SECTION 3

SERVICING

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SERVICING

LIST OF CHAPTERS

Note.—*A list of contents appears at the beginning of each chapter*

Chapter 1

ROUTINE SERVICING

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

1. Servicing the engine consists of making the routine checks and inspections listed in the aircraft Servicing Schedule; only those checks which require explanation are covered by this chapter. When it is found necessary to run or motor the engine over, or remove a component, reference should be made to Sect.2, Chap.2, and to Vol.6A, Part 1, Sect.2, respectively.

WARNING: THE ENERGY STORED IN THE IGNITER UNIT CONDENSER MAY UNDER CERTAIN CIRCUMSTANCES BE LETHAL. IT IS NECESSARY, THEREFORE, TO DISCONNECT THE L.T. SUPPLY AND WAIT FOR ONE MINUTE TO ALLOW THE STORED ENERGY TO DISSIPATE, BEFORE HANDLING THE H.T. CABLE OR THE UNIT FOR SERVICING.

Precautionary notes

2. (1) Before starting work on the engine ensure the battery switch is OFF and that the catridges are removed from the turbo-starter.

(2) Fit protective covers to the air intake and other apertures before commencing work on, or in the vicinity of, the engine.

(3) Fit blanks immediately to any apertures resulting from the removal of components or the disconnection of pipes or electrical plugs.

(4) Examine all jointings and gland rings disturbed during servicing and renew where necessary. Renew all expendable locking devices such as tabwashers and split pins, and use 22 S.W.G. stainless steel wire for all wire locking.

(5) Use ground equipment where an electrical supply is required during servicing, motoring over or starting.

(6) Bleed the fuel system before attempting to start the engine if the l.p. fuel filter has been removed, a fuel pipe upstream of the throttle has been disconnected, the fuel tank has been drained, or air has entered the system.

(7) The aircraft tank must contain fuel and the l.p. cock must be ON before turning the engine.

(8) If the engine is to stand idle for more than a week, apply the anti-corrosive treatment described in AP 102C-1502 to 1511-7; if this treatment has been applied, the engine must be prepared as described in Sect.2, Chap.1, before being put into service again.

(9) The oil quoted in Leading Particulars for use in these engines is a synthetic product which must not be mixed with any other oil. Since the oil is injurious to paintwork and certain types of rubber it must be used only for internal lubrication of the engine and should not be permitted to contaminate any parts not normally in contact with the oil. Any oil spilled during servicing must be carefully wiped off at once. Blr

(10) On completion of work, thoroughly clean the engine nacelle and its vicinity, removing all loose parts such as nuts, locking wire and split pins. Ensure that any drain holes in inspection panels or bay doors are free from obstruction.

Air intake and compressor

2A. If corrosion is apparent on the front bearing housing it should be treated in accordance with AP 102C-1512 to 1517 and 1522-7, para.5.B.(4).

3. The intake guide vanes, the casing inner walls and those compressor blades which can be seen from the front of the engine should, with the aid of a strong spotlight, be frequently examined for damage and cleanliness. The inspection procedure and limits of acceptable damage are described in Vol.6A,Sect.2,Chap.10. On engines accepted for further service, apply anti-corrosion inhibiting fluid PX24 (34B/2244966) to the compressor rotor blade platforms as detailed in sub-para.(1) to (6).

Table 1

Stage	Position from drilled hole
1	3.4 in
2	7.0 in
3	10.1 in

(2) With the drilled hole positioned vertically downwards, secure the marked tube described in (1), to the nozzle of a suitable hand spray gun. Insert the tube through the rotor and stator blades at the top dead centre position, until the mark for the stage to be sprayed is aligned with the leading edge of an inlet guide vane in the closed position.

(3) Using the hand spray gun, inject PX24 (34B/2244966) downwards onto the rotor blade platforms. Repeat this process for each stage, as positioned on the marked tube.

Note...
2 injections are sufficient for each stage.

(4) Withdraw the tube then, turn the rotor through 120 degrees. Repeat (2) and (3).

Note...
The quantity of PX24 (34B/2244966) is approximately 500 ml., most of which will drain out of the engine intake.

