higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

AIRCRAFT MAINTENANCE THEORY N3

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This marking guideline consists of 12 pages.

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QUESTION 1

1.1
- Cable engraving in the pulley
- Sharp edges
- Foreign objects that are embedded in the pulley
- Sized bearings
- Cleanliness
- Proper lubrication
- Excessive deflection (more than 2°)
- Excessive wear in one sector (Any 3 × 1) (3)

1.2
- Distortion
- Skin wrinkling cracks
- Cracks
- Skin wrinkling
- Loose or broken screws (Any 3 × 1) (3)

1.3
- Glass face
- Pipeline and wiring attachment
- Casing
- Dial and range markings
- Pointers (Any 3 × 1) (3)

1.4 1.4.1
- Defects on flexible lines (hoses)
- Defects on tubing
- Defects on hydraulic jacks and rams (3 × 1) (3)

1.4.2
- cracks
- cuts
- abrasions
- soft spots
- swelling
- indication of deterioration
- leakage (Any 3 × 1)

OR

1.4.2
- leaks
- loose/broken mountings
- cracks
- scratches
- dents
- leakage (Any 3 × 1)

OR

1.4.2
- leakage
- corrosion
- bow in chrome part of ram
- broken mounting points (Any 3 × 1) (3)

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1.5 1.5.1 Casing/housing is inspected for:
- alignment
- leakage
- signs of overheating
- distortion
- cracks
- wear
- chafing
- secure attachment (Any 2 × 1) (2)

1.5.2 Brake disks are inspected for:
- alignment
- free movement
- signs of overheating
- distortion
- cracks
- wear (Any 2 × 1) (2)

[19]

QUESTION 2

2.1 Defects include:
- excessive play in its mounting points
- corrosion
- cracks
- excessive wear
- bending
- poor lubrication
- misalignment
- fractures
- nicks (Any 3 × 1) (3)

2.2 2.2.1 With the engine warmed up and idling, proceed as follows:
- Move mixture control to auto lean position.
- Advance throttle rapidly to accelerate engine to the required r/min.
- Close throttle.
- Move mixture control to auto rich position.
- Advance throttle rapidly to accelerate engine to required r/min.
- Close throttle.
- Engine should accelerate without a tendency to backfire or to cut.
- Record the results. (Any 6 × 1)

OR

2.2.2 With the engine idling, proceed as follows:

- Open the throttle completely.
- Take time with engine acceleration.
- During acceleration, check that the engine accelerates evenly and smoothly, checking the functioning of the acceleration control unit.
- Close the throttle and check deceleration from maximum revolutions.
- Check for vibration during tests.
- Record the results. (6 × 1) (6)

2.3

- Remove oil sump drain plug and drain oil.
- Replace drain plug, torque and safety with wire.
- Remove oil filter.
- Install new oil filter, torque and safety with wire.
- Service engine to proper sump capacity with preservative oil.
- Perform engine run-up to warm engine to operating temperature.
- Run engine at operating temperature for a minimum of 15 minutes.
- After engine run, remove all spark plug leads.
- Protect the ignition lead ends with the prescribed protectors.
- Remove the top spark plugs.
- Install protective cap plugs in bottom spark plug holes.
- Using a spray gun, spray atomised concentrated preservative oil at room temperature through the upper spark plug hole of each cylinder with the piston at bottom dead centre position.
- Rotate crankshaft as opposite cylinders are sprayed.
- Stop crankshaft with none of the pistons at top dead centre.
- Respray each cylinder.
- To thoroughly cover all surfaces of the cylinder interior, move the nozzle or spray gun from the top to the bottom of the cylinder.
- Spray atomised concentrated preservative oil into the engine through the breather fitting and the oil filter ports.
- Install the prescribed dehydrator plugs in each of the upper spark plug holes. Make sure each plug is blue in colour when installed.
- Before engine has cooled, install desiccant bags in exhaust pipes.
- Attach a red 'Remove Before Flight' streamer to each bag of desiccant in the exhaust pipes and seal the openings.
- Seal all engine openings exposed to the atmosphere using suitable plugs and covers.
- Complete and sign all the required documentation.

(Any 6 × 1) (6)

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2.4 2.4.1

- Improper grade of oil
- Failing or failed bearings
- Incorrect installation of piston rings
- Worn piston rings
- Broken piston rings
- Worn cylinder barrels
- Failure of rings to seat properly (new nitrided cylinders)
- Worn valve guides
- Improper venting of oil system
- Cracked pistons
- T1N3Piston oil drain holes clogged
- Oil pressure too high
- Breather line exiting in low pressure area and blocked
- Missing vacuum break hole on breather line
- Excessive oil leaks through seals and gaskets
- Oil being siphoned from engine during flight
- Expander in oil control ring improperly installed
- Expander in oil control ring lost its tension
- Oil level too high
- Oil passing though turbocharger/supercharger seals on turbocharged/ supercharged engines (Any 2 × 1)

