(ii) **Skin friction**, which refers to the tendency of air flowing over the aeroplane to cling to its surface.

Parasite drag is proportional to airspeed so it increases as airspeed increases.

Induced drag is a product of the lift generated by the wing so it is proportional to the angle of attack.

An aeroplane will produce the maximum amount of induced drag when at its heaviest, requiring the greatest amount of aerodynamic lift to be generated. This would occur at the point of rotation on take-off when flying at the slowest safe speed with a large angle of attack in the take-off configuration.

As airspeed increases, the angle of attack required to generate the same amount of lift will decrease:

$$L = C_L \tfrac{1}{2} \rho V^2 S$$

If airspeed (**V**) is increased, the angle of attack C_L must decrease to maintain the same amount of lift. Reducing the angle of attack will decrease induced drag.

As TAS increases, parasite drag will increase and induced drag decrease.

TEC39(B)

See TEC38.

TEC40(C)

An aileron fixed trim tab is adjusted on the ground by an engineer following a flight test to achieve a level attitude in the cruise configuration with ailerons neutral.

Elevators and rudder may also be fitted with a fixed trim tab on some aircrfat types.

TEC41(D)

See fig T12.

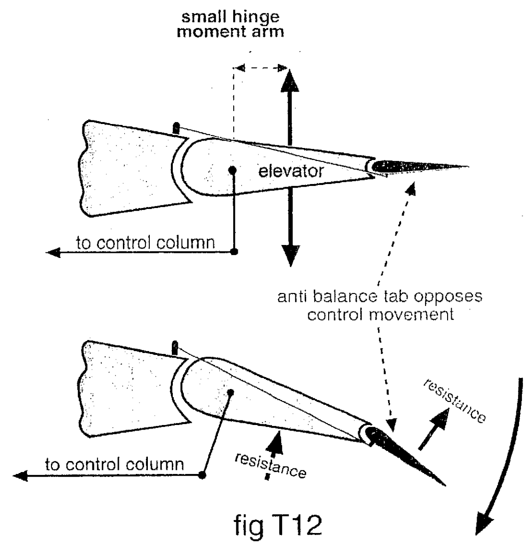


fig T12

Some control surfaces have small hinge moments resulting in low aerodynamic loads on the control column that could result in over-controlling the aeroplane that, in turn, could over stress the airframe.

The incorporation of an anti-balance tab that moves in the same sense as the main control surface will increase the load on the pilot's control the further that control surface is deflected. The angle of attack of the anti-balance tab increases at a greater rate than the main control surface so control loading is not linear.

TEC42(A)

A trim tab is an adjustable device located at the trailing edge of a control surface such as elevators.

Its function is to permit the pilot to operate the aeroplane at a desired attitude at various airspeeds and conditions without having to maintain a physical (hands on) pressure in any particular direction on the flying control.

Once set, the simple trim tab will always maintain the same position relative to the main control surface, irrespective of how much that main control surface is deflected by the pilot when manoeuvring the aircraft.

TEC43(B)

See fig T13

L = Total lift
Lv = Vetical component of lift
Lh = Horizontal component of lift
Cf = Centrifugal force
W = Aircraft weight

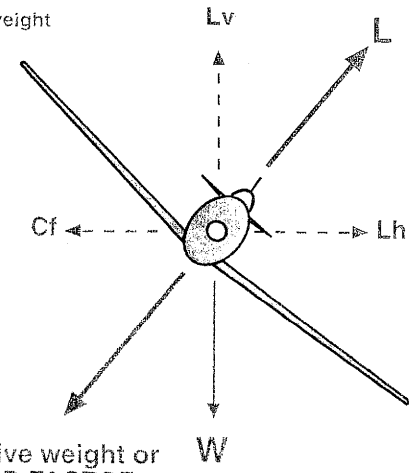


fig T13

Stall speed is a function of the **LOAD FACTOR.** Another way of understanding load factor is to appreciate that, when the total lift (**L**) required to be generated by the wings is equal to the aeroplane's weight, then the **LOAD FACTOR equals 1**.

When an aeroplane is banked, **L** no longer acts vertically upward to oppose weight **W**. To maintain altitude, the total lift **L** must be increased to a point where its vertical component **Lv** is equal and opposite to **W**. This is achieved by increasing the angle of attack. Because **L** in a turn is greater than **W**, the **LOAD FACTOR will be greater than 1** and the **LOAD FACTOR** may be expressed as a fraction by dividing **L** by **W**.

When increasing the angle of attack in a turn to maintain altitude, drag is increased. To maintain airspeed and prevent loss of altitude, power (thrust) must be increased to balance drag.

Because an aircraft always stalls at the same angle of attack, the stall speed in the turn will be increased proportional to both the angle of bank and load factor.

The mathematical relationship between the stall speed and load factor may be demonstrated by example where the straight and level stall speed = 60kt.

Angle of Bank in the turn = 60°

Load Factor = Secant of the angle of bank

$$\text{Load Factor} = \frac{1}{\text{cosine } 60°} = \frac{1}{0.5} = 2$$

Straight and level stall speed = 60kt

Stall speed in a 60° banked turn: =

square root of the Load Factor x normal stall speed

$= \sqrt{2}$ x 60kt = 1.4 x 60kt

= **84kt**

TEC44(B)

See fig T14.

In respect of an aerofoil, an angle of attack is that subtended by the aerofoil chord and the relative airflow.

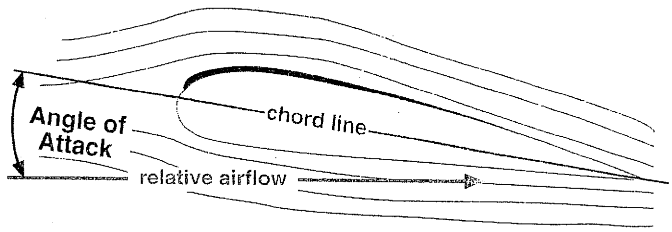


fig T14

TEC45(C)

See fig T15.

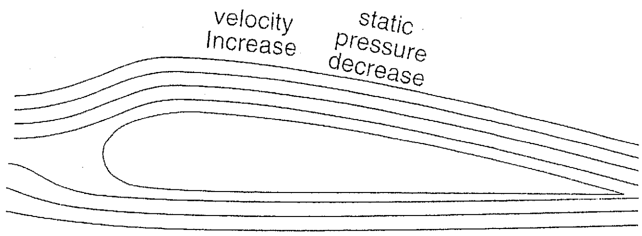


fig T15

Just before the free airf meets the wing leading edge, it separates to pass over and under the wing.

The aerofoil design is such that the effective distance over the upper wing from leading edge to trailing edge is greater than the distance under the wing. As the wing is travelling through and separating the air, just as a ship passes through water, the airflow over the upper wing surface will have to travel faster to meet the airflow under the wing at the trailing edge.

Because pressure is inversely proportional to velocity, the velocity increase over the upper wing surface results in a pressure reduction. Consequently, the static pressure over the wing will be lower than that of the undisturbed free airflow.

TEC46(C)

See fig T16

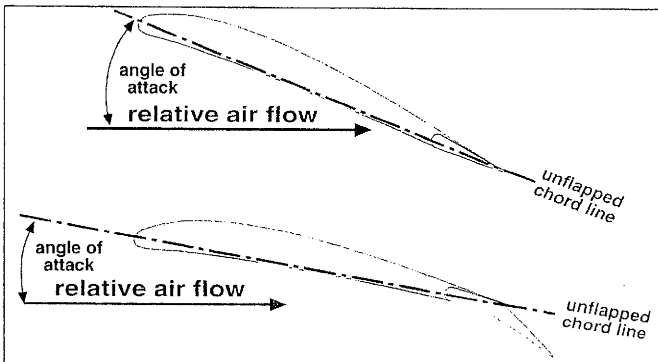


fig T16

The angle of attack is the angle subtended between the chord line and relative air flow.

The chord line is a straight line between an aerofoil's leading and trailing edge which may include flap when extended.

Because flap does not generally span an entire wing, the chord line used to measure angle of attack for all configurations is that for a clean wing. With flap extended, lift is increased so the original lift may be restored by pitching nose down which in turn reduces the angle of attack. When referred to the unflapped chord line, the angle of attack at which the flapped wing stalls will be less than that for a clean wing.

TEC47(D)

The FIN.

See fig T17.

TEC48(D)

Yawi.

See TEC47 and fig T17.

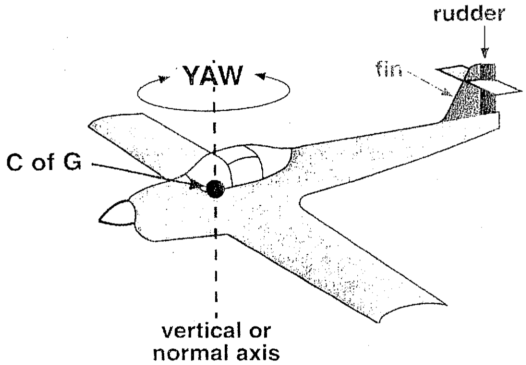


fig T17

TEC49(B)

See fig T18.

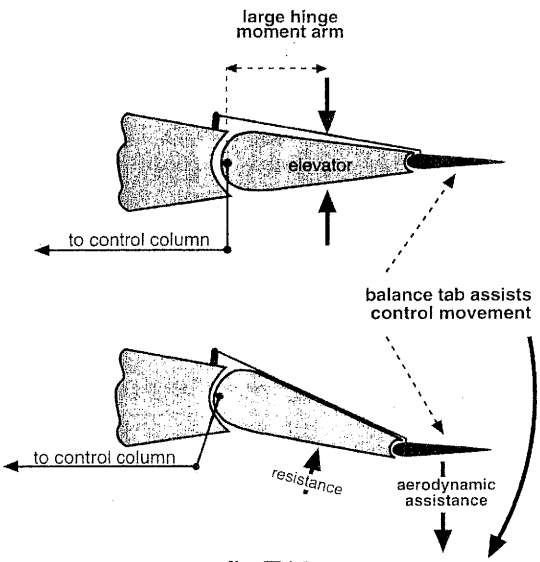


fig T18

Some control surfaces have large hinge moments resulting in high aerodynamic loads on the control column that could result in excess physical effort being required by the pilot to move the control surface.

The incorporation of a balance tab that moves in the opposite sense to the main control surface will decrease the load on the pilot's control.

In the case of a rudder, forward movement of the rudder bar to the left, to yaw the aircraft to the left, will move the rudder itself to the left and the balance tab to the right.

TEC50(D)

See fig T19.

Mass Balance

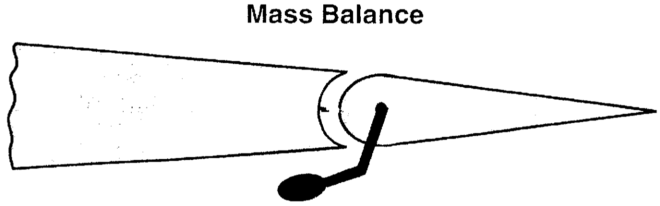


fig T19

Control surfaces are sometimes balanced by fitting a mass (usually lead) of a streamlined shape forward of the control surface hinge. This is known as mass balancing, incorporated to prevent control surface flutter due to buffeting which may occur at high speeds. The mass balance may be fitted internally forward of the hinge line or externally similar to that in fig T19.

TEC51(C)

See TEC50 fig T19.

TEC52(A)

See fig T20.

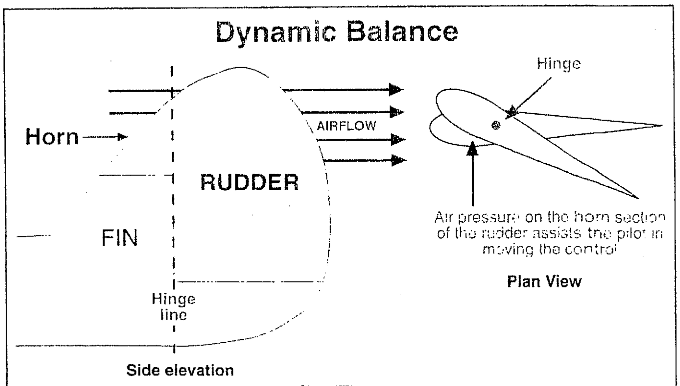


fig T20

Control surfaces are often aerodynamically balanced to provide a force that will aid their movement, thus reducing the physical effort that would otherwise have to be made by the pilot. By placing a section of the control surface forward of the hinge line, any airflow striking this section will assist in moving the control surface in the desired direction.

An example is the horn balance illustrated in fig T19 which may be a feature of the rudder, elevator or aileron.

TEC53(B)

The relatively slower airflow under the wing is more dense (ρ) than the faster moving airflow over the wing, so the down-going aileron moving into the denser air, generates more drag than the up-going aileron.

Drag = $C_D \frac{1}{2} \rho V^2 S$. In addition, the up-going aileron is moving into a more streamlined position than the down-going aileron.

The result is asymmetric drag known as 'adverse aileron drag', which produces a yawing moment that acts in the opposite sense to the bank angle.

To counteract adverse drag, the up-going aileron may be designed to deflect further into the airflow than the down-going aileron. Such a design feature is termed 'differential aileron'.

TEC54(C)

See fig T21.

When the rudder is deflected, the primary effect is yaw about the vertical axis '**1**', causing the fuselage to be turned into wind. If for instance, the yaw was to the left, the left wing would be partially shielded from the airflow by the fuselage.

This would have a secondary effect of the left wing producing less lift than the right wing and a roll to the left would ensue '**2**'. If not corrected, a spiral dive would develop.

When aileron is used to roll on bank, the total lift (**L**) no longer acts vertically upwards to oppose weight . Lift may now be seen vectorially to have two components, one of which (**Lv**) acts vertically opposing weight and the other (**Lh**) horizontally producing a side slip in towards the turn '**3**'.

The side slip gives rise to a relative airflow against the large keel area comprising the rear fuselage and fin, which are behind the centre of gravity. The side slip and large keel area combine to create a secondary effect of aileron which is to yaw the aeroplane in the same direction as the roll '4'.

Again, If not corrected, a spiral dive would quickly develop.

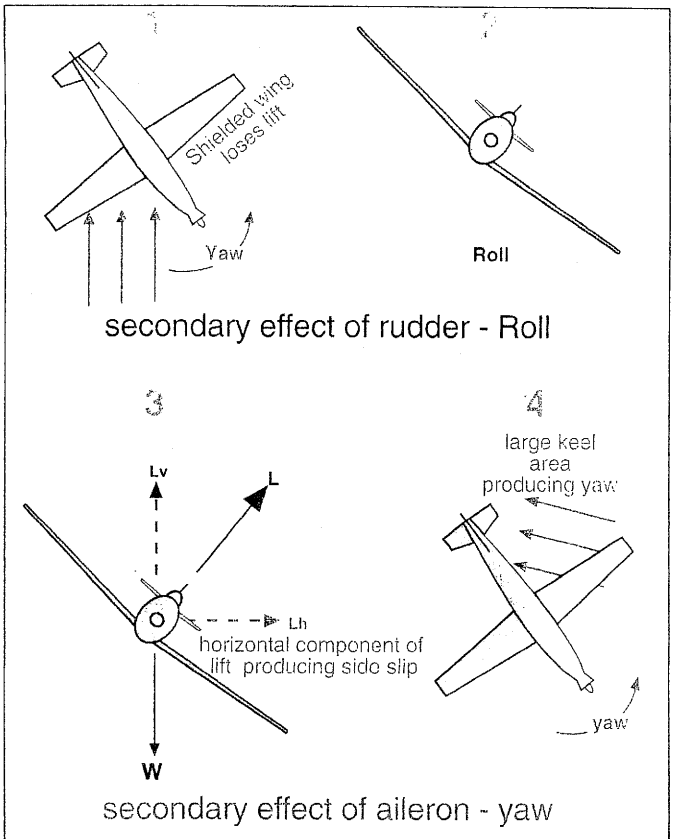


fig T21

TEC55(C)

See fig T22.