(5) Repeat (4).

(6) Withdraw the tube after completion of (5).

4. The number of blades and stages affected by acceptable damage is limited only by the effect on engine handling and performance Vol.6A, Sect.2, Chap.10 deals with various types of acceptable and unacceptable damage.

4A. Cracking in the outer annulus of the compressor outlet casing is a common feature. Cracks found acceptable during engine overhaul will have been marked using an automatic centre punch at a position 0.100 in from, and level with, the ends of the crack. Only the top half of the compressor outlet casing is visible, and acceptable standards for cracking in excess of the manufacturer's limits are defined in AP 102C-1512 to 1517-6A, Part 1, Sect.2, Chap.10, para.13.

Combustion chambers

5. No routine servicing is necessary except periodic examination for local overheating of the outer casing, gas leaks from the joints and general security of the assembly.

6. Hot spots may be indicated by discoloured patches on the air casings, and these should be carefully noted and the affected area enclosed by a lightly pencilled ring; if regular inspection then shows any increase in the area affected, furhter investigation will be necessary.

7. Gas leaks at the combustion chamber joints may be indicated by a sooty deposit around the point of leakage; scorching and blistering of paintwork may also be apparent in the vicinity. Action should be taken to remedy the leakage as described in Vol.6, Part 1, Sect.2, Chap.3.

Enamelled surfaces

8. The enamelled surfaces of the engine should be examined for corrosion and damage. Any affected surface should be treated in accordance with AP 4471A.

Pipes

9. Examine all pipes for damage, corrosion, loose connections and chafing. Engines returned to service after repair or reconditioning may exhibit markings on oil, air, rigid and semi-rigid fuel pipes; the pipe markings are as follows:

(1) A pipe marked with an ellipse ◯ indicates acceptable smooth indents which do not require blending. SM IHS

(2) A pipe marked with arrows ⟷ indicates originally sharp indents which have been blended smooth.

Note...
These markings should not be removed as they indicate areas where further treatment could result in thinning of the pipe section.

Engine anti-icing system

10. Periodic checks should be made of the functioning of the anti-icing hot air valve. Select anti-icing OPEN and check that the hot air valve indicator pointer moves steadily to the fully OPEN position; then select CLOSED and check that the pointer returns to the fully CLOSED position.

Engine controls

11. A manual check for freedom of control lever movement should be made regularly, and

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each inspection which entails the removal of cowlings should include a visual check for security and general condition.

12. The controls should be mtaintained with the minimum amount of backlash consistent with free movement. Lubricate the ball joints with grease XG-275 (Ref. No.34B/9100513). When checking the range of control lever movement ensure that it is limited by the stops on the engine and not by those on the cockpit quadrant.

Exceeding operating limitations

13. If an engine has exceeded the Operating Limitations, the cause should be thoroughly investigated and any defect rectified prior to acceptance for further flight.

14. When the maximum jet pipe temperature (j.p.t.) is known to have been exceeded the following checks should be made in addition to those outlined in para. 18 and 19 .

(1) With the engine cold, check the rotating assembly for freedom of rotation.

(2) Examine the l.p. turbine blades, visually or by touch, for evidence of growth indicated by reduction of the mid-section thickness or a 'bump' on the trailing edge of the blades.

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(3) Ground run the engine as described in Sect.2, Chap.2, and check for abnormal vibration.

(4) Check that the engine runs down freely after closing the h.p. cock at idling rev/min. If doubt exists as to the freedom of the engine, a run-down time check should be made with the accessory gearbox drive disconnected at the engine end; the time taken from idling rev/min to rest should not be less than 40 sec.

If the checks reveal nothing abnormal, the engine should be regarded as serviceable.

15. Overspeeding of up to approximately 200 rev/min is not considered harmful to the engine, provided that it does not occur too frequently and is not accompanied by excessive j.p.t.

16. Overspeeding usually occurs on 'slam' acceleration, but it should first be ascertained that any apparent overspeeding is not in fact 'overswing' of the rev/min indicator. This can be assessed by noting the rate at which the indicator needle falls back; i.e. if the needle returns sharply this would denote indicator overswing, whereas a relatively slower fall back would indicate engine overspeeding.