OR

2.4.2

- Extended leakage repair of oil leak
- Restriction in scavenge tubes – unable to scavenge oil will cause bearing area flooding
- Defective packing on oil filter housing
- Clogged scavenge screen in rear case
- Defective labyrinth seals
- Oil to fuel heater leak – oil migrating to fuel system and is burned
- Oil from breather is excessive – cocked or defective carbon seal
- Defective or missing packing's on oil tank centre tube
- No. 1 bearing pressure and/or scavenge tube packing's are defective
- Defective filter check valve – will allow oil to migrate to pressure system overflowing bearing areas
- Seal on pressure pump backwards – will cause excessive oil in scavenge system, overloading oil separator
- System over-serviced
- Oil line leakage
- Accessory seal leakage
- Incorrect oil grade (too low)
- Failing or failed bearing
- Scavenge pump failure

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- High sump pressures
- Gearbox seal leakage
- Incorrect or ineffective
- Gas turbine/turboprop engine
- Servicing of engine with oil (Any 2 × 1) (2)

[17]

QUESTION 3

3.1 Inspect the micro switch for:

- cracks
- correct adjustment
- corrosion
- wear of the plunger
- correct alignment
- secure attachment
- cleanliness
- proper operation
- proper routing of wiring
- chafing of wiring
- proper installation of protective covers on wiring terminals
- the condition of the rubber dust boots that protect the micro switch plungers from dust and corrosion (Any 3 × 1) (3)

3.2 3.2.1 Ignition harness of a piston engine:
Inspect the braiding or rigid conduit for:

- overheating
- excessive play
- adequate support throughout its length
- correct routing
- twisting
- excessive bending
- loose clamps
- chafing
- kinking
- fluid contamination

Inspect cable insulation (where possible) for:

- overheating
- damaged insulation
- twisting
- chafing
- fluid contamination
- perishing

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Inspect (generally) for:
- loose cable and sleeve at the spark plug and distributor block
- security of all attachment bolts and spark plug sleeves
- cracked cigarette ends

Complete both insulation and continuity tests (Any 5 × 1)

OR

3.2.2 Ignition system leads of a gas turbine engine:
Inspect connectors for:
- damaged threads
- corrosion
- cracked insulators
- bent or broken connector pins

Inspect leads for:
- worn or burned areas
- deep cuts
- fraying
- general deterioration

Complete continuity check of ignition leads (Any 5 × 1) (5)

3.3
- Cracks
- Leaks
- Secure mounting
- Cleanliness
- Loose bolts and nuts
- Deterioration of hoses and flex elbows
- Chafing
- Seal integrity (Any 3 × 1) (3)

3.4
- Remove all necessary obstructions, i.e. air conditioning and hydraulic pipelines, electrical wiring, flying control rods and wing de-icing equipment.
- Stop-drill the crack in the spar.
- Prepare two webs or suitable stiffeners to fit inside the spar to support the spar extending to three times the length of the crack.
- Drill the necessary holes into both webs in the positions of the existing holes. The webs should be held firmly in position inside the spar.
- Remove all burrs, nicks and other surface irregularities from the damaged area and the repair parts.
- Send the two webs for chromate treatment to prevent corrosion between the parts.
- Apply zinc chromate primer to all interior surfaces of the repair and do the necessary riveting.

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- Treat the area against corrosion.
- Complete an inspection of the repair to ensure that it is done correctly.
- Reattach all components that were removed.
- Complete a loose article inspection.
- Complete a duplicate inspection if any control system components were removed.
- Complete all necessary documentation (a new centre of gravity has to be determined or a fixed ballast should be added if necessary).

(8 × 1 in a logical order) (Marker's discretion) (8)

[19]

QUESTION 4

4.1
- Rivets that are fitted too close together.
- Rivets that are fitted too far apart.
- Rivets that are fitted too close to the edge of the plates.
- Incorrect diameter of holes.
- Incorrect rivet length.
- Sheets of metal that are not fixed tightly against one another.
- Bulging of the plates.
- Holes that are not drilled square to the plate or out of line.
- Rivets that are damaged due to burrs left on the holes.
- Rivets of which the head and bucked head are not in line.
- Head or bucked head that is damaged due to the set or dolly not held square to the rivet head.
- Bucked heads that are hammered too little or too much. (Any 4 × 1) (4)

4.2 Accurate propeller tracking requires:
- Securing the aircraft in a stationary position and ensure that the engine propeller shaft is tight against the thrust bearing.
- Make a blade-tracking datum by placing a block on the ground in front of the aircraft in the propeller arc.
- Raise the block as required to obtain a clearance between the blade tip (blade vertical) and the datum block not exceeding 1/4-inch. (Another method is to raise a block in front of the propeller with a small gap. A cowling fixture can be used as well.)
- In some aircraft, it may be necessary to relieve engine compression by loosening some spark plugs.
- Draw a line on the block next to the blade tip position.
- Move the blade in a fore-and-aft direction and mark the limits of such motion.
- Pull all the blades past the drawn datum, checking fore-and-aft free play as before.
- No blade should deviate more than 1/16 inch from the plane of rotation, as defined by the drawn marks, unless the manufacturer’s service manuals define greater limits.
- Record any abnormal condition in the propeller log.