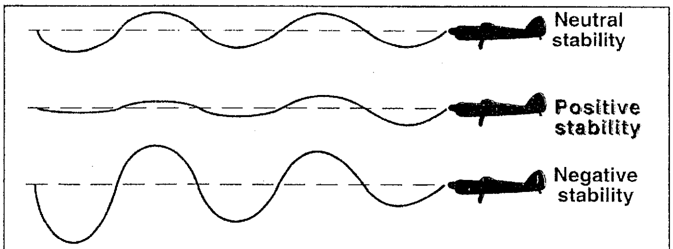


fig T22

Dynamic stability is the subject of an aircraft being involuntarily displaced from its flight attitude or path by an external force and its inherent ability or lack of ability to return to its original path or attitude when that force is removed.

Neutral stability is where the aircraft oscillates at a constant magnitude about its original flight path or when disturbed, takes up a new flight path or attitude. Some examiners refer to this a static stability.

Negative stability is where the oscillations increase in magnitude with the aircraft increasing its deviation from its original flight path.

Positive stability is where the oscillations diminish with the aircraft eventually returning to its original flight path or attitude without any pilot control input.

TEC56(A)

See TEC53 fig T22.

TEC57(A)

See fig T23.

A design feature of thrust and drag lines is that they are not coincidental and a couple is set up that creates a pitching moment about the lateral axis. This is generally balanced by the lift/ weight couple together with forces generated by the tail plane.

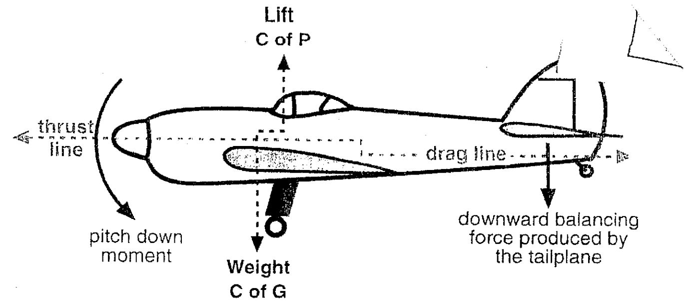


fig T23

The function of the tail plane is to balance all the other forces acting on the aeroplane to maintain a desired pitch attitude.

The design tendency of the thrust/ drag couple where the drag line is below the thrust line is to produce a nose pitch down moment. This is balanced by a downward force on the tailplane.

TEC58(D)

Flying control locks are devices attached to either the control surfaces or control column to prevent control surface movement on the ground. They prevent involuntary control surface movement that may become violent during gusty conditions, resulting in system damage.

TEC59(B)

See fig T24.

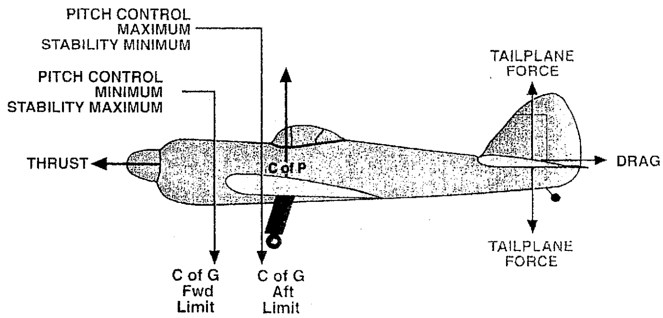


fig T24

The centre of gravity (C of G) is naturally forward of the centre of pressure (C of P). If the C of G is close to its forward limit, a large downward pitching moment will be produced by the lift/ weight couple. The increased moment arm between the C of G and elevator will make the aeroplane longitudinally overstable which may result in a dangerously high physical effort being required of the pilot to achieve a desired pitch attitude. Trying the flare an aeroplane at low airspeed with inherent diminished aerodynamic effectiveness, could prove disastrous.

TEC60(C)

See fig T25.

A carburettor venturi causes the air passing through it to increase in velocity which results in a pressure drop. Any pressure reduction will produce adiabatic cooling of the air that in turn, through conduction, will lower the temperature of the carburettor venturi. When air is cooled, its relative humidity increases.

Fuel entering the venturi is vapourised (changes state by evaporation). This will require the fuel in its liquid state to gain (latent) heat in order to evaporate.

The fuel takes latent heat from both the air passing through the venturi and the carburettor body setting up a cooling process that may lower the temperature of the carburettor body and the airflow within it by as much as 30°C.

The temperature reduction may achieve two things.

1 The air temperature may be reduced to below its dewpoint initiating condensation.

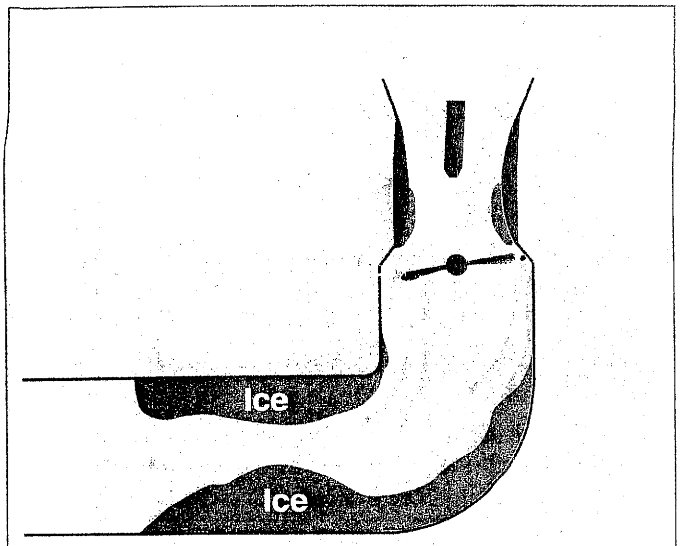


fig T25

2 The carburettor body temperature may be reduced to below 0°C.

Should both 1 and 2 occur, water vapour in the air that is in contact with the sub-zero carburettor body will SUBLIMATE into ice and form around and downstream of the throttle butterfly choking off the airflow to the engine.

Sublimation is the process of changing state directly from a gas to a solid: In this case, from water vapour directly to ice, missing out the water droplet (liquid) state.

Conditions most favourable to carburettor icing are:

1 Warm weather and high humidity, as this will provide an abundant supply of water vapour. The greater the relative humidity, the smaller the temperature drop required to reach the dewpoint temperature.

2 Low power settings, such as idle in the descent, when the throttle butterfly is only partially open will produce a large velocity increase and corresponding large pressure reduction as the air accelerates to pass the restrictive space created between the partially open throttle butterfly and carburettor wall. The consequence is a significant cooling effect which may cause moisture present to form as ice on the downstream side of the throttle butterfly, further restricting the flow of fuel/ air mixture to the engine. This is known as throttle ice.

Carburettor icing can occur in clear air with temperatures up to +25°C because the carburettor is capable of producing a temperature reduction of up to 30°C.

Note: Warm air has a greater capacity to hold water vapour than colder air so warm air is capable of producing larger amounts of ice. Below –5°C carburettor icing is improbable as air at low temperatures is relatively dry and incapable of producing ice in any significant quantity.

TEC61(C)

See fig T26.

A partially filled fuel tank subjected to a temperature fall (for instance when the aircraft has been parked outside overnight) may result in water droplets condensing out of the air within the tank as the air temperature falls to its dewpoint.

Water, having a greater density is heavier than fuel and will collect at the bottom of the tank. Water entering the engine may result in power loss or worse, a dead cut. This is most likely to happen during departure when the consequence could be catastrophic.

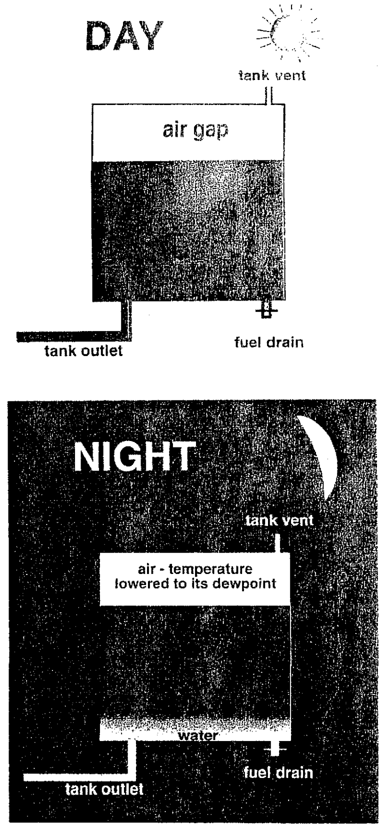


fig T26

TEC62(D)

See fig T27.

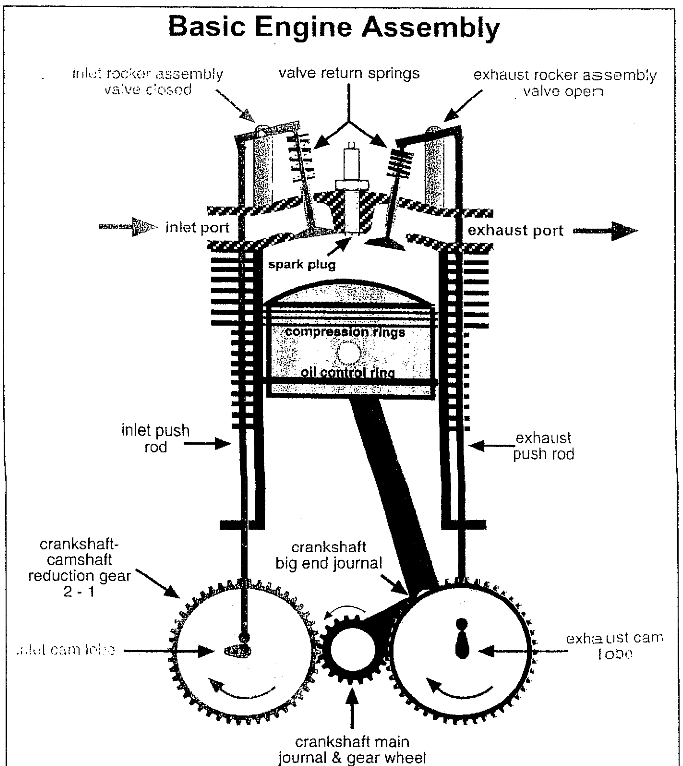


fig T27

Pistons are connected to the crankshaft via a connecting rod.

Fuel/ air mixture burned in the combustion chamber above the piston expands and drives the piston downward in the cylinder which, via the connecting rod, causes the crankshaft to rotate. This is reciprocating movement converted to rotary motion.

TEC63(A)

See figs T27 & T28.

Each valve will open and close once. The valves are opened and closed by the camshaft via the push rods and rockers.

THE PRACTICAL OTTO CYCLE

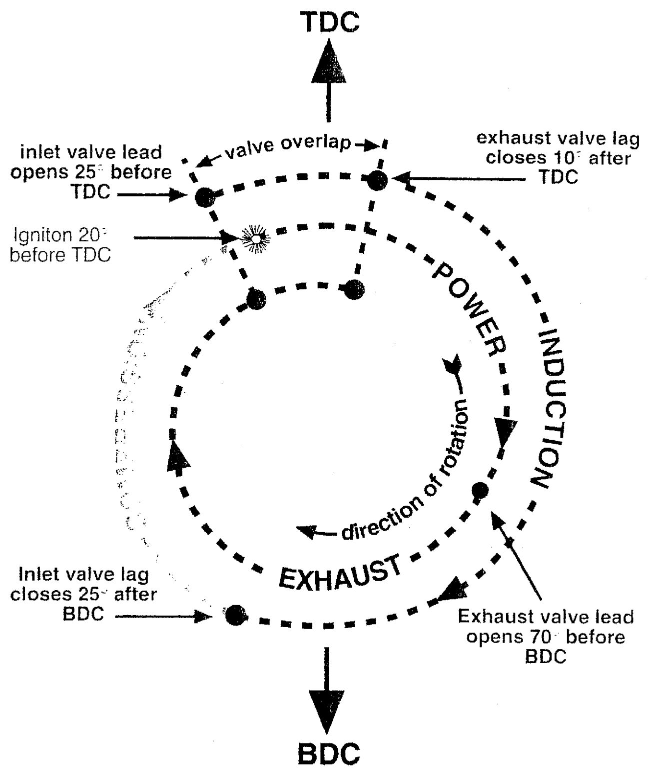


fig T28

A camshaft rotates once during each engine cycle but the crankshaft (which drives the camshaft via a reduction gear) rotates twice for each engine cycle, causing the piston to travel up and down the cylinder twice. See fig T28.

Just before the end of the power stroke, that is just before the piston reaches bottom dead centre (BDC), the exhaust valve in the cylinder head will open. The exhaust valve opens early as most of the useful energy developed by the burned gases has been expended in driving the piston downward.

The piston will pass BDC and move up the cylinder on the exhaust stroke expelling the burned gases from the cylinder via the exhaust valve. Because the burned expanded gases driven upwards by the piston have inertia, and because valves take time to open and close, the exhaust valve will not close until after the piston has passed top dead centre (TDC). This allows the maximum amount of exhaust gas to be scavenged from the combustion chamber.

The inlet valve will open before the piston reaches TDC on the exhaust stroke because the inertia of the expanded gases leaving the engine and the partial vacuum they create, will induce the cooler denser fuel air mixture to enter the combustion chamber via the inlet valve.

The period or angular movement of the crankshaft when both exhaust and inlet valves are open is known as valve overlap.

TEC64(C)

See fig T29

When an aircraft with either a wet or dry sump engine has been parked for some time, oil may drain down from the oil galleries into the sump or to the bottom of the crankcase.

Particularly in very cold weather, the oil may thicken, inhibiting its flow around the engine when initially started.

After the engine has fired up and is idling, a maximum of 30 seconds should be allowed for oil to circulate around the engine and for pressure to indicate on the oil pressure gauge.

Should a safe working oil pressure not indicate after 30 seconds, the engine must be shut down.