17. When overspeeding occurs, it is usually of a transitory nature and does not afford much time for observing the j.p.t. indicator; consequently, the inspectional checks detailed in para.14,18 and 19 should be made in all instances unless it is established that the maximum j.p.t. has not been exceeded.

Exhaust unit, turbine and jet pipe

18. With the aid of a strong spotlight, examine the low pressure turbine blades for indications of growth and overheating, refer to para.14(2). Examine the blades for indications of impact damage, shroud weld cracking and aerofoil leading edge and trailing edge cracking, refer to AP 102C-1512 to 1517-6A, Sect.2, Chap.11.

18A. If aluminium deposits are found on the turbine blades, nozzle guide vanes, exhaust unit or the jet pipe, the deposits may be caused by either breakaway of material from compressor blades or flaking of the protective coat of the combustion chamber air casings. If damage to the inlet guide vanes and/or visible stages of the compressor has been established, remove the engine for front end examination, refer to para.3. If damage to the inlet guide vanes and/or visible stages of the compressor is not apparent, the source of the deposits must be ascertained by chemical test, refer to Part 3, Sect.1, para.5. Deposits from the coating of the air casings are acceptable but, if it is determined the deposits are from compressor blades, remove the engine for further investigation.

19. Examine the exhaust unit and jet pipe for cracks and ripples of the inner skin, refer to AP 102C-1512 to 1517-6A, Sect.2, Chap.5. Examine the jet pipe for signs of 'Alfol' insulating foil having blown from the rear of the jet pipe.

(1) Mk.109

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(a) If foil blowing is not accompanied by inner skin cracks, the jet pipe must be removed to permit renewal of the deteriorated foil, refer to AP 102C-1512 to 1517-6A, Sect.2, Chap.5.

(b) If the inner skin shown signs of overheating e.g. discolouration, the jet pipe must be removed to permit examination of the 'Alfol' foil, refer to AP 102C-1512 to 1517-5A, Sect.2, Chap.5.

(2) Mk.122

(a) Deterioration of the 'Alfol' foil is acceptable.

20. Periodic checks for condition, security and installation clearance of the jet pipe and exhaust unit are required. The check for installational clearance of the jet pipe in the airframe is covered in the aircraft Air Publication.

Fire extinguisher pipes

21. Visually examine the spray pipes for chafing and for security of clips and wirelocking. Disconnect the engine spray pipes from the extinguisher supply and apply air pressure to the pipes to ensure that the discharge holes are clean. If any holes are blocked, they must be carefully cleared, using a drill of appropriate size, turned by hand. Care must be taken not to enlarge any holes and upset extinguisher distribution. All connections should be checked for leakage under air pressure, by brushing on soap solution.

Fuel filter

22. The low pressure fuel filter should be checked for fuel contamination. If the following sequence of operations is observed it will eliminate the necessity for bleeding the fuel system unless the filter is completely removed.

(1) Clean the filter casing.

(2) Ensure that the h.p. cock is OFF.

(3) Turn ON the l.p. fuel cock.

(4) Switch ON the l.p. fuel pump

(5) Detach the drain plug lockplate and unscrew the plug by its hexagon to allow a sample of fuel to drain into a glass container.

(6) Tighten and lock the drain plug.

(7) Switch OFF the l.p. pump.

(8) Turn OFF the l.p. fuel cock.

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23. If the drained fuel contains an excessive amount of water or suggests contamination, the source of contamination must be traced and rectified. The l.p. filter element must be changed and the fuel system bled as described in Vol.6, Part 1, Sect.2, Chap.6.

Ground run

24. Before ground running it is important to check that the anti-icing switch is CLOSED. If the anti-icing switch is left OPEN it may promote compressor surge. Ground run the engine as described in Sect.2, Chap.2, making all the necessary checks. With the engine idling, check that there is no continual excessive spill from the fuel system drains; finally check that the engine runs down freely and that there are no rubbing noises from the rotating assembly.

Ignition system

WARNING...

The energy stored in the igniter units may under certain circumstances be lethal. Before handling the unit or its h.t. cable it is essential to disconnect the l.t. supply to the unit and wait for at least one minute to permit stored energy to dissipate.