(Any 6 × 1) (6)

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4.3 Inspect:

- Header plate flanges for damage and distortion
- Cooler shell for any external damage
- Baffle plates for general damage particularly tie rods and cooling tube holes
- Cooler supports for damage and cracks
- Header plate gasket surface for damage or scratches
- Oil drain and vent plugs for thread damage and proper sealing
- Tubes for damage or looseness
- Shell barrel and shell ends for cracks particularly around inlet and outlet ports
- Weld between cooler body and end shells using the magnetic particle crack test
- All drain holes for blockage
- All tie rods for thread damage
- Fixed-end tube sheet for thread damage of tie rod holes
- Fixed-end tube sheet for cooling tube hole damage
- Packed end tube sheet for damage. (Any 3 × 1) (3)

4.4

- Excessive corrosion
- Numbers of wires broken exceeds permitted number
- Excessive chafing internal
- Excessive chafing external
- Elongation
- A swaged end fitting that came loose
- A swaged end that is broken
- Excessive wear in a certain area
- Pinch marks
- Bird caging of the cable
- Kinks (Any 3 × 1) (3)

4.5

- Suspending the aircraft from a spring balance.
- Placing the aircraft directly on platform scales.
- Placing the aircraft on jacks on platform scales.
- Using electronic load cells. (4)

[20]

QUESTION 5

5.1 Measuring a connecting rod squareness or twist:

- Fit arbors into the rod bores.
- Place the parallel blocks on a surface plate.
- Place the ends of the arbors on the parallel blocks.
- Use a thickness gauge to check the clearance at the points where the arbors rest on the blocks.
- This clearance divided by the separation of the blocks in inches, gives the twist per inch of length.

Determining bushing or bearing parallelism (convergence):

- Fit arbors in the rod bores.
- Measure the distance between the arbors on each side of the connecting rod at points that are equidistant from the rod centreline.
- For exact parallelism, the distances checked on both sides should be the same.
- Consult the manufacturer's table of limits for the amount of misalignment permitted. (Any 4 × 1) (4)

5.2 Inspect the cable for:

- corrosion
- wear
- correct travel
- backlash
- kinks
- damaged end fittings

Inspect the conduit/casing for:

- dents
- distortion
- corrosion
- lubrication
- sharp bending
- kinks
- wear (Any 4 × 1) (4)

5.3
- The device consists of a half-circle which is hinged to the upper half collar which extends in the form of a beak on the one side.
- Between the lower half-circle and the collar is a drum.
- An adjustment screw can be tightened to clamp the drum to form a friction brake.
- The drum is fitted on the propeller shaft.
- The beak or lever arm has a specific length calculated to give correct readings.
- The arm is placed on a scale.
- Once everything is attached, the engine is started and allowed to warm up.
- Once the engine is at running temperature the throttle is opened up to a certain rotational speed.
- The adjustment screw is tightened over the drive shaft until the engine starts to labour hard due to the friction being created. (Friction should be applied to the drum and propeller shaft only to impose an appreciable load to the engine and in doing so the r/min is reduced to a reasonable level.)
- The arm will press down on the scale, due to the friction between the collar and the drum and provide a reading that is necessary for calculating the torque.

(Any 5 × 1 in a logical order) (Marker's discretion) (5)

5.4 Inspect the counterweights for:
- wear
- cracks
- corrosion
- free movement
- nicks
- misalignment

Inspect the shaft for:
- wear
- cracks
- corrosion
- signs of overheating

Inspect the springs for:
- pitting
- cracks
- chafing
- spring length (Any 4 × 1) (4)

5.5 **NOTE**: Stay within the minimum and maximum pressure and temperature limitations during the entire test!

- Start the engine and observe oil pressure. (Should oil pressure not rise to the required value within 5 seconds, shut engine down and investigate the cause. When proper oil pressure is reached, idle the engine for 5 minutes.
- Allow the oil temperature to stabilise to working temperature.
- Advance the throttle slowly in 500 r/min increments until take-off power is reached.
- Pause at each r/min step and allow the engine to stabilise (the turbocharger will lag slightly).
- At each r/min step, record the oil pressure, oil temperature, turbine inlet temperature (TIT), exhaust gas temperature (EGT) and manifold air pressure (MAP). These indications should not fluctuate but remain steady. Oil pressure above idle should be within the required limits.

NOTE: Take care not to overboost the engine when approaching take-off power – throttle movement at power is sensitive.

- Retard the throttle slowly back to idle.

NOTE: Great care should be taken not to reduce power rapidly on some engines.

- Run the engine at idle for 3 to 5 minutes to allow the turbine wheel to slow down.
- Shut down the engine and inspect for oil leaks and general security.
- Record the results.
- If proper TIT/EGT or MAP was not achieved, investigate cause.
- Compare all recorded engine parameters to the requirements in the maintenance manual and if necessary, perform an engine setup per the applicable aircraft service or maintenance manual.
- If required, repeat this check.

(8 × 1 in a logical order) (Marker's discretion) (8)

[25]

TOTAL: 100

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