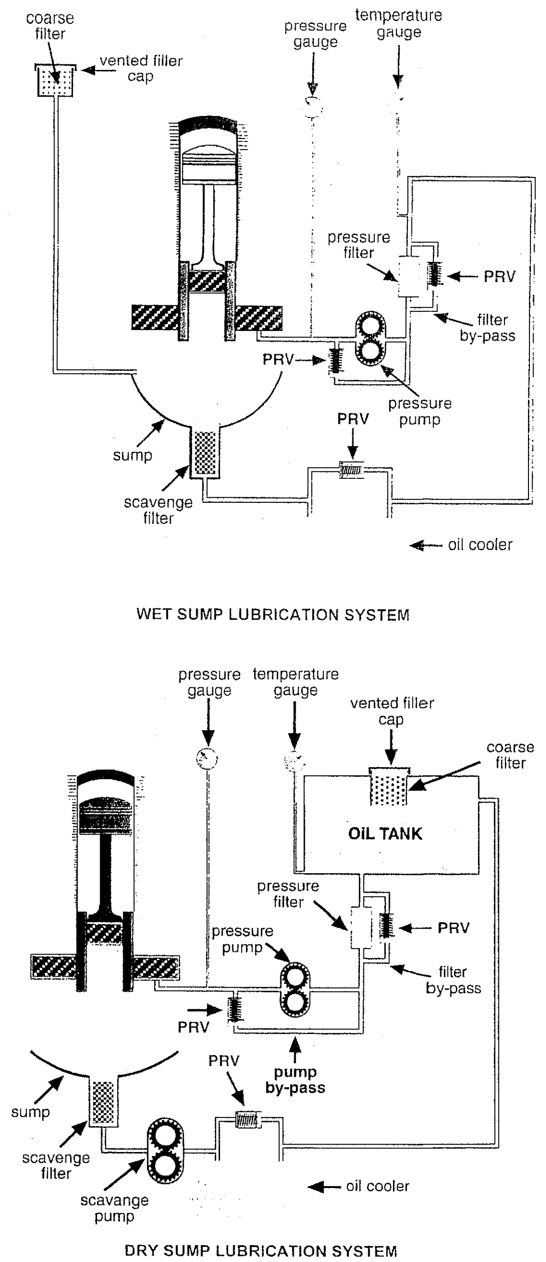


fig T29

TEC65(B)

The starter warning light indicates that the starter solenoid is energised and the starter has engaged with the engine.

Should the light fail to go out after the engine has fired up and the starter button is released, the starter may still be engaged with the engine and be driven by the engine.

This will result in serious mechanical damage to both the starter motor and engine.

The engine should be stopped immediately if the starter warning light fails to go out after the starter button is released.

TEC66(D)

There have been occasions, due to industrial disputes and world oil crises, when shortages of AVGAS 100 LL has occurred. At such times, the use of motor vehicle grades of petroleum fuel (MOGAS) have been approved by the CAA. Notification of such approval is via CAA Airworthiness Notices.

TEC67(A)

All labels relating to the storage and delivery of 1 00 LL are coloured **red** and the fuel itself is dyed **blue**.

TEC68(A)

A function of a fuel booster pump is to ensure a positive fuel supply to the engine driven pump.

Located at the lowest part of a fuel tank, they are of significant importance in low wing aircraft where the fuel has to be raised from tanks that are below the engine.

TEC69(D)

The problem with starting an engine that has become very cold is that the air is also very cold and dense. Together these two factors alone will inhibit the evaporation of fuel entering the engine.

This is overcome by delivering neat fuel via the hand operated primer pump to either the induction manifold close to the combustion chamber or to the inlet valve port.

When the engine is turned over, not all the fuel entering the engine will evaporate. However, sufficient will evaporate to provide a fuel air mixture that will sustain combustion when ignited.

Note: Injected engines have no requirement for a primer pump.

TEC70(C)

The fuel element of the fuel/ air mixture has two functions:

1 When mixed with air, provide a volatile chemical mixture for combustion.
2 Act as a coolant to aid cylinder head cooling.

If the mixture is too lean, this could lead to detonation, during which, the pressure and temperature of the burning mixture will be excessive, both of which could lead to structural damage.

Too rich and the mixture burn will be inefficient with the engine developing less power. In the extreme, unburned fuel will wash lubricant from the cylinder walls and accelerate both piston ring and cylinder bore wear.

The fuel mixture is determined by the weight of its component parts. Ideally the mixture should be in the region of 1 part fuel to 12 parts air.

With altitude increase, the weight of air is reduced hence the fuel should be leaned to maintain the correct fuel/air weight ratio.

TEC71(D)

The idle cut-off valve in light aircraft forms part of the mixture control unit within a carburettor and is operated via a Bowden cable attached to the mixture control lever.

When the mixture control is fully closed at the idle cut-off position, the idle cut-off valve is closed preventing fuel flow from its discharge nozzle. Ultimately, its function is to stop the engine.

TEC72(A)

1 The mixture control should be moved towards lean until the engine RPM ceases to increase and begins to decrease.
2 The mixture is then enriched to a position of maximum RPM and then moved slightly (approximately 2 turns) to the rich side of peak RPM.

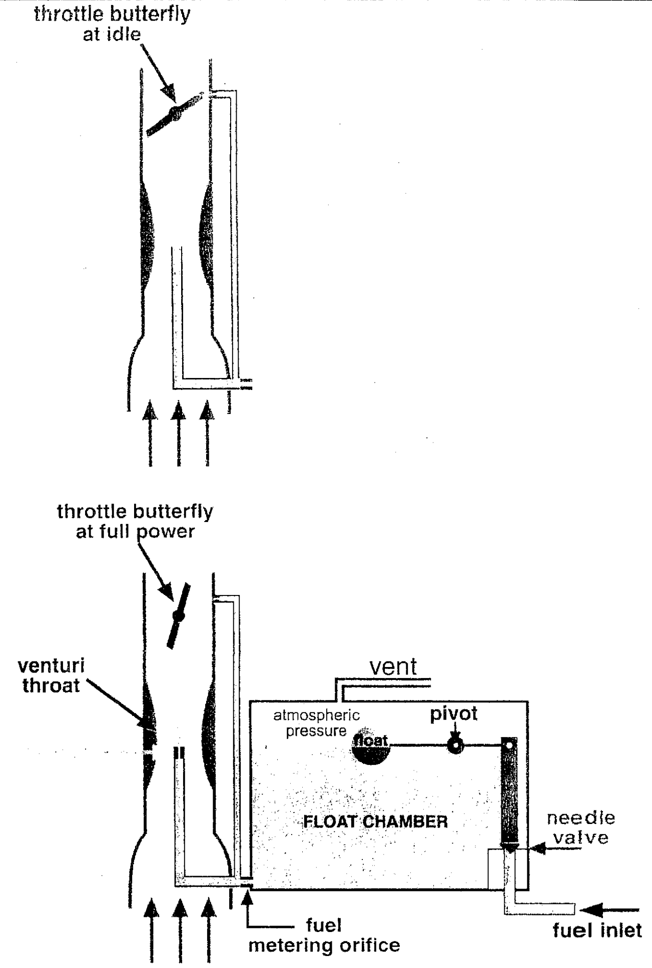
Remember, fuel is a cooling agent!

TEC73(C)

See fig T30

From the entry point, the cross sectional area of the venturi reduces to form a convergent duct, becoming narrowest at the mid point (throat).

Air entering a convergent duct increases in velocity and its ambient pressure decreases because velocity is inversely proportional to pressure. The greatest change occurs at the narrowest point which then widens to form a divergent duct. Air passing through a divergent duct decreases in velocity and expand.



UPDRAUGHT CARBURETTOR

fig T30

The narrowest point is the venturi throat at which the drop in ambient (or static) pressure to below outside atmospheric pressure (sensed by the fuel in the float chamber) draws fuel through the main jet into the venturi throat. (fig T29).

TEC74(A)

See TEC64 fig T29.

Excessive oil pressure could be the result of a blockage downstream of the pressure pump and oil pressure sensor.

Excessive pressure is relieved by a pressure relief valve (PRV) also situated downstream of the pressure pump. When open, the PRV allows some oil to return to the inlet side of the pressure pump.

TEC75(A)

See TEC64 fig T29.

Should the oil cooler become blocked, a complete blockage of the main oil gallery would occur, leading rapidly to engine failure. Should the oil cooler become blocked, an oil pressure relief valve (PRV) automatically opens, allowing oil to by-pass the oil cooler.

TEC76(D)

See TEC62 & 63 fig T27 & T28.

In a four-stroke piston engine, the camshaft is driven by the crankshaft via a set of reduction gears with a ratio of 2:1 that cause the camshaft to rotate once for every two crankshaft revolutions or half engine speed.

Via push rods and rocker arms, the camshaft opens the inlet and exhaust valves located at the top of the cylinder combustion chamber. Valves are fully open when their associated cam lobe is at the top of its rotation. As each cam lobe passes the bottom of its rotation, its associated valve closes under the influence of a return spring located at the top of the valve below the rocker

arm. Each valve will open and close once for every two crankshaft revolutions which makes one Otto cycle.
The gear on the end of the crankshaft has half the circumference of the reduction gears located at the end of each camshaft. This causes the camshaft to rotate only once for every two crankshaft revolutions or, at half engine speed.

TEC77(B)

See TEC62, TEC63 figs T27 and T28
There are four elements to one complete Otto cycle of a piston engine, namely: ***induction***, ***compression***, ***power*** and ***exhaust***. Each element involves 180° of crankshaft rotation, which in total equals 720° or two complete crankshaft revolutions which equals one engine cycle.

During the induction stroke, crankshaft rotation pulls the piston down to bottom dead centre (BDC), drawing fuel/ air mixture into the cylinder. The piston then moves past BDC and begins to rise on the compression stroke and as the name suggests, compresses the fuel/ air mixture to the top of the cylinder which forms the combustion chamber.

Just before reaching top dead centre (TDC) on the compression stroke, the fuel/ air mixture is ignited. As the piston passes TDC, the burnt expanding gases drive the piston back down to BDC on the power stroke.

After passing BDC the piston again rises on the exhaust stroke to expel the burnt fuel/ air mixture.

Hence, in one complete Otto cycle, each piston moves up and down twice.

TEC78(C)

See fig T31.

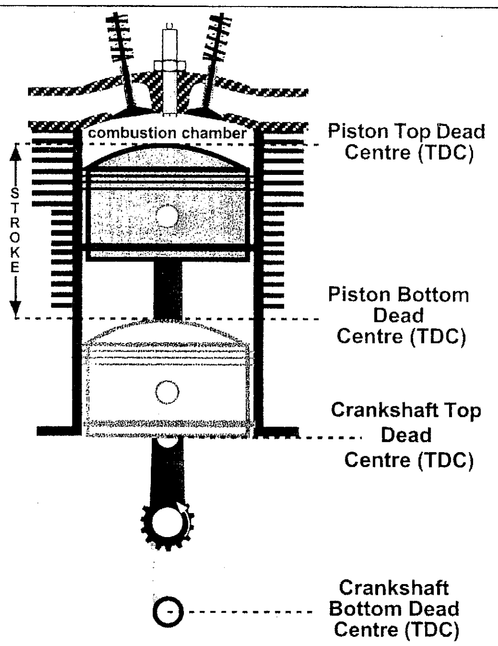


fig T31

The compression ratio is the volume of the cylinder above the piston when it is at bottom dead centre (BDC) to the volume of the cylinder above the piston when it is at top dead centre (**TDC**) often referred to as the ***swept volume*** to the ***clearance volume***.

TEC79(B)

The power developed by a piston engine is determined by the weight of fuel air mixture that is induced into the combustion chamber. For a given throttle butterfly valve position, the **volume** of air passing the butterfly valve remains constant. Therefore, the **weight** of air entering the combustion chamber will only vary with temperature, pressure and humidity.

The dominant factor is air density because with altitude increase air density reduces and the weight of fuel air mixture induced into the combustion chamber decreases. Hence, as altitude is increased, for any given throttle setting, engine power will progressively decay.

Light aircraft naturally aspirated piston engines operate at relatively low RPM. Common to all naturally aspirated aeroplane engines with fixed pitch propellers is that they are designed for optimum efficiency at sea level where air density is greatest.

Consequently, at sea level, the more power the engine develops, the greater the RPM, becoming maximum at full throttle.

TEC80(B)

Fuel is normally raised from the tanks of a low wing aeroplane by an engine driven fuel pump but an electrically driven (booster) pump is incorporated into the system to initiate fuel flow under pressure before the engine is started. Its function is also to lift the fuel from tank to engine in the event of the engine driven pump becoming inoperative.

Failure to close the fuel drain (apart from losing all the fuel and putting your life in jeopardy) may result in fuel draining back down the line from the engine to the tank, creating an air lock that could cause fuel starvation.

TEC81(D)

See TEC64 fig T29.

Oil temperature is predominantly sensed at a location where it is at its coolest. This is after it has been scavenged from the engine and passed through the oil cooler. A common location for the the oil temperature sensor is the bottom of the oil tank where it will be at its coolest.

The logic in sensing temperature at the coolest part of the system is that cooler temperatures require less expensive instrumentation and that any indicated increase above the normal operating range must be indicative of the oil temperature at any other part of the system. Hence, the instrumentation is calibrated accordingly.

TEC82(D)

In contrast to the controlled slow burning of normal combustion, detonation is characterised by the inability of the fuel air mixture to burn slowly. It may be defined as a very rapid, almost instantaneous combustion that either replaces normal combustion or occurs simultaneously with normal combustion.

Detonation occurs because of weak mixtures and/ or high cylinder head temperatures that lead to spontaneous combustion of the fuel air mixture.

Such conditions may prevail during a long climb when the airflow around the engine is inadequate for cylinder head cooling. Fuel itself is a coolant and the incorrect fuel specification or an over lean fuel mixture will cause the cylinder head temperature to rise.

When detonation occurs, cylinder head pressures rise rapidly and violently to peaks that are frequently beyond the structural design limitations of the combustion chamber, piston, connecting rods and crankshaft bearings. It is best detected by a rising cylinder head temperature indication.

TEC83(B)

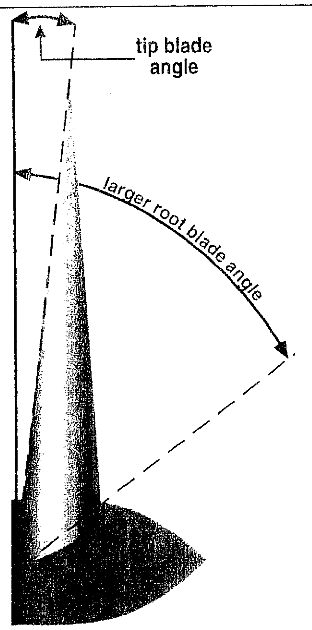
Pre-ignition is the combustion of a fuel air mixture before the desired position on the compression stroke.

A property of carbon is high heat retention. Continuous use of rich mixtures or incorrect fuel grade leads to inefficient combustion, a by product of which is carbon deposit on the piston crown and combustion chamber surfaces.

During engine operation, these carbon deposits absorb heat and if at sufficiently high temperature, will glow and prematurely ignite the fuel/ air mixture leading to a loss of power.

TEC84(C)

See fig T32.



the diagram assumes a rotating propeller with the aircraft stationary.

fig T32

It is desirable that a propeller develops uniform thrust along its length so the propeller is twisted to reduce the blade angle and subsequently the angle of attack from hub to tip.

Moving from hub to tip, as the radius increases, linear velocity increases, so if the blade was not twisted to maintain an optimum angle of attack, it would progressively develop more thrust towards its tip.

Like a wing, a propeller blade is an aerofoil and subject to Bernoulli's Theorem. $L = C_L \frac{1}{2} \rho V^2 S$

L becomes Thrust '**T**' in the formula.

CL is coefficient of lift and the product of angle of attack and aerofoil design.