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25. Apart from periodic checks for security and visual inspection of the plug h.t. lead insulation, no routine servicing is necessary on the igniter system, but frequent serviceability checks are recommended.

26. To ascertain if the igniter are functioning satisfactorily, first ensure that there is no accumulation of fuel within the combustion chambers, then with the ignition switch ON, operate the relight button and listen for the sharp 'crack' of the electrical discharge across the igniter plugs. The operation of each unit can be distinguished aurally, but may be confirmed by alternate removal of the l.t. connection to each unit and making separate functional checks.

Intake guide vanes and operating ram

27. Distortion of the guide vanes can cause loss of thrust, or surge, and render the engine unserviceable; acceptance standards for guide vane damage are quoted in Vol.6A, Sect.2, Chap.10. The operation of the air flow control system can be checked during ground running as described in Sect.2, Chap.2.

Oil filters

28. The pressure filter is drained by releasing the lockplate on the drain cock adjacent to the filter, and partly unscrewing the cock. To withdraw the filter, release the lockplate on the central retaining nut, unscrew the nut and remove the cover and filter (fig.1).

29. Examine the filter carefully; if an unusual amount of foreign matter or metal is found, further investigation will be necessary and reference should be made to Part 3, Sect.1. Wash the filter assembly in clean kerosine and immerse the assembly in clean engine oil before refitting.

Note...

To determine whether non metallic foreign matter in the filter is from a damaged rubber seal or merely stray particles of jointing compound, remove the particles from the filter and attempt to smear them on a sheet of clean white paper. If blue marks appear on the paper, indicating that the particles are jointing compound, wash the filter is trichlorethylene to remove all traces of the compound, dry the filter, and immerse it in clean engine oil before refitting. If it is established that the particles are rubber, reject the engine. JK Mth

30. Clean the joint faces and examine the sealing ring between the filter cover and the element; renew as necessary. Lightly coat the retaining stud with engine oil and refit the filter assembly, turning the cover so that its locating square registers with the square portion on the retaining stud. Tighten the centre nut to the torque load specified in Vol.6A, Sect.2, Part 1, refit the lockplate; tighten the filter drain plug and refit the lockplate. After initial ground running, top up the sump oil to the correct level.

31. The three l.p. oil filters should not be disturbed during normal servicing. If, however, it becomes necessary to drain the sump completely, release the lockplate and partly unscrew the central retaining bolt on the centre filter. By completely unscrewing their captive centre

