higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

AIRCRAFT MAINTENANCE THEORY N2

14 APRIL 2020

This marking guideline consists of 9 pages.

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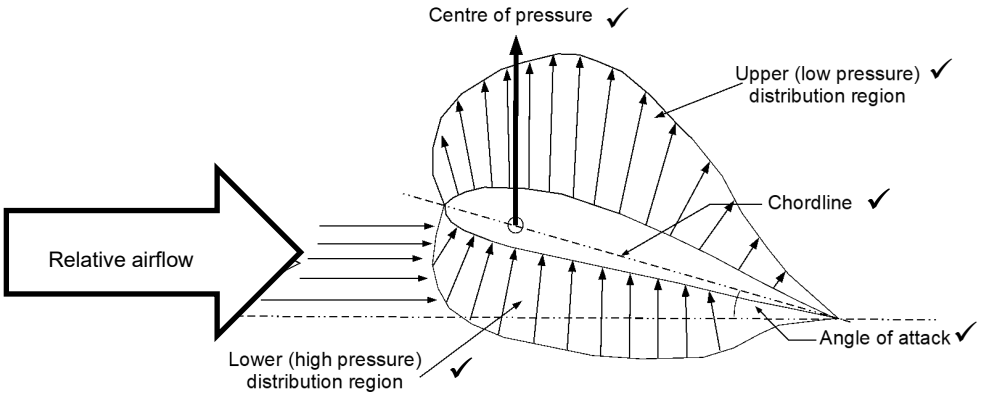
QUESTION 1

1.1



(5)

1.2
- Aerofoil B will produce more lift than aerofoil A.
- Aerofoil B has a greater camber.
- It causes the air to travel a longer path thus accelerating more which creates a lower pressure on the top of the aerofoil.
- This increases the lift produced by the aerofoil. (4)

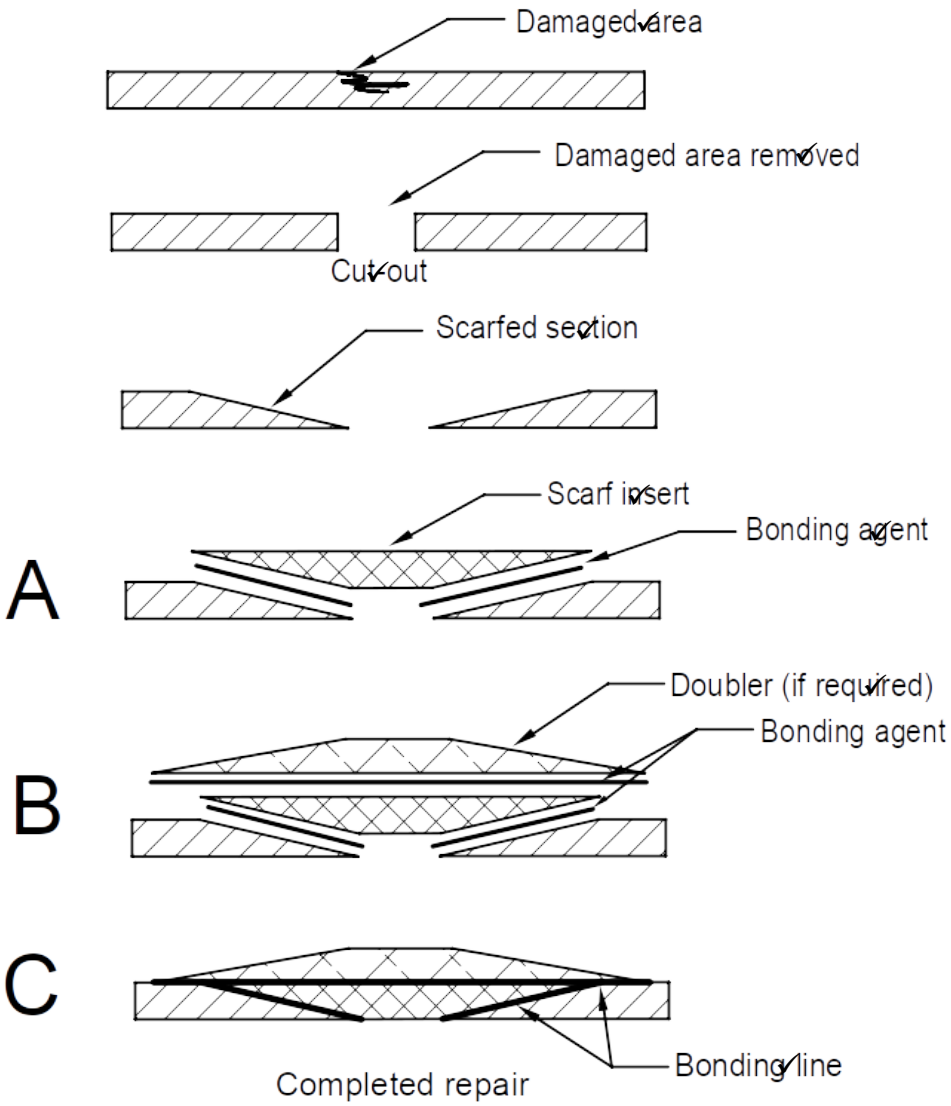
1.3
- When aerofoils are flown at a positive angle of attack, a pressure differential exists between the upper and lower surfaces of the aerofoils.
- The pressure above the wings is less than the atmospheric pressure and the pressure below the wings is equal to or greater than the atmospheric pressure.
- As air always moves from high pressure towards low pressure and the path of least resistance is towards the aerofoils' tips, there is movement of air across the span from the bottom of the aerofoils outward from the fuselage around the tips.
- This flow of air results in 'spillage' over the tips, thereby setting up a whirlpool of air called a vortex.
- At the same time the air on the upper surfaces has a tendency to flow in toward the fuselage and off the trailing edge.
- This air current forms a similar vortex at the inboard portion of the trailing edges of the aerofoils, but because the fuselage limits the inward flow, the vortex is insignificant.
- Consequently, the deviation in flow direction is greatest at the outer tips where the unrestricted lateral flow is the strongest. (Any 5 × 1) (5)