V rotational velocity.

To maintain **T** constant, the greater rotational velocity **V** towards the tip must be balanced by reducing something else.

Angle of attack is a variable element of **CL** so reducing the angle of attack in proportion to the increased velocity will maintain **T** (Thrust) constant.

TEC85(C)

See TEC84.

TEC86(A)

See fig T33.

An aircraft can arguably only accelerate with constant power if it assumes a pitch down attitude or is accelerating during the take-off run. During the take-off run with full throttle selected, the engine RPM will progressively increase as airspeed increases.

In a steep dive, the propeller RPM would increase also due to increased airspeed which would, in turn, reduce the propeller angle of attack subtended by its chord line and relative airflow.

If the angle of attack is reduced then drag is reduced allowing the propeller under the influence of the airflow passing through it to rotate faster which will be the case for any power setting.

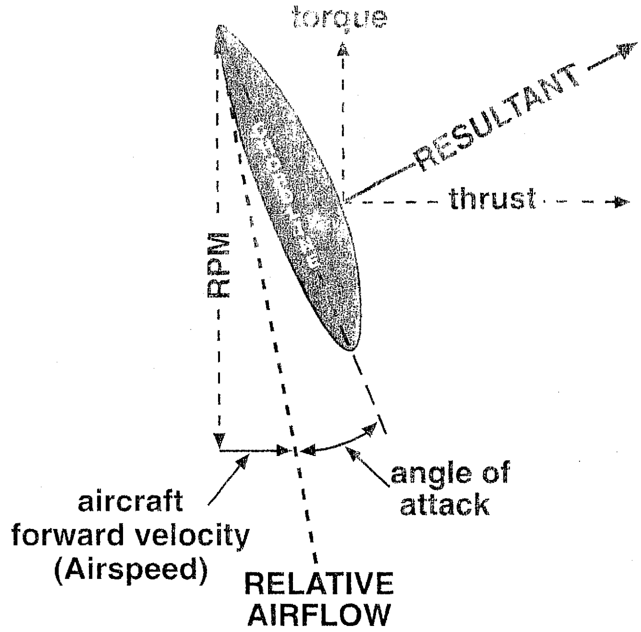


fig T33

TEC87(C)

See fig T34.

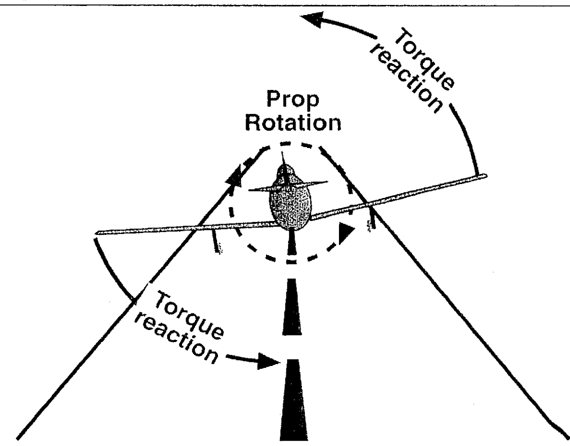


fig T34

Newton's Law of motion states that::

For very action there is an equal and opposite reaction.

Torque reaction or the reaction to rotation acts in the opposite direction to normal rotation. If it was possible to suspend an aeroplane with a clockwise rotating propeller and prevent the propeller from rotating, which way would the aeroplane rotate if the engine was driving the propeller? The answer is anticlockwise.

An aeroplane with a propeller rotating clockwise when viewed from the rear will, on take off, tend to roll in an anticlockwise direction left wing down.

TEC88(D)

An engine operated at low RPM will not achieve its optimum operating temperature and consequently inefficient combustion of the fuel air mixture. Inefficient combustion may be exacerbated by an overrich fuel air mixture. Unburned fuel will cause carbon deposits to build up particularly on the exhaust valves and spark plugs electrodes, the latter resulting in misfiring and rough running. Spark plug fouling may be avoided by not operating an engine for long periods at low RPM.

TEC89(A)

See fig T35.

A magneto is an self-contained unit driven by the engine camshaft independent of any other aircraft electrical system.

Q81 Information transmitted to the cockpit mounted engine oil temperature gauge is provided by a temperature sensor located:

A - within the hot sections of the engine.

B - upstream of the oil cooler.

C - within the engine sump.

D - after passing through the oil cooler but before reaching the hot sections of the engine.

Q82 Detonation of the fuel/ air mixture in a piston engine is usually associated with:

A - a designed interrupted ignition sequence during start-up when backfiring occurs.

B - rich mixtures and low cylinder head temperatures.

C - carbonised sparking plugs due to protracted engine operation using overly rich mixtures.

D - weak mixtures and high cylinder head temperatures.

Q83 Pre-ignition, a phenomenon that disrupts the smooth running of a four-stroke piston engine is often the result of:

A - an uncontrolled explosion of the fuel/ air mixture.

B - a carbonised hot spot in the combustion chamber causing premature ignition of the fuel/ air mixture.

C - slow burning of a rich mixture in a hot engine.

D - rapid combustion of a normal mixture in a hot engine.

Q84 A propeller blade that is twisted along its length:

A - prevents aerodynamic interference with the engine cowling.

B - reduces drag at the propeller tips, thereby reducing torque.

C - ensures an optimum angle of attack throughout the blade length.

D - induces drag at the propeller tips, thereby maintaining torque balance.

Q85 A propeller blade that is twisted throughout its length is designed to:

A - maintain the same blade angle from hub to tip.

B - increase the blade angle towards the tip.

C - reduce the blade angle towards the tip.

D - off-set the blade angle of attack and drag towards the tip.

Q86 During acceleration at a constant power setting in an aircraft with a fixed pitch propeller, the engine RPM will:

A - increase.

B - remain unchanged.

C - decrease.

D - remain unchanged but the propeller RPM will increase.

Q87 With regard to a single engined aircraft on take-off, the torque reaction generated by its propeller turning clockwise (viewed from the rear) will tend to cause:

A - the tail to rise.

B - roll, right wing down.

C - roll, left wing down.

D - the nose to pitch up.

Q88 Carbon deposits on spark plugs otherwise known as fouling may be prevented by:

A - cleaning them daily.

B - running the engine at high RPM with a lean mixture for about 5 minutes.

C - not running the engine continuously at high RPM with a lean mixture.

D - avoiding prolonged running of the engine at low RPM.

Q89 In respect of an aircraft piston engine ignition system, the high tension supply to the spark plugs originates from:

A - the magneto's primary and secondary self-generation and distribution system.

B - the battery during start-up and low idle, then the magneto once the engine is running at fast idle.

C - the battery and is transformed by the magneto.

D - the magneto and then transformed by the battery.

Q90 When a magneto is selected OFF, the switch located in the primary circuit:

A - is closed and the circuit is earthed.

B - is opened, breaking circuit continuity.

C - is opened and the circuit is earthed.

D - is closed and the high tension circuit is closed.

Q91 A magneto that inadvertently becomes disconnected from its ignition switch will:

A - cause a dead cut when the other magneto is switched off.

B - cause the engine to continue running when both magneto switches are turned off.

C - cause the failure of one plug in each cylinder.

D - cause the engine to misfire when the other magneto is switched off..

Q92 Spark plugs receive their high tension supply from:

A - the alternator.

B - a magneto, independent of the aircraft electrical system.

C - a magneto distributor supplied from the aircraft electrical system.

D - a magneto supplied from the aircraft battery.

Q93 The principle of operation of an impulse coupling employed in an aircraft engine ignition system is that it:

A - advances ignition to compensate for slow combustion in a cold engine.

B - increases the rotation speed of the magneto to generate a high tension spark sufficient to ignite a cold fuel air mixture.

C - retards ignition to ensure pre-ignition of an enriched starting mixture does not occur.

D - accelerates capacitor discharge to the secondary winding that in turn generates a shower of sparks sufficient to ignite a cold fuel air mixture.

Q94 If, on a single engined aircraft, the only alternator or generator fails during flight:

A - the flight may continue normally as the battery will cope with any electrical load.

B - the master switch should be turned off and the flight continued without electrical power.

C - the master switch should never be switched off but battery discharge rate should be monitored.

D - the electrical loads should be reduced to a minimum and a landing made as soon as safely practicable.

Q95 Operating an aircraft knowing that it has a flat battery:

A - is normal practice, because the alternator will charge the battery during flight.

B - is a normal practice, as the battery is not required during normal operations.

C - is not recommended, as plate damage may be sustained due to the heat generated by the battery's high internal resistance and high current draw during the initial stage of recharge.

D - is not recommended, as the alternator may not fully charge the battery during normal operations.

Q96 A fuse that blows during flight:

A - may be replaced in the air by a fuse that has a current rating not more than 40% greater than the original fuse, to ensure that it will not blow again.

B - should not be replaced until after landing.

C - may be replaced with a spare fuse of the same voltage rating and 50 amp current rating once only.

D - may be replaced once only by one of the same value.

Q97 A 100 amp/ hour battery will, in theory, supply 20 amps for up to:

A - 2 hours.

B - 4 hours.

C - 5 hours.

D - 6 hours.

Q98 Both starter switch and starter motor draw current from the battery. When activated, the current flow through a starter switch compared with that flowing through the starter motor:

A - is much lower.

B - is much higher.

C - is the same.

D - initially higher when the starter motor resistance is high, but reduces to become less as the starter motor winds up.

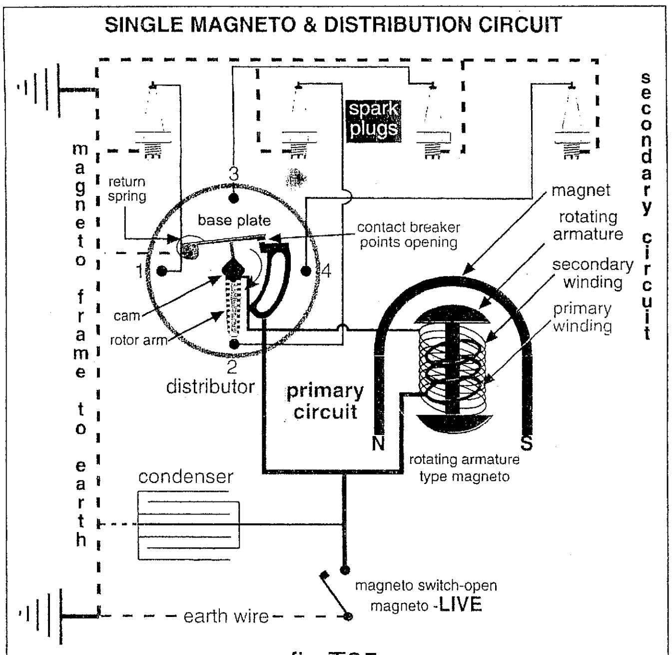


fig T35

The coarse primary winding of the rotating armature cuts the magnetic field of the permanent magnet, inducing a low voltage current in the primary winding.

The contact breaker points are located in the primary circuit and when opened, arrest the low voltage flow collapsing the magnetic field erected around the primary winding. This induces a high voltage current in the much finer wound secondary coil. The high voltage current is directed to the appropriate sparking plug via the distributor which also houses the contact breaker points.

Note: The ignition switch (normally open) forms part of the primary circuit. If the ignition switch is closed, the low voltage current is sent to earth via the magneto frame or body making the contact breaker points ineffective. Should the switch malfunction or the earth wire become detached from the switch so that the magneto could not be earthed, the engine would continue to run when the ignition switch was turned off, (closed).

TEC90(A)

See TEC 89.

TEC91(B)

See TEC 89.

TEC92(B)

See TEC 89.

TEC93(B)

When a cold engine is turned slowly by the starter, the tension of the spark at the plugs may be too weak to initiate combustion.

An impulse coupling consists of a set of spring loaded fly weights that coil and release when the engine is turned over by the starter motor. When released, the impulse coupling provides enough rotational speed to the magneto for it to generate a current that is sufficient to initiate combustion.

The impulse coupling normally retards ignition to prevent propeller kick back, the spark occurring after the piston has passed Top Dead Centre.

TEC94(D)

The capacity of an aircraft battery is very limited. Should the generator or alternator fail during flight, despite the engine operating totally independently of the battery, all non-essential electrical equipment should be switched off and a landing made as soon as is practicably possible.

It should be remembered that radios, lights and in some cases, flap and landing gear extension require electrical power which are needed during landing.

TEC95(D)

When a battery is totally discharged (flat), its internal resistance is at a maximum.

The normal output from an aircraft generator or alternator is normally about 2 volts greater than the battery's rated voltage. However, this may be insufficient to overcome the battery's internal resistance and establish a charge.

When a flat battery is bench charged, only a small current is used. This is because the battery's high internal resistance will generate a significant amount of heat which could warp its plates rendering it useless.

During a flight of short duration, if the generator or alternator failed, the initial technical problem of a flat battery could lead to serious consequences, particularly if you were in IMC.

For reasons besides those mentioned above, BCARs states that if a battery is fully discharged, it must be replaced with a fully serviceable battery before the next flight.

TEC96(D)

If a fuse blows during flight, the circuit the fuse protected should be switched off and the fuse replaced by one of the same value.

If the replacement fuse blows when the system is switched back on, the system should be switched off and the defect entered in the appropriate technical log.

TEC97(C)

A 100 amp/ hr battery means that the battery has the capacity to discharge at the rate of 1 amp per hour for 100 hours.

Discharging at a rate of 20amps, the battery will theoretically last for 5 hours.

$$\frac{100\cancel{\text{amp}}}{1\cancel{\text{amp}}} \times \frac{1\text{hr}}{20\cancel{\text{amp}}} = 5\text{hr}$$

TEC98(A)

See fig T36

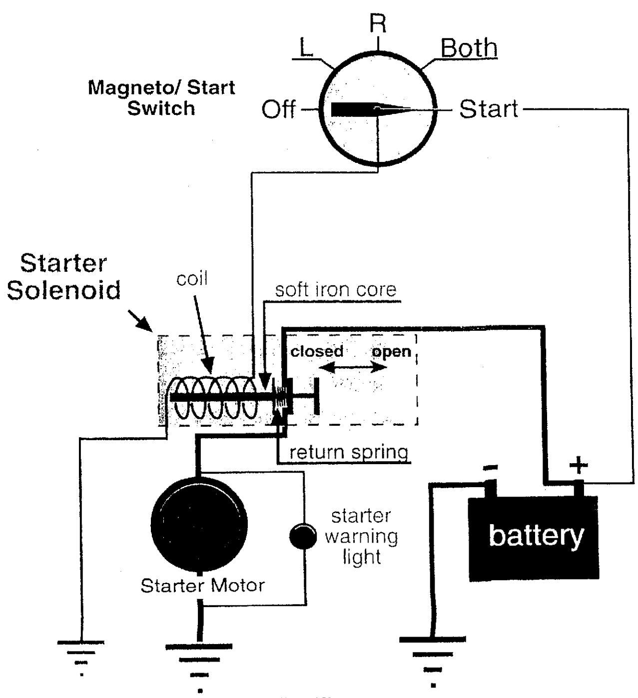


fig T36

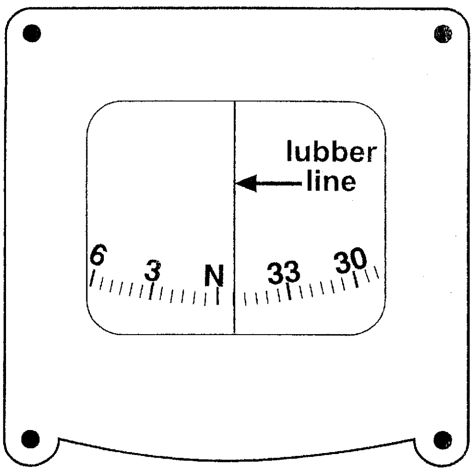
The current drawn from a battery by a starter motor is large, in the order of 60amps or more when the starter is first engaged. Such electrical loads are too large to be carried by conventional cockpit switches and small gauge electrical wiring.

Current from the battery to the starter motor is via a heavy duty cable controlled by an electromagnetic solenoid, itself controlled by a switching circuit that carries a much smaller current in the order of 5amps. When the cockpit mounted starter switch is selected to start, the starter switching circuit is closed and current flows from the battery to the starter solenoid.

Within the solenoid, an electro magnet which when energised, closes or completes the circuit from battery to starter motor via the heavy duty cable. This circuit is not protected by a fuse or circuit breaker because the current involved is too great. Hence the 'starter engaged' warning light in the cockpit.

TEC99(C)

See fig T37.



FOR	N	030	060	E	120
STEER	003	031	061	090	122
FOR	S	210	240	W	300
STEER	179	209	241	270	298

fig T37

The direct reading magnetic compass is subject to errors produced by local magnetic influences, such as magnetic fields generated by radio equipment or ferrous items that form part of the aircraft structure.

Such magnetic influences cause the compass to deviate from magnetic north, the magnitude of which is termed DEVIATION and may vary with change of aircraft heading.

The rule (east is least and west is best) that requires local VARIATION between magnetic north and true north to be either added to or subtracted from the true heading to give magnetic heading, also applies to compass deviation.

The rule 'west is best,: add westerly DEVIATION to the magnetic heading to give compass heading.

'East is least': subtract easterly DEVIATION from magnetic heading to give compass heading.

When compass deviation is applied to a magnetic heading, the resulting compass heading is expressed in degrees compass (°C).

The object of swinging the compass is to remove as much deviation error as possible, but a residual deviation error always remains on some, if not all, headings.

On completion of the compass swing, the amount the compass deviates on twelve magnetic headings at 30° intervals is noted and a compass deviation card is then compiled giving the compass heading to steer on the bottom line to maintain the desired magnetic heading on the top line.

TEC100(B)

If two 12volt 40 ampere-hour batteries are connected in series, their combined voltage output will be the sum of the two individual battery voltages. In this case:

12v + 12v = 24v

The capacity of two 40 ampere-hour batteries connected in series will be the average capacity of the two.

$$= \frac{40 \text{ amp hr} + 40 \text{ amp hr}}{2} = \frac{40\text{amp}}{\text{hr}}$$

answer = 40 amp hours at 24 volts

TEC101(A)

If two 12volt 40 ampere-hour batteries are connected in parallel, their combined voltage output will be the average of the two individual battery voltages. In this case:

$$\frac{12v + 12v}{2} = 12 \text{ volts}$$

The capacity of two 12volt 40 ampere-hour batteries connected in series will be the sum of the two capacities.

$$40 \text{ amp hr} + 40 \text{ amp hr} = \frac{80\text{amp}}{\text{hr}}$$

answer = 12 volts for 80 amp hours

TEC102(A)

See fig T38.

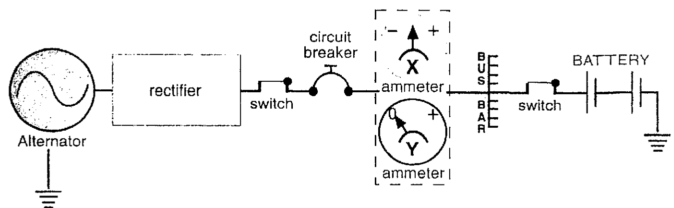


fig T38

Depending on the system and the ammeter type, if the ammeter needle is in the vertical position between + and - as in ammeter **X**, this normally indicates that the battery is fully charged and a negative value when the alternator has failed.

Some system ammeters such as ammeter **Y** will indicate zero if the alternator fails to charge the battery and the battery itself is discharging. When the battery is being charged, the indication will be between **0** and **+**. In a 12 volt system, the alternator voltage will be in the region of 14 volts to ensure that the battery, (its output being slightly less than 12v) will always receive charge from the alternator and not the other way round.

TEC103(B)

See TEC 97

TEC104(A)

See fig T39.

Altimeter

The outside of the partially evacuated (Aneroid) capsule within the altimeter body senses atmospheric pressure which, due to decreasing pressure, will expand during a climb and contract

Q99 The purpose of a cockpit mounted compass deviation card is to:

A - correct the compass headings for ferrous items that may be added to or removed from the A/C.

B - show the difference between the aircraft magnetic track and true north.

C - display the difference between the compass headings and actual magnetic headings.

D - correct the gyro headings for ferrous items that may be added to or removed from the A/C.

Q100 Two 12 volt 40 ampere-hour capacity batteries connected in series would result in a total capacity of:

A - 80 ampere-hours at 12 volts.

B - 40 ampere-hours at 24 volts.

C - 20 ampere-hours at 24 volts.

D - 40 ampere-hours at 12 volts.

Q101 Two 12 volt 40 ampere-hour capacity batteries connected in parallel would result in a total voltage and capacity of:

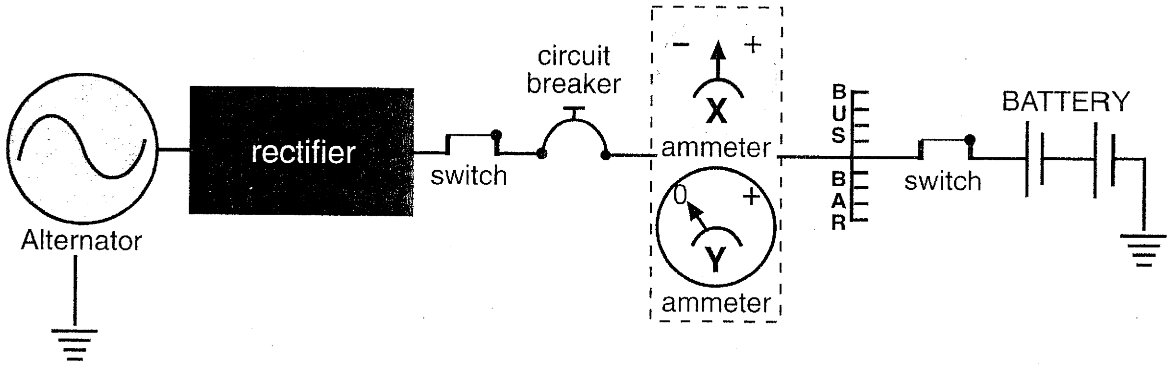
A - 12 volts and 80 ampere-hours.

B - 24 volts and 40 ampere-hours.

C - 24 volts and 20 ampere-hours.

D - 12 volts and 40 ampere-hours.

Q102 Study the light aircraft electrical system below which includes two types of ammeter. The most probable cause of the needle of ammeter '**X**' being in the vertical position is:



A - the battery is fully charged.

B - an alternator failure.

C - a flat battery.

D - the battery is drawing a normal charge.

Q103 Refer to the schematic above in question 102. The most probable cause of ammeter '**Y**' reading zero would be:

A - the battery is fully charged.

B - an alternator failure.

C - a flat battery.

D - the battery is drawing a normal charge.

Q104 If a static vent became blocked at cruise level, how would this affect the barometric instruments during a subsequent descent? Select the correct response.

	ALTIMETER	ASI
A -	remain static	over-read
B -	remain static	under-read
C -	under-read	over-read
D -	under-read	remain static

Q105 If the gyro of a turn coordinator spins at a slower rate than that at which it was designed to, the aircraft rate of turn will be:

A - the same as the rate indicated.

B - less than the rate indicated.

C - greater than the rate indicated.

D - disproportionate to the rate indicated.

Q106 The gyro of an artificial horizon:

A - is a space gyro that rotates in the vertical plane about a horizontal axis.

B - is a tied gyro rotating in the horizontal plane about the vertical axis.

C - is an Earth gyro rotating in the vertical plane about the horizontal axis.

D - is an Earth gyro rotating in the horizontal plane about the vertical axis.

Q107 A DI may be aligned with the magnetic compass by:

A - using the caging knob to rotate the DI azimuth card when turning onto a heading.

B - using the caging knob to rotate the DI azimuth card when the wings are level.

C - housing the caging knob which will automatically align the azimuth DI card with the magnetic compass.

D - by maintaining the wings level, disengaging the caging knob and allowing the gyro to realign with the magnetic compass.

Q108 Select from the following those statements you consider to be characteristic of a direction Indicator (DI).

1 Mechanical friction in the gyro gimbal bearings although small, produces real drift.

2 The gyro will tilt during acceleration and wander during any turn greater than rate 1.

3 It is unaffected during acceleration or during a turn.

4 Any precession of the gyro may be corrected by the pilot by using the slaving knob.

5 Earth rotation and motion through space produces apparent drift from the fixed position in space to which it was aligned.

A - 1,2,4 and 5

B - 1,3,4 and 5

C - 2,3,4 and 5.

D - 1,2,3 and 4.

Q109 Which of the following employ either an air or electrically driven gyro?

1 Radio Magnetic Indicator

2 Horizon Indicator

3 Turn Coordinator

4 Rate of Turn Indicator

5 Vertical Speed Indicator

6 Heading Indicator

A - 2,3,4,5 and 6

B - 1,2,3 ,5 and 6

C - 1,2,3,4 and 6

D - 1,3,4,5 and 6

Q110 The function of an engine driven vacuum pump is to create sufficient airflow:

A - across a turbine that, in turn, drives the gyros.

B - through a helical impulse impeller which drives the gyros.

C - onto the gyro rotor to drive it around.

D - through a spiral impeller which drives the gyros.

Q111 A tied gyro, elemental to a direction indicator has its axis in the horizontal or yawing plane of the aircraft. It suffers from apparent wander (drift) because of:

A - friction generated by moving parts in the gimbal bearings.

B - fluctuations in vacuum pressure as engine RPM changes.

C - rotation of the earth about its axis.

D - its rigidity in space.

Q112 The gyro of a heading indicator continuously precesses during flight operations and should be regularly re aligned with the magnetic compass:

A - when the wings are level during accelerated flight or slowing down.

B - when the wings are level with all non essential electrical loads switched off.

C - during straight constant speed flight or constant speed climb or descent.

D - when the wings are level in straight and level constant speed flight.

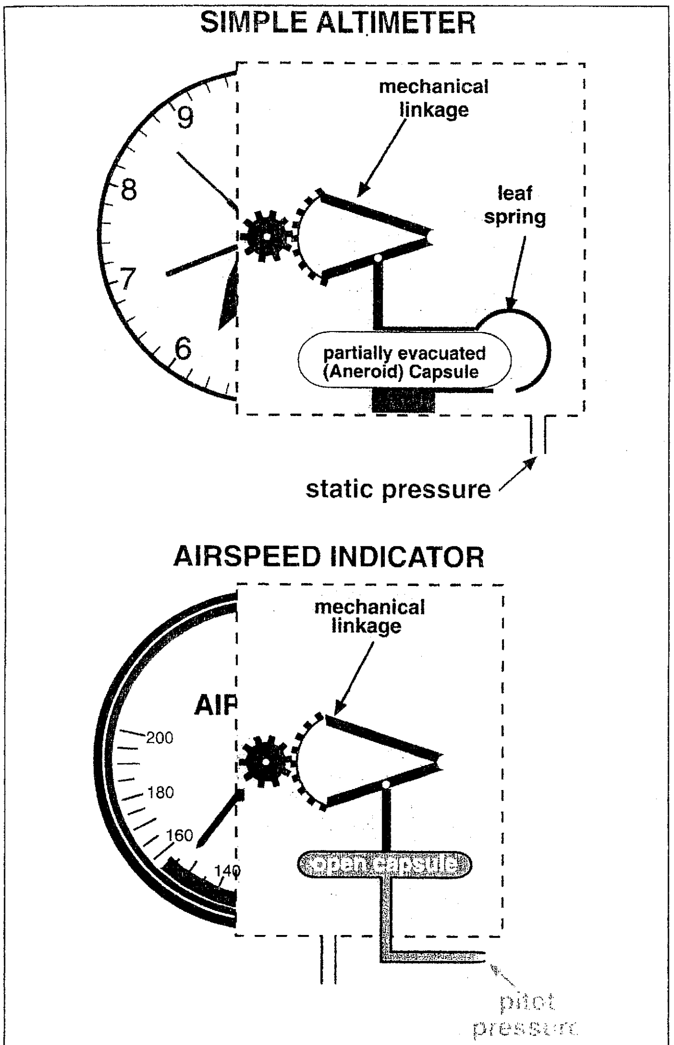


fig T39

during a descent. The partially evacuated capsule is prevented from collapsing by leaf spring action. Any capsule movement due to atmospheric pressure change is transmitted via a mechanical linkage to dials on the instrument face.

If the static pressure source became blocked in level cruise trapping the pressure at that level within the gas tight casing, during a subsequent climb or descent, the altimeter indication would remain static indicating the altitude at which the static vent became blocked.

Airspeed Indicator

An airspeed indicator employs both static and pitot pressure and is the only light aircraft instrument to employ both.

Pitot pressure sensed by the pitot tube is the product of two different pressures:

1 Dynamic pressure due to the forward speed of the aeroplane.

2 Static or atmospheric pressure.

Pitot pressure (dynamic pressure + static pressure) is fed to the inside of the capsule, while static pressure is fed to the inside of the instrument casing surrounding the capsule.

The effect of static pressure as a component of pitot pressure on the inside of the capsule is neutralised by static pressure acting on its outside. Therefore, any expansion or contraction of the capsule will be due solely to the value of dynamic pressure.

As dynamic pressure is the product of airspeed (Dynamic pressure = $\frac{1}{2}\rho V^2$, (where V = TAS), any movement of the capsule will be proportional to airspeed.

Should the static vent become blocked in level cruise, during a subsequent climb static pressure (as an element of pitot pressure) sensed inside the capsule would decrease, while that sensed by the outside of the capsule would remain static at a greater pressure, resulting in a partial capsule collapse. This would cause a lower airspeed to be indicated on the instrument face. The ASI would therefore under-read.

During a subsequent descent, static pressure (as an element of pitot pressure) sensed inside the capsule would increase, while that sensed by the outside of the capsule would remain static at a lower pressure, resulting in a partial capsule expansion. This would cause a higher airspeed to be indicated on the instrument face. The ASI would therefore over-read.

TEC105(C)

If the gyro of a turn coordinator rotates at less than its design speed, it will have less inertia and will be less rigid. It will tilt less, and indicate a slower rate of turn than the rate at which the aeroplane is actually turning.

TEC106(D)

See fig T40.