1.4 1.4.1
- Longerons take the primary bending loads which usually extend across several points of support (formers and bulkheads).
- The strong, heavy longerons hold the bulkheads and formers in place.
- Longerons prevent tension and compression stresses from bending the fuselage. (Any 2 × 1) (2)

1.4.2
- They have some rigidity but are mainly used for giving shape to the air frame structure and for attachment of the skin.
- Stringers to a lesser extent also prevent tension and compression stresses from bending the fuselage but it is not their primary function if longerons are present.

(2 × 1) (2)

1.5



Scarf repair of composite structure

(3 marks for labelling, 2 marks for drawing)

(Candidates may draw the whole sequence or only A, B or C.) (5)
(Marks should be allocated for each of the parts and labels.) **[23]**

QUESTION 2

2.1 2.1.1 The function is to convert pressure energy into mechanical force or action to perform work. (1)

2.1.2
- When the selector valve is placed in the ON-position or EXTEND-position, fluid is admitted under pressure into the left-hand chamber of the actuating cylinder.
- This results in the piston being forced toward the right.
- As the piston moves toward the right, it pushes return fluid out of the right-hand chamber and through the open selector valve to the reservoir.
- When the valve is placed in the RETRACT-position, fluid pressure enters the right-hand chamber, forcing the piston toward the left.
- As the piston moves toward the left, it pushes return fluid out of the left-hand chamber and through the selector valve to the reservoir. (3)

2.2 A heat exchanger is a device used to transfer heat✓ between two or more fluids.✓ (2)

2.3 The purpose of the outflow valve is to vent cabin air overboard✓ through suitable openings in the wing fillet or the fuselage skin to control the pressure within the cabin.✓ (2)

2.4 It is a system that ensures the comfort and safety of crew and passengers by controlling/regulating✓ the cabin pressure, oxygen content and the exchange of air from the inside of the aircraft to the outside.✓ (2)

2.5
- Lateral datum plane
- Longitudinal datum plane (2)

2.6
- After checking and verifying the rigging of the horizontal stabiliser, the verticality of the fin relative to the lateral axis can be checked.
- Measurements are taken from points specified on the horizontal stabilisers to specified points on the top of the fin.
- The measurements are then compared with each other and with the specifications in the maintenance manual. (3)

2.7
- Check the system for freedom of movement by moving the cockpit controls.
- Check for correct cable routing.
- Check that all control surface movements correspond to cockpit control movement by carrying out a directional (synchronisation) check.
- Check the system for the correct static friction.
- Check the system for lost motion.
- Check the travel of the control surfaces for the correct amount of deflection.
- Check that the trim-, balance- or antibalance tab move correctly in relation to control surface movement. (Any 2 × 1) (2)