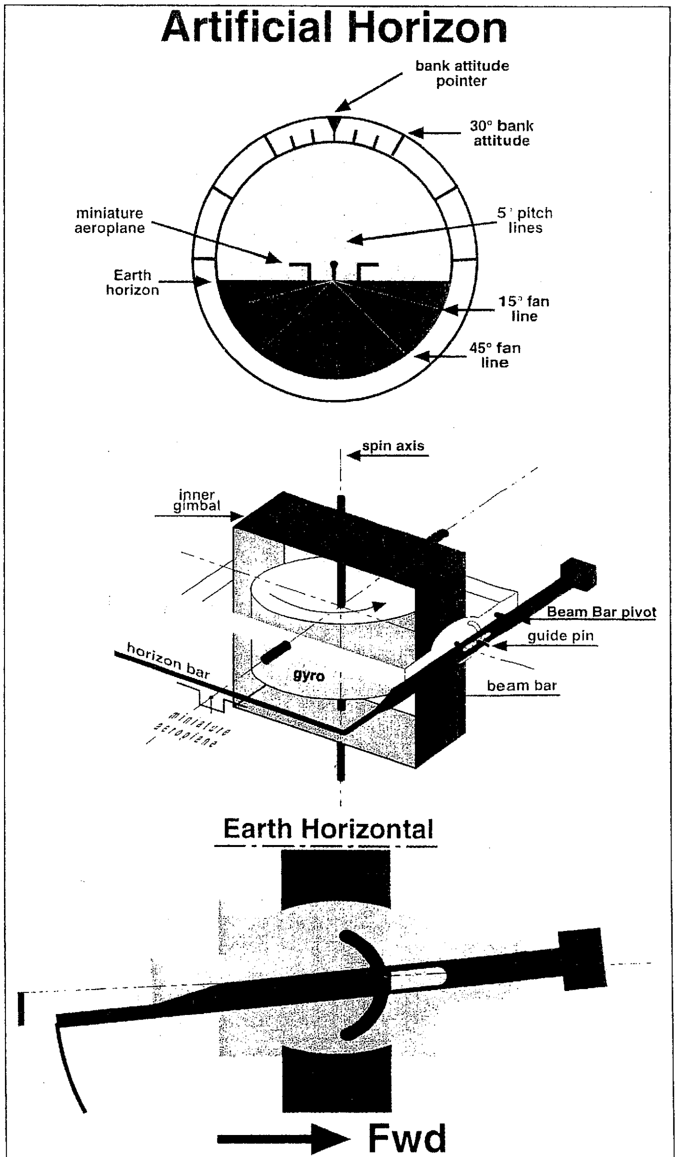


fig T40

The datum of an artificial horizon is provided by an Earth gyro. Irrespective of whether the the gyro is electrically driven or vacuum driven, the spin axis is maintained earth vertical by gravity so the gyro spins about the vertical axis through the horizontal plane.

TEC107(B)

See TEC108

Using the caging knob to rotate the DI compass card to synchronise it with the magnetic compass when the wings are level.

TEC108(B)

When a directional gyro is synchronised with a magnetic compass, it is actually aligned with a fixed point in space. Precession is the generic term used to describe the slow shift of a directional (tied) gyro away from its aligned fixed reference point in space..

However, unlike the magnetic compass, it does not suffer from acceleration or turning errors.

Mechanical friction within the gyro assembly produces a *mechanical drift* factor away from its desired fixed reference point.

The Earth itself rotates about its axis and orbits the sun, hence the direction of the fixed point in space to which our gyro is referenced will continually change. This is referred to as *apparent drift or wander*.

The aircraft itself travels though space over the Earth's surface which creates a change in the direction of the fixed point in space. This is called *transport wander*.

To summarise, there are three elements which cause precession.

1 - mechanical friction

2 - Earth rotation and solar orbit.

3 - aircraft transportation over the Earth

All three can be compensated for by re-aligning the directional indicator about every 10 minutes with the magnetic compass which is permanently aligned with magnetic north. Remember, when synchronising the DI with the magnetic compass, the aeroplane must be operated at a constant TAS with the wings level.

TEC109(C)

An RMI is a radio magnetic indicator, its compass card being slaved to a master electrically driven directional gyro and maintained referenced to magnetic north via magnetic field sensitive flux gates often located in the wing tips.

An horizon indicator in most light aircraft employs a vacuum driven earth gyro which has a vertical axis.

Both a turn and slip indicator and a turn coordinator employ a rate gyro and are normally electrically driven.

The laterally mounted horizontal axis rate gyro of the turn and slip indicator has only one gimbal so is only free to move about two axis. See fig T41.

Turn Indicator

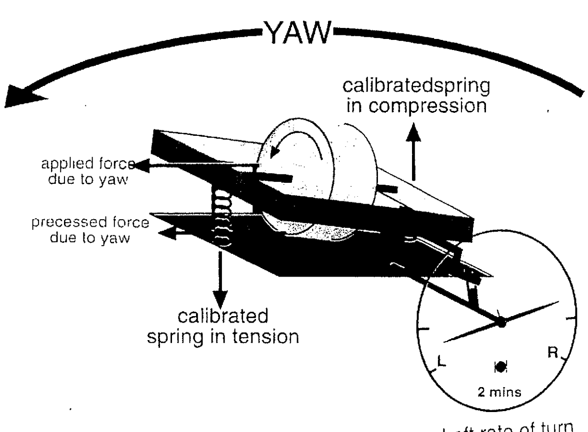


fig T41

There is no freedom of movement about the aircraft's vertical (normal) axis.

Aircraft yaw about the vertical axis will be precessed and cause the gyro to topple against the force of the retaining springs. The rate of yaw and consequently the amount of precessed force will determine the angle through which the gyro platform topples. The gyro platform will settle at an angle where the precessed force is equal and opposite to the spring force opposing it. This angular movement via a simple angular indicator is visualised by the pilot as a rate of turn.

Now largely redundant, the turn and slip indicator has been superseded by the turn co-ordinator.

Construction of the turn co-ordinator differs from the turn and slip indicator in that it is sensitive to both yaw and roll. The additional sensitivity is achieved by tilting the gyro axis upwards by approximately 30° - 35° making the platform sensitive to both roll and yaw precession.

The gyro gimbal is connected to the miniature aeroplane on the instrument display so when the aeroplane is turning, the miniature aeroplane banks in the direction of turn. The ball indicator being sensitive to inertia gives the same information as that in the turn and slip indicator.

The vertical speed indicator is a barometric instrument connected to the aircraft static system and displays rate of change of altitude or vertical speed.

A heading indicator or direction indicator employs a horizontal axis tied gyro which is vacuum driven. The spin axis is tied to remain within the aircraft's yawing plane. When the heading knob is depressed to reset the heading, a caging clamp engages with the inner gimbal aligning the spin axis with aircraft's horizontal plane. Hence the necessity for the wings to be level and the aircraft not turning when synchronising the heading indicator with the magnetic compass.

TEC110(C)

See fig T42.

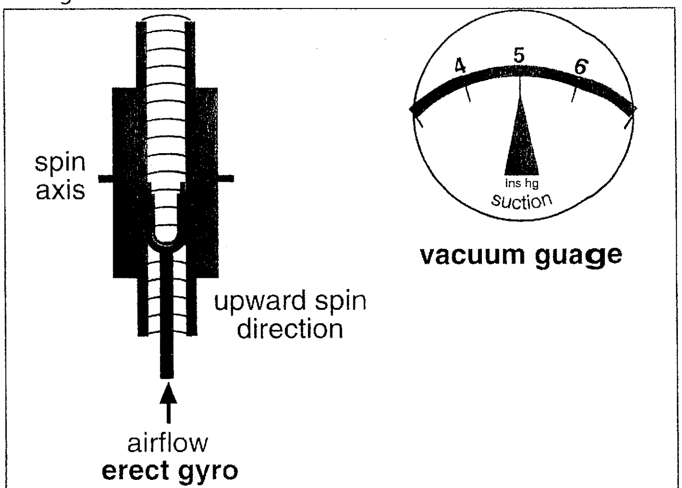


fig T42

Both the Artificial Horizon and Direction Indicator Gyros are vacuum driven.

An engine driven vacuum pump draws air through a filter upstream of the gyro onto buckets that form the outside of the gyro rotor. The reaction to the air striking the buckets is rotation of the gyro.

A vacuum pressure gauge on the instrument panel indicates the system vacuum in inches of mercury. The operating range is normally 3.5 to 5.5 inches of mercury, represented by a green arc on the instrument face.

TEC111(C)

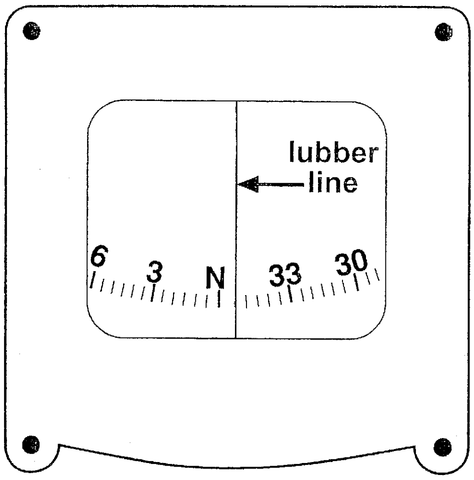
See TEC108

TEC112(D)

See TEC108

TEC113(D)

See fig T43.



FOR	N	030	060	E	120
STEER	003	031	061	090	122
FOR	S	210	240	W	300
STEER	179	209	241	270	298

fig T43

The direct reading magnetic compass is subject to errors produced by local magnetic influences, such as magnetic fields generated by radio equipment or ferrous items that form part of the aircraft structure.

Such magnetic influences cause the compass to deviate from magnetic north, the magnitude of which is termed DEVIATION and may vary with change of aircraft heading.

The rule (east is least and west is best) that requires local VARIATION between magnetic north and true north to be either added to or subtracted from the true heading to give magnetic heading, also applies to compass deviation.

The rule 'west is best,: add westerly DEVIATION to the magnetic heading to give compass heading.

'East is least': subtract easterly DEVIATION from magnetic heading to give compass heading.

When compass deviation is applied to a magnetic heading, the resulting compass heading is expressed in degrees Compass (°C).

The object of swinging the compass is to remove as much deviation error as possible, but a residual deviation error always remains on some, if not all, headings.

On completion of the compass swing, the amount the compass deviates on twelve magnetic headings at 30° intervals is noted and a compass deviation card is then compiled, giving the Compass Heading to steer on the bottom line to maintain the desired Magnetic Heading on the top line.

The compass lubber line is etched onto the glass face that forms part of the compass body, which itself is attached to the airframe with the lubber line aligned with the aeroplane's fore and aft axis..

The compass card is suspended in a viscous fluid inside the compass body so is free to rotate independent of aircraft movement.

The compass card (subject to deviation) always points to magnetic north and the aeroplane and compass body turn about the compass card.

The lubber line being aligned with the aeroplane's fore and aft axis always coincides with the aircraft heading.

TEC114(D)

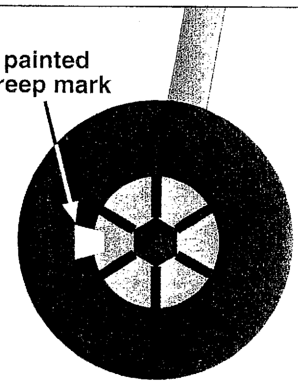
See TEC108

TEC115(A)

Due to higher temperature, air pressure inside the cockpit of an un-pressurised aircraft is generally less than outside air pressure. If selected, the alternate static source will produce a very small barometric instrument error proportional to the pressure difference.

TEC116(A)

See fig T44



Wheel Assembly
fig T44

Particularly at touch down, when a wheel assembly is subjected to rapid acceleration, there is a tendency for the tyre to rotate or creep a minute distance around the wheel hub.

This not only stresses the tyre, but also the inflating valve and inner tube, so the amount the tyre creeps has to be monitored.

Creep is made visible by painting an alignment mark, usually yellow or white, across the tyre and wheel flange assembly. Any excessive creep is made apparent by splitting of the paint mark.

TEC117(C)

Push-pull rods or cables connect the rudder pedals to a yoke at the top of the nose leg oleo, which rotates when a force is applied to the rudder pedals.

This rotary steering movement is transferred via a torque link to the bottom of the oleo which houses the nose wheel.

TEC118(C)

Carbon monoxide gas is lethal and is both odourless and colourless making it difficult to detect.

TEC119(C)

See TEC118.

TEC120(D)

Water based fire extinguishers are only suitable for extinguishing paper and some furnishing fabrics.

TEC121(A)

Although BCF and CO2 extinguishants may adequately deal with a wheel fire that involves not only burning rubber but also hydraulic fluid and combustible metals at very high temperatures, the recommended extinguishant published in CAP 562 is dry powder.

TEC122(D)

See fig T45.

Flap settings may be divided into two categories which are take-off flap and landing flap.

Take-off flap involves small flap settings in the order of 0° - 20°. Extra lift is generated with a relatively small drag penalty resulting in a slower take-off airspeed and shorter take-off run required.

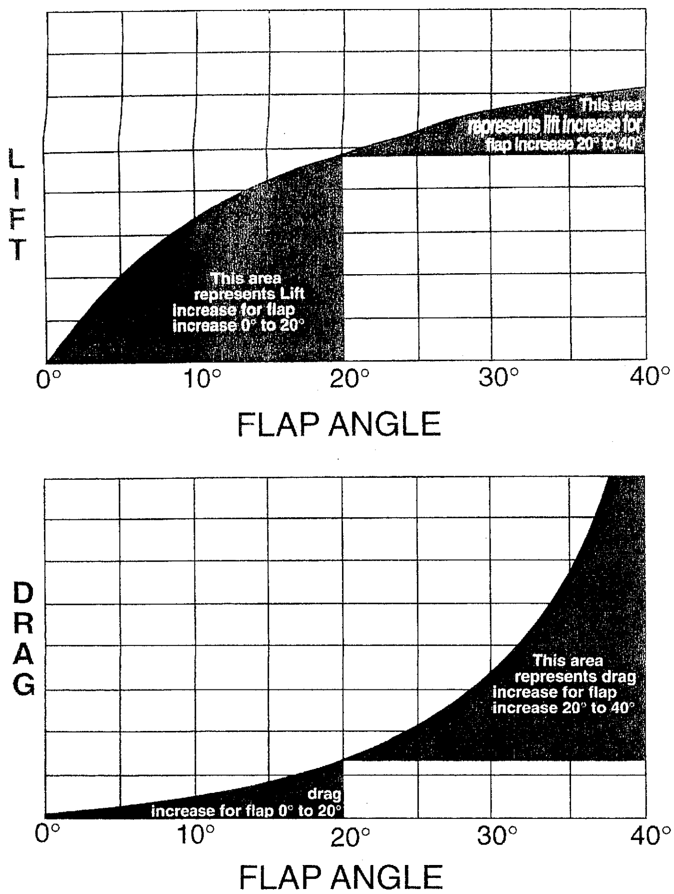


fig T45

The initial climb performance, although degraded with take-off flap selected will vary from aircraft to aircraft but the primary consideration is the reduced take-off run required.

TEC123(C)

BCF when exposed to heat gives off a toxic gas, but when attempting to extinguish a cockpit fire, as much oxygen as is practicably possible must be isolated from the heat source.

In the event of a cockpit fire, all windows and vents should be closed. After extinguishing the fire with the BCF extinguisher, the cockpit must be adequately ventilated.

TEC124(B)

An engine fire is normally fuelled by Avgas or oil or both. In the event of an engine fire, the throttle should be closed and the fuel isolated from the engine side of the fire wall by turning off the fuel valve.

All cabin air intakes should be closed to prevent fumes from entering the cockpit.

Should smoke and fumes persist, it is advisable to side slip the aeroplane to keep the fumes away from the cockpit.

TEC125(C)

In a single engine aeroplane, take-off safety speed is a target speed that should be achieved at the point of becoming airborne.

It allows safe control of the aeroplane by providing a safety margin over the stalling speed that is never less than 20% of the stall speed.

TEC126(B)

Common sense dictates that if an aircraft is going to ditch, the last thing the pilot wants when concentrating on more urgent matters is the nervous occupants of a cramped cabin compartment all struggling to locate and put on their life jackets.

Life jackets should be worn un-inflated when crossing a large expanse of water. At the point of evacuation, an inflated life jacket may impede an occupant's escape, or become punctured, or both.

TEC127(B)

The vacuum gauge has failed.

When you have an abnormal indication, always look for two parameters to identify what has occurred. In the case of a vacuum gauge failure on a light aircraft, if the vacuum driven gyros are functioning normally, then you will have only one abnormal parameter, the gauge itself.

If the engine driven pump failed, you would have three possible parameters; run down of the artificial horizon and directional indicator gyros together with the vacuum gauge reading zero.

TEC128(D)

Carbon dioxide: one reason for its use is that it is incombustible.

TEC129(D)

A Certificate of Airworthiness (C of A) is normally issued for a three year period at the end of which it will expire.

During that three year period, the validity of the C of A is maintained, amongst other things, by continuous maintenance carried out in accordance with the approved schedule of maintenance.

TEC130(C)

See fig T46.

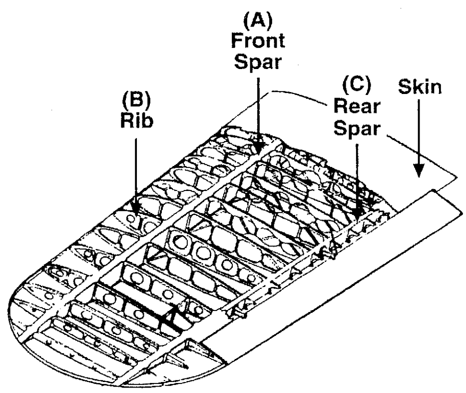


fig T46

A and **C** are respectively the front and rear spars which connect the wing to the fuselage and predominantly carry the lateral bending loads imposed during flight by the aircraft self weight and additional aerodynamic loads imposed during manoeuvres.

Aerodynamic loads imposed on the skin **D** are transmitted to the spars via the ribs **B** which also give the wing its aerodynamic profile.

TEC131(C)

See fig T47.

The Vertical Speed Indicator (VSI) displays the rate in feet per minute at which the aeroplane is climbing or descending. The principle of operation is the rate of change of barometric pressure that occurs with change of altitude.

The instrument is contained in a sealed case, inside of which is is a capsule connected to the aircraft static air source.

Static air is fed directly to the inside of a capsule at the same time being allowed to leak at a much slower rate via a calibrated restrictor, into the sealed casing surrounding the capsule.

If altitude is changed, this sets up a differential pressure inside the case that will cause the capsule to either expand or contract. Capsule movement is transmitted via a mechanical linkage to

VERTICAL SPEED INDICATOR

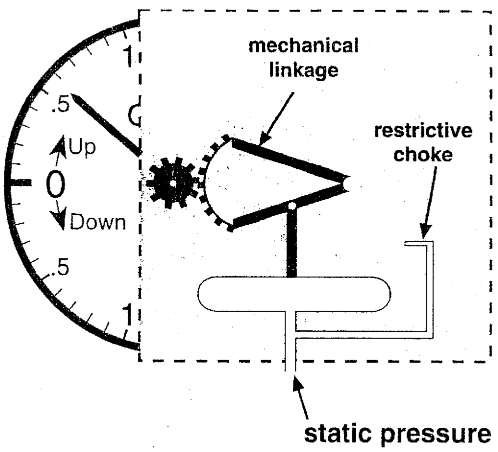


fig T47

the dial on the instrument face to indicate a rate of change of altitude or vertical speed.

The magnitude of the pressure differential is directly proportional to the aircraft's rate of climb or descent.

Once level after changing altitude, the pressures inside and outside the capsule will equalise and the indicator will read zero.

Should the static source become blocked during a climb or descent, the pressures inside and outside the capsule will equalise and the instrument will return to zero.

TEC132(A)

Altimeter See fig T48.

SIMPLE ALTIMETER

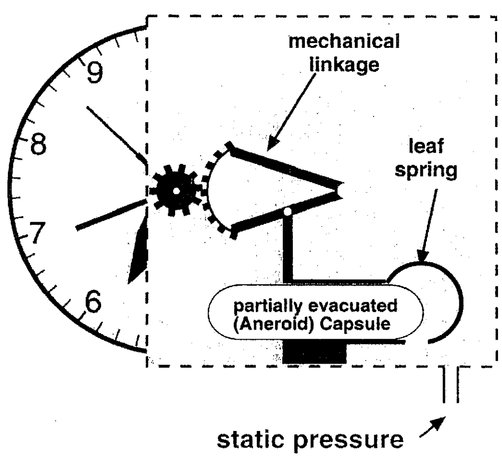


fig T48

The outside of the partially evacuated (Aneroid) capsule within the altimeter body is connected to the aircraft static system and senses atmospheric pressure. During a climb, the capsule will expand due to decreasing atmospheric pressure and contract during a descent. The partially evacuated capsule is prevented from collapsing by leaf spring action. Any capsule movement due to atmospheric pressure change is transmitted via mechanical linkage to dials on the instrument face.

TEC133(C)

A supplement contains CAA observations and directives that limit the operation of the aircraft and normally conflict with the operational parameters specified by the manufacturer.

An example being a CAA supplement that renders an aeroplane unsuitable for spinning when its manufacturer deems spinning as a suitable manoeuvre.

A supplement is normally found at the back of the flight manual.

TEC134(A)

What a pilot may or may not undertake is something that just has to be learned, as there are 17 such repairs or replacements listed in the Air Navigation Order (ANO).

ANO Sect 3/(16) page 22.

Any maintenance work carried out by a pilot as laid down by Regulation 16 must be entered into a log book or other appropriate document and certified by the pilot concerned.

TEC135(C)

Away from base, a pilot qualified on the aircraft type may carry out the second inspection to a control system that has undergone adjustment.

TEC136(B)

The C of A becomes invalid until such time that the required maintenance is carried out in accordance with the approved schedule of maintenance.

TEC137(B)

See fig T49.

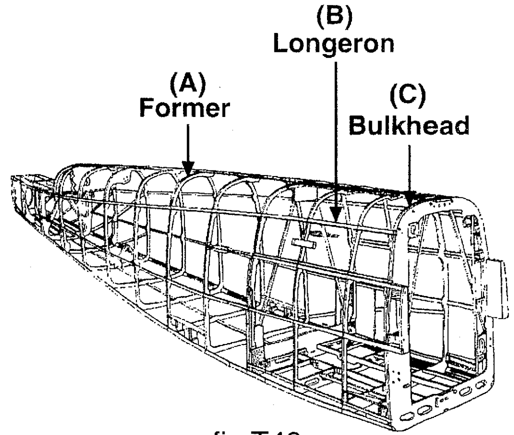


fig T49

Illustrated in the question and above is an exposed wooden fuselage construction. Although normally employing more component parts than a metal structure, the same component nomenclature applies.

(**A**) Formers give the fuselage its basic shape and absorb torsion and bending loads.

(**B**) Longerons running fore and aft, stiffen the structure and distribute loads between the formers. Bulkheads

(**C**) Bulkheads are of more robust construction than formers and usually define compartment extremities or are situated where additional support structure is required such as the location of internal doors.

TEC138(B)

Flying control stops are mechanical devices that confine the angular movement of flying control surfaces to prescribed limits. Their function is to prevent excessive control surface deflection by the pilot.

TEC139(D)

The two functions of a wheel spat are to provide a streamlined surface around undercarriage wheel assemblies to reduce form drag and prevent debris from being thrown up into the airframe by the undercarriage wheels during ground operations.

If spats become contaminated with mud, which may also contain stones and other extraneous matter, the aircraft weight will be increased and any foreign bodies contained by the mud could damage both the tyre and wheel brake assemblies.

Spats must be removed and freed of any extraneous matter before flight.

TEC140(B)

See fig T50

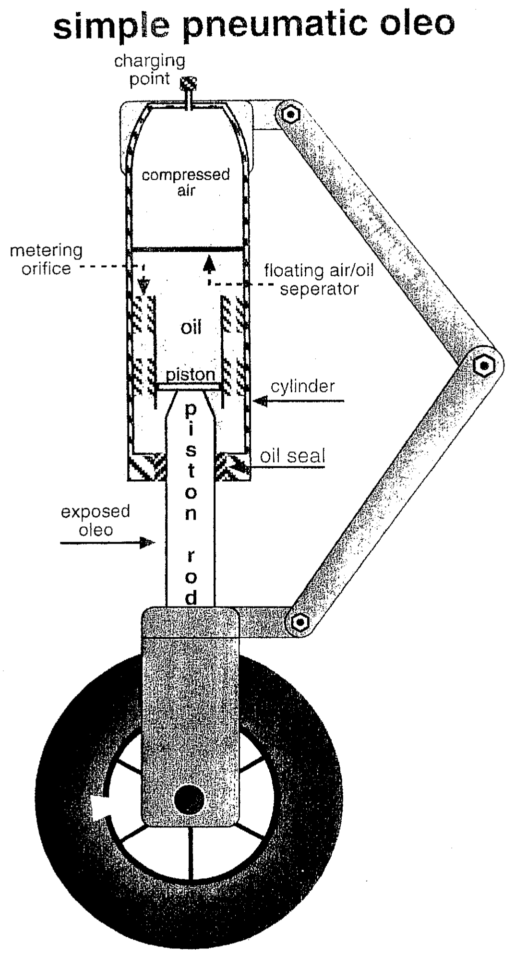


fig T50

Nose wheel shimmy is an involuntary oscillation of the nose wheel from side to side.
The torque link connects the top and bottom parts of the oleo. Its function is to restrict oleo extension and transmit to the the lower part of the oleo (which houses the nose wheel) steering movement applied to the the upper part of the oleo, by the pilot, via the rudder bar.

When the torque link is worn, the nose wheel will have a limited amount of free movement, which allows an oscillatory motion to set up when taxying. This is a common occurrence when taxying over an irregular surface.

Note: The shimmy damper is not designed to cope with a worn torque link.

TEC141(A)

When standing water is present on a runway, the aeroplane may ride up onto the film of water. The wheels under braking action will cease to rotate and that part of the tyre in contact with the water will super heat resulting in a flat spot. Skidding on a dry surface will have the same result except braking action will not be lost and the aeroplane's forward velocity will be retarded.

Flat spots are unacceptable as the tyre will be out of balance resulting in possible severe vibration during high speed taxy plus the tread in the area of the flat spot may be thin making the tyre susceptible to puncture.

TEC142(C)

Fuel is an effective coolant. If the fuel air mixture is enriched above that required for normal engine operation, the excess fuel will largely remain unburned and will conduct heat away from the combustion chamber walls, thereby lowering the cylinder head temperature.

TEC143(C)

Baffles are located inside engine cowlings to direct air towards the cylinder heads and other components such as magnetos and generators.

TEC144(A)

The one fixed parameter that determines to what extent the airflow conducts heat away from an engine is its surface area, particularly that of the cylinder heads in contact with the airflow. By designing a cylinder head with fins, two things are achieved.

1 - The area of cylinder head in contact with the airflow is significantly increased.

2 - The fins by design help concentrate the airflow close to the cylinder head and achieve uniform cooling.

TEC145(C)

Land as soon as possible as the engine could fail.
The oil in an Internal combustion engine conducts heat away from and lubricates bearing surfaces. If an oil leak is evident, diminished oil quantity will cause a rise in oil temperature and a drop in pressure. Eventually, the engine will fail. Continually monitor your engine parameters and land at the nearest available airfield.

It would also be advisable to continually monitor the surrounding topography in the event a forced landing became a necessity.

TEC146(A)

Static vent blocked by ice.

ALTIMETER: See fig T51.

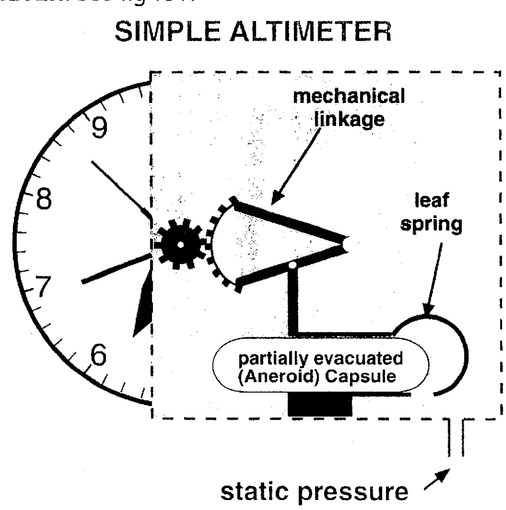


fig T51

The outside of the partially evacuated (aneroid) capsule within the altimeter body senses atmospheric pressure which due to decreasing pressure, will expand during a climb and contract during a descent. The partially evacuated capsule is prevented from collapsing by leaf spring action. Capsule movement due to atmospheric pressure change is transmitted via mechanical linkage to dials on the instrument face.

If the static pressure source became blocked due to icing in level cruise, pressure at that level would become trapped within the gas tight casing.

During a subsequent climb or descent, the altimeter would remain static, indicating the altitude at which the static vent became blocked.

VERTICAL SPEED INDICATOR

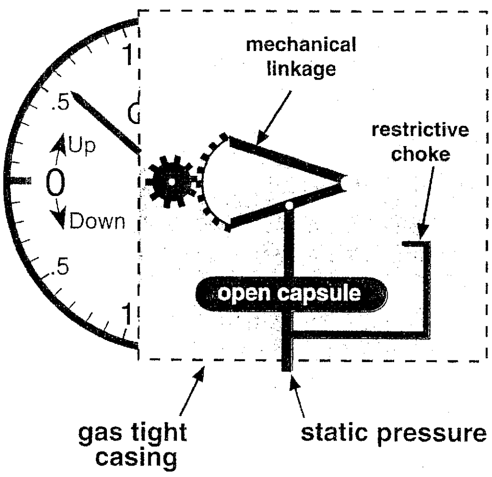


fig T52

Vertical Speed Indicator (VSI): See fig T52.

The Vertical Speed Indicator (VSI) displays the rate in feet per minute at which the aeroplane is climbing or descending. The principle of operation is the rate of change of barometric pressure that occurs with change of altitude. The instrument is contained within a sealed case inside of which is a capsule connected to the aircraft static air source.

Static air is fed directly to the inside of a capsule at the same time being allowed to leak at a much slower rate via a calibrated restrictor into the sealed casing surrounding the capsule. If altitude is changed, this sets up a differential pressure inside the case that will cause the capsule to either expand or contract.