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2.8
- The incidence of the left or right main plane is incorrect.
- Ailerons are out of alignment when the control column is central/neutral.
- The dihedral of the main plane is incorrect.
- The adjustment of the aileron trimming tab was incorrectly done.
- One of the main planes are distorted or damaged.
- There is unequal wing loading. (Any 3 × 1) (3)

[20]

QUESTION 3

3.1 3.1.1 Annealing = 400 °C

3.1.2 Normalising = 500 °C

(2 × 1) (2)

3.2
- Anodise aluminium and aluminium alloys.
- Apply chromate treatment to magnesium and magnesium alloys.
- Apply coslettising or similar processes to steel.
- Cover the metal with another metal that is less likely to corrode, i.e. covering duralumin with a layer of aluminium ('alclad') and steel with cadmium plating.
- Apply the correct heat treatment.
- Correct alloying of metals with other metals that are highly resistant to corrosion such as nickel, chrome, etc.
- Preventing dissimilar metals in contact.
- Avoid, if possible, fitting metals in over-stressed areas.
- Covering the surface with a protective agent such as enamel, paint varnish, grease, lanolin, etc. (Any 4 × 1) (4)

3.3
- Pitting of the surface.
- Formation of invisible micropores with no apparent sign of erosion. (2)

3.4 Adding of lead to aviation gasoline was done to increase the antiknock rating (octane number) of the fuels✓ to reduce its tendency to detonate and increase its power output.✓ (2)

3.5
- Allow ease of flow under all operating conditions.
- Allow quick starting of the engine.
- Have a high calorific value.
- Provide complete combustion under all conditions.
- Be noncorrosive.
- By-products of combustion should have no harmful effect on the flame tubes and turbine section.
- Be a minimum fire hazard.
- Be available in large quantities.
- They must be inexpensive.
- They must be readily available. (Any 2 × 1) (2)

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3.6 3.6.1
- Viscosity of a lubricant is its degree of resistance to flow - the thinner the oil, the easier it flows and vice versa.
- This is also connected to the temperature of the oil, the lower the viscosity, the easier the oil will flow.
- Viscosity determines how easy it is for oil to be pumped and move through lines and passages.
- The oil must be thick enough to keep moving parts from contacting each other and thin enough to permit adequate flow and minimise viscous drag. (4)

3.6.2
- If the viscosity is too high:
  The oil will not flow easily enough and will not flow well into the small bearing spaces which will reduce the ability of the lubricant to prevent wear and friction.
- If the viscosity is too low:
  The oil will flow too easily and will be too thin which allows the lubricant to squeeze out of the bearing spaces under pressure and this will reduce the ability of the lubricant to prevent wear and friction. (2)

3.7
- The function of the venture in the carburettor is to increase the velocity of the airflow through the venturi which results in the pressure decreasing.
- The reduced pressure within the venturi creates a suction that draws fuel into the airstream from the float chamber. (2)

[20]

QUESTION 4

4.1
- A supercharger's impeller can be driven directly from the engine by means of a gearbox or a belt drive.
- A supercharger's impeller can also be directly driven by an electric motor.
- A turbocharger's impeller is driven solely by exhaust gas pressure and the velocity in the exhaust pipe
- that drives a turbine that is connected to the impeller. (4)

4.2 4.2.1 A variable-pitch propeller permits a change of blade pitch or angle, while the propeller is rotating (in flight) which allows the propeller a blade angle that gives the best performance for particular flight conditions. (1)

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4.2.2
- The blade pitch can be changed during flight while the propeller is rotating.
- The pitch can be set for most optimum efficiency under all operating conditions.
- Reduced take-off roll and improved climb performance are achieved.
- It has an improvement in fuel efficiency and a greater range is achieved.
- Higher top speeds can be achieved without the engine over-speeding while the propeller absorbs high power.
- Steeper descent and shorter landing roll can be used.
- Reduced strain is placed on the engine. (Any 3 × 1) (3)

4.3
- Indicated horse power (IHP) (the indicated power produced by an engine) is the power calculated from the indicated mean effective pressure and the other factors which affect the power output of an engine.
- Brake horse power (BHP) is the power actually delivered to the drive-shaft (propeller) for useful work. (2)

4.4 PISTON ENGINE
- Switch off all nonessential systems.
- Switch battery or master on.
- Turn fuel valves on.
- Switch booster pumps on and check the fuel gauge to ensure that fuel is delivered.
- Prime the engine for the recommended period.
- Open throttle to idle, start or prescribed position depending on engine type.
- Close cowl flaps fully.
- Turn ignition switch to both.
- Press the start button to rotate the engine. (Any 6 × 1) (6)