Capsule movement is transmitted via a mechanical linkage to a needle on the instrument face to indicate a rate of change of altitude. The magnitude of the pressure differential is directly proportional to the aircraft's rate of climb or descent. Once level after changing altitude, the pressures inside and outside the capsule will equalise and the instrument will read zero.

Should the static source become blocked during level flight, the pressures both inside and outside the capsule would remain equal and the instrument would indicate zero rate of altitude change during any subsequent climb or descent.

Airspeed Indicator (ASI): See fig T53

AIRSPEED INDICATOR

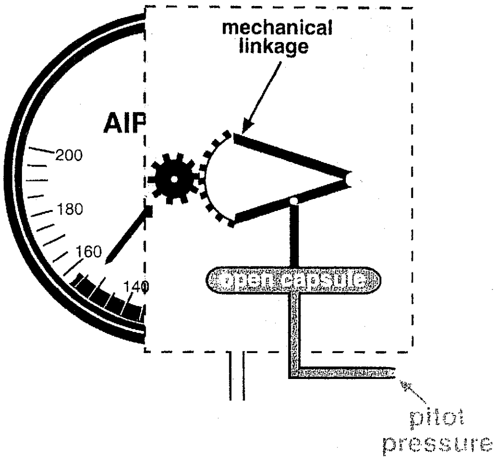


fig T53

An airspeed indicator employs both static and pitot pressure and is the only light aircraft instrument to employ both.

Pitot pressure sensed by the pitot tube is the product of two different pressures:

1 Dynamic pressure due to the forward speed of the aeroplane.

2 Static or atmospheric pressure.

Pitot pressure (dynamic + static) is fed to the inside of the capsule, while static pressure is fed to the inside of the instrument casing surrounding the capsule.

The effect of static pressure inside the capsule is neutralised by static pressure acting on its outside. Any expansion or contraction of the capsule will be due solely to the value of dynamic pressure.

Dynamic pressure is the product of airspeed:

Dynamic pressure = $\frac{1}{2}\rho V^2$ where **V** = **TAS** so any movement of the capsule will be proportional to airspeed.

Should the static vent become blocked in level cruise, during a subsequent climb, static pressure (as an element of pitot pressure) sensed inside the capsule would decrease while that sensed by the outside of the capsule would remain static at a greater pressure. A partial collapse of the capsule would occur causing a lower airspeed to be indicated. The ASI would therefore under-read.

In a descent the reverse would be true as the ASI would over-read.

TEC147(D)

See fig T54.

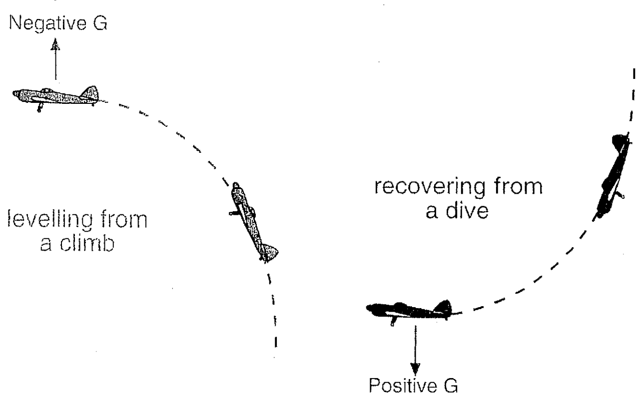


fig T54

An aircraft in straight and level unaccelerated flight is generating enough lift to overcome gravity and support its own weight. This equals 1G (its own weight) which is a positive load factor of 1G.

Any manoeuvre imposing additional positive loads such as the centrifugal force generated during a steep turn or the downward inertia that has to be overcome when pitching up to arrest a rapid descent will effectively increase the aircraft weight. If the imposed load due to a manoeuvre is also equal to the aircraft weight, the effective aircraft weight is doubled or subject to a load of 2G

ie. The aircraft self weight + the imposed load. 1G +1G = 2G

An example of negative G would be when levelling rapidly from a high rate of climb. If the applied negative force in this instance was -1G then the aircraft and its occupants would effectively weigh nothing and would momentarily experience weightlessness.

ie: .The aircraft weight + the imposed load. 1G + (-1G) = 0G

The aircraft C of A prescribes the G limits. Normally, the prescribed negative G limits within which an aircraft must be operated are less than the positive G limits and these should be well understood by any aircraft commander.

If any G limit is exceeded, even momentarily, the aircraft must be inspected by a qualified engineer as structural damage or failure could have occurred.

TEC148(D)

Slow response of a vacuum driven gyro instrument is a normal consequence of a lack of rigidity produced by the gyro rotor under speeding. Either a leak in the vacuum system or a partial blockage of the vacuum system filter would produce such results. Check the vacuum gauge for the correct vacuum pressure.

TEC149(A)

A dry sump engine scavenges oil from the bottom of the engine and returns it to an oil storage tank. The scavenge pump has a greater capacity than the pressure pump to ensure an adequate supply of oil from the storage tank. See fig T55.

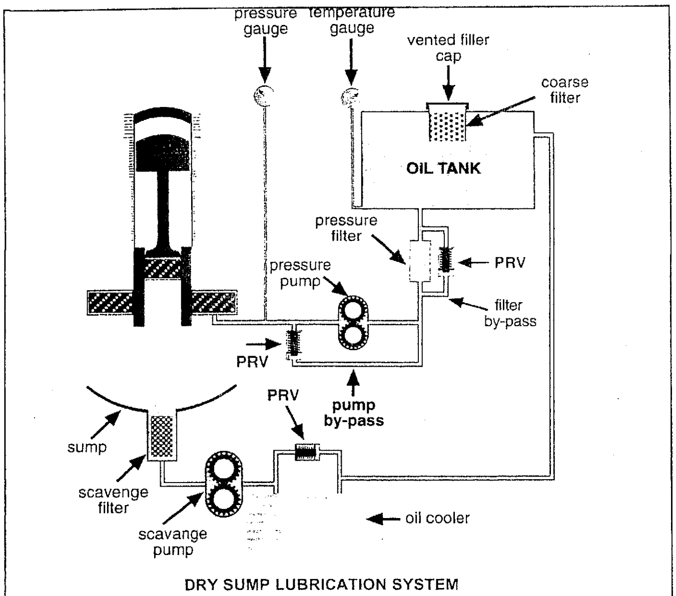


fig T55

A wet sump engine does not feature either a storage tank or a scavenge pump, allowing oil to be collected at the bottom of the engine or sump. The pressure pump draws oil directly from the sump via a coarse scavenge filter then directs it via a pressure filter to the main oil gallery. See fig T56.

TEC150(B)

See fig T56

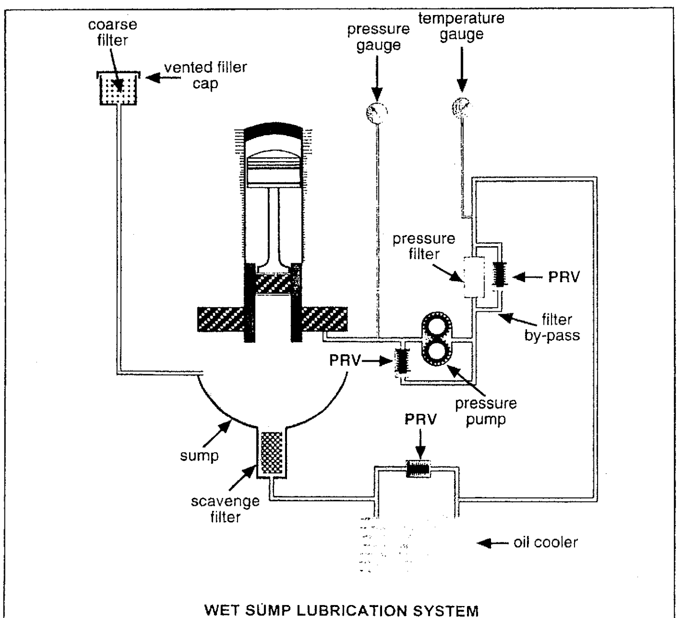


fig T56

The oil pressure sensor is located on the outlet side of the pressure pump because any undue wear of bearings that are pressure lubricated via the main oil gallery will result in a lower than normal indicated oil pressure. Also, wear of the oil pressure pump itself will be indicated by a lower than normal oil pressure. Low and/ or fluctuating oil pressure could eventually lead to engine failure so if noticed during flight, land as soon as possible and have the problem investigated by a qualified engineer.

TEC151(B)

See TEC149 and figs T55 & T56.

Fluctuating oil pressure together with rising oil temperature is commonly associated with low oil quantity. Low quantity may cause the pressure pump to cavitate resulting in fluctuating oil pressure indication whilst insuffient oil necessary to transmit heat away from hot areas of the engine will cause a rise in the indicated oil temperature. **Land as soon as possible**

TEC152(A)

See TEC149.

TEC153(A)

See TEC15.

An integral stressed skin with no apertures.

TEC154(B)

A semi-monocoque structure is a stressed skin with supported apertures and a light internal framework.

See TEC15.

TEC155(C)

See TEC138

Aircraft certificated in the normal or utility category are usually limited to manoeuvres that do not impose high positive and negative load factors.

Aircraft certificated in the aerobatic category may be flown through manoeuvres such as loops, spiral dives and spins which could impose higher than normal loads on the airframe.

Hence, an aircraft certificated in the normal or utility categories will have positive and negative load factor limits that are less than an aircraft certificated in the aerobatic category.

TEC156(B)

See fig T57.

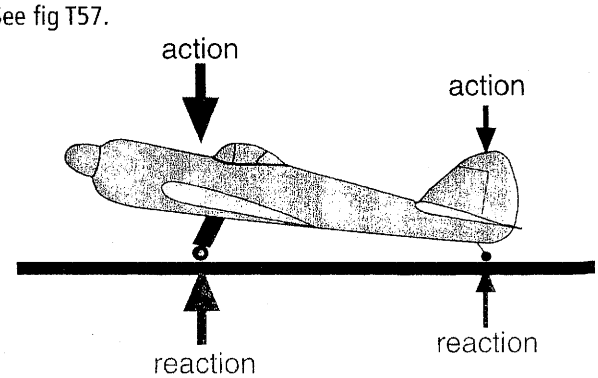


fig T57

This question explores the candidates knowledge of Newton's Laws of Motion.

His third law states that:

To every action, there is an equal and opposite reaction.

A body at rest on the ground will exert a force (action) vertically downward by virtue of its own weight which is the effect of gravity. The body remains at rest because of a reaction equal to the body's weight acting vertically upwards opposing gravity.

TEC157(D)

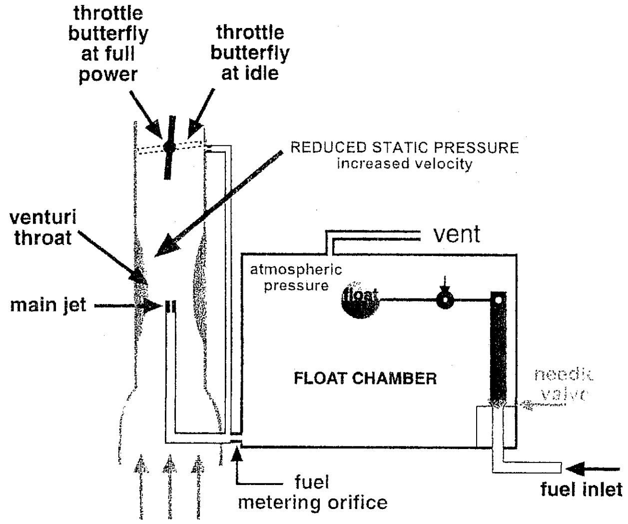
Engine cowlings have two functions.

(a) They streamline the airflow around the engine thus reducing drag.

(b) They permit a metered amount of air to be ducted inside the cowling around the engine to maintain the correct engine operating temperatures.

TEC158(D)

See fig T58.



UPDRAUGHT CARBURETTOR

fig T58

From the entry point, the cross sectional area of the venturi reduces to form a convergent duct, becoming narrowest at the mid-point (throat). Air entering a convergent duct will increase in velocity and its static pressure will decrease, the greatest pressure drop being at the throat which then widens to form a divergent duct. Air passing through a divergent duct will decrease in velocity and expand.

The static pressure drop in the venturi throat to below outside atmospheric pressure (sensed by the fuel in the float chamber) draws fuel from the float chamber, through the main jet into the venturi throat.

TEC159(B)

The fuel element of the fuel/ air mixture has two functions:

1 When mixed with air, provide a volatile chemical mixture for combustion.

2 Act as a coolant to aid cylinder head cooling.

When a correct fuel/ air mixture under pressure is ignited, it burns at a relatively much slower, controlled rate than an uncontrolled explosion.

If the mixture is too lean, detonation could occur. Detonation is the uncontrolled explosive combustion of the fuel/ air mixture during which, combustion temperature and combustion chamber pressure will be excessive, both of which could lead to structural damage.

Too rich and the mixture burn will be slow and inefficient with the engine developing less power. In the extreme, unburned fuel will wash lubricant from the cylinder walls and accelerate both piston ring and cylinder bore wear.

The fuel/ air mixture is determined by the weight of its component parts. Ideally the mixture should be in the region of 1 part fuel to 12 parts air by weight.

With altitude increase, the weight of air for a given volume is reduced because it is less dense hence, the fuel weight should be reduced by leaning to maintain the correct fuel/ air weight ratio.

1 The mixture control should be moved towards lean until the engine RPM ceases to increase and begins to decrease.

2 The mixture is then enriched to a position of maximum RPM and then moved slightly (approximately 2 turns) to the rich side of peak RPM.

Remember, fuel is a cooling agent!

TEC160(A)

A simple carburettor is normally slow to respond to a rapid throttle advance, causing the fuel quantity entering the carburettor venturi to lag behind the increased air flow caused by the throttle butterfly opening. If the fuel flow was not enhanced, an over lean mixture could cause the engine to misfire or worse, cut out.

Fuel flow is enhanced by a simple plunger type accelerator pump immersed in the float chamber, its piston connected to the throttle linkage. A rapid throttle advance such as that demanded during a missed approach results in the delivery of a compensating amount fuel to the venturi and a combustible fuel air mixture.

TEC161(A)

See TEC 159.

TEC162(D)

See fig T58 and fig T30 page 184.

The main fuel jet in a carburettor has a fixed orifice designed to supply the correct amount of fuel to mix with the volume of air passing through the venturi, the volume of air being determined by the position of the throttle butterfly. As such, the main fuel jet is designed to function across a wide range of power settings. When the throttle is closed, or set to idle, the throttle butterfly valve creates a small aperture across the idle jet orifice, the ambient pressure drop being sufficient to draw a small amount of fuel into the venturi and sustain the engine at a low RPM.

TEC163(B)

Aircraft piston engines are typically designed to operate at 60-65% power in the cruise with anything greater than 75% deemed to be a high power setting. One element that determines the cooling efficiency of the airflow passing over and around an engine is its cross sectional area and another is airspeed. In the cruise configuration with cruise power set, the engine is designed to operate at its optimum temperature. However, at high power settings and low airspeed such as in a climb, the airflow may be inadequate to maintain the optimum operating cylinder head temperature.

Fuel itself is a cooling agent and if selected, the excess fuel in a rich mixture entering the combustion chamber will absorb heat from the cylinder head in the process of evaporation and help maintain the operating temperature close to optimum.

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