OR

GAS TURBINE ENGINE
- Switch off all nonessential systems.
- Switch battery or master on.
- On a turbopropeller engine, move the pitch change lever into the 'ground idle position'.
- Turn fuel valves and ignition switch on.
- Switch booster pumps on and check gauge to ensure that fuel is supplied.
- Move throttle to idle, start or prescribed position depending on engine type.
- Press starter button to rotate the engine.
- If applicable prime engine during rotation.
- As soon as the engine starts rotating check that the oil pressure rises.
- Monitor exhaust gas temperature and r/min during entire starting sequence. If it is abnormal, shut down the engine. (Any 6 × 1) (6)

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4.5 Inspect:

- Entire cockpit and cabin for cleanliness and loose equipment that should be secured.
- Entire cockpit and cabin for loose articles and tools that do not belong there.
- Seats and safety belts for condition and security.
- Windows and windshields for visibility, deterioration, cracks and breakage.
- Instruments for condition, mounting, marking and proper operation.
- Flight and engine controls for proper installation and correct operation.

(Any 4 × 1) (4)

[20]

QUESTION 5

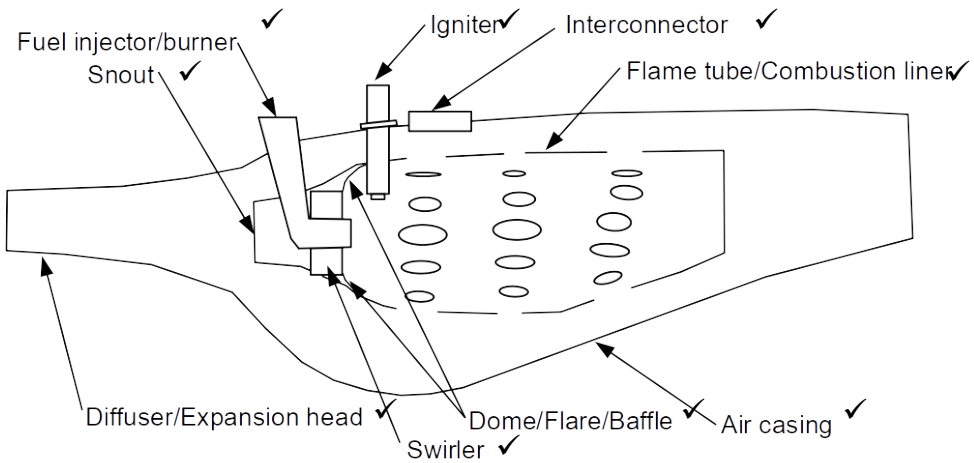
5.1

- The effect of altitude on thrust is a function of density. As an aircraft gains altitude, the pressure of the outside air decreases, and the temperature of the air will, in general, become colder.
- As the pressure decreases, so does the thrust, but as the temperature decreases, the thrust increases. However, the pressure of the outside air decreases faster than the temperature, so an engine actually produces less thrust as altitude is increased.
- The temperature becomes constant at about 36,000 feet. But the ambient pressure continues to drop steadily with increasing altitude. Because of this, thrust will drop off more rapidly above 36,000 feet. (3)

5.2 5.2.1

- Air casing
- Expansion head
- Flame tube/combustion liner
- Snout
- Baffle/dome/cone/flare
- Swirler
- Burner/fuel injector
- Interconnectors
- Igniters (Any 4 × 1) (4)

5.2.2



Gas turbine engine combustion chamber

(2 marks for labelling, 2 marks for drawing) (4)

5.3
- The gyroplane (autogyro) has more the appearance of an ordinary aeroplane fitted with conventional propulsion and empennage and may have stub wings.
- The helicopter has a fuselage that does not resemble an aeroplane, has no propulsion for producing forward thrust, but relies solely on its rotor for lift and thrust. A small propeller or rotor (or other method) is provided at the tail in order to counterbalance the rotor torque. (It may even have dual counter rotating main rotors and an empennage.) (2)

5.4 The main rotor gearbox serves to reduce the velocity✓ at which the engine shaft rotates.✓ (2)

5.5 The coning angle is the angle formed between the longitudinal axis of the rotor blade✓ and the tip path plane.✓ (2)

[17]

TOTAL: 100

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