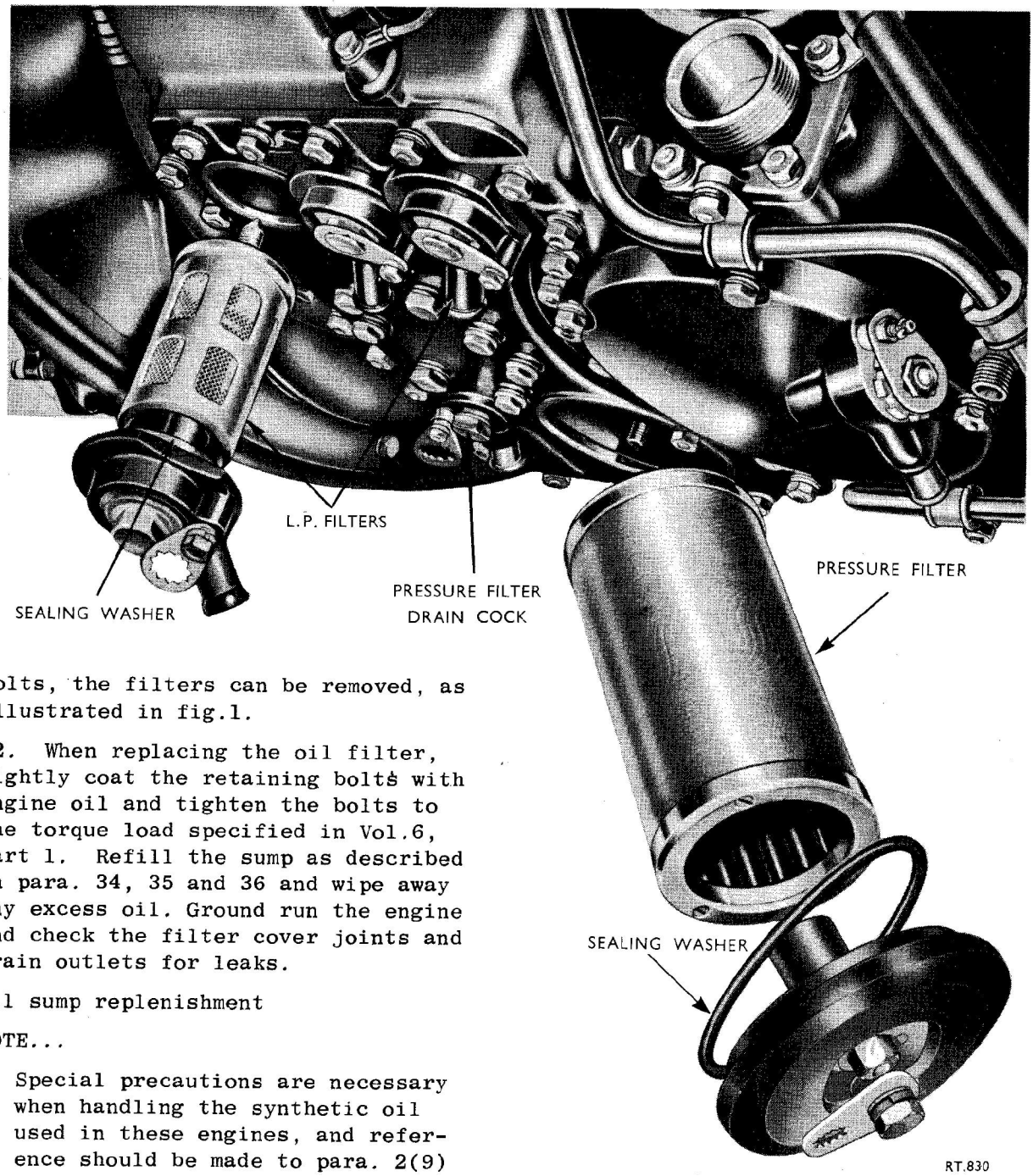


Fig.1 Oil filter removal

bolts, the filters can be removed, as illustrated in fig.1.

32. When replacing the oil filter, lightly coat the retaining bolts with engine oil and tighten the bolts to the torque load specified in Vol.6, Part 1. Refill the sump as described in para. 34, 35 and 36 and wipe away any excess oil. Ground run the engine and check the filter cover joints and drain outlets for leaks.

Oil sump replenishment

NOTE...

Special precautions are necessary when handling the synthetic oil used in these engines, and reference should be made to para. 2(9)

33. The oil sump has a total capacity of 16 pints; oil to the specification quoted in Leading Particulars must always be used. Provision is made for gravity filling, and a filter neck is located on either the left-hand or right-hand side of the sump. Check that the filler cap

sealing washer is clean and undamaged; on replacing the cap, ensure that the self-locking wingnut is tightened down securely.

34. The oil level should be checked with the aircraft on level ground, and with the engine cold. The level is indicated on all engines, except the Mk.109, by a graduated sight window in the sump wall.

OIL SUMP REPLENISHMENT

35. To obtain the correct oil level after the system has been drained, fill the sump to the appropriate level, then run the engine for two minutes at idling rev/min to circulate the oil. Stop the engine, then wait for ten minutes to allow the oil in the system to drain back into the sump, then recheck the level and 'top up' as required.

36. On installed Mk.109 engines the sump oil level of the left-hand engine should be approximately $1\frac{1}{2}$ in. below the seal face of the filler neck (fig.2); the sump oil level on the right-hand engine should be approximately $\frac{1}{2}$ in. below the seal face of the filler neck (fig.2).

37. When replenishing, if the amount of oil needed suggests consumption in excess of that specified in Leading Particulars, or if the sump level tends to increase after flight, refer to Part 3, Sect.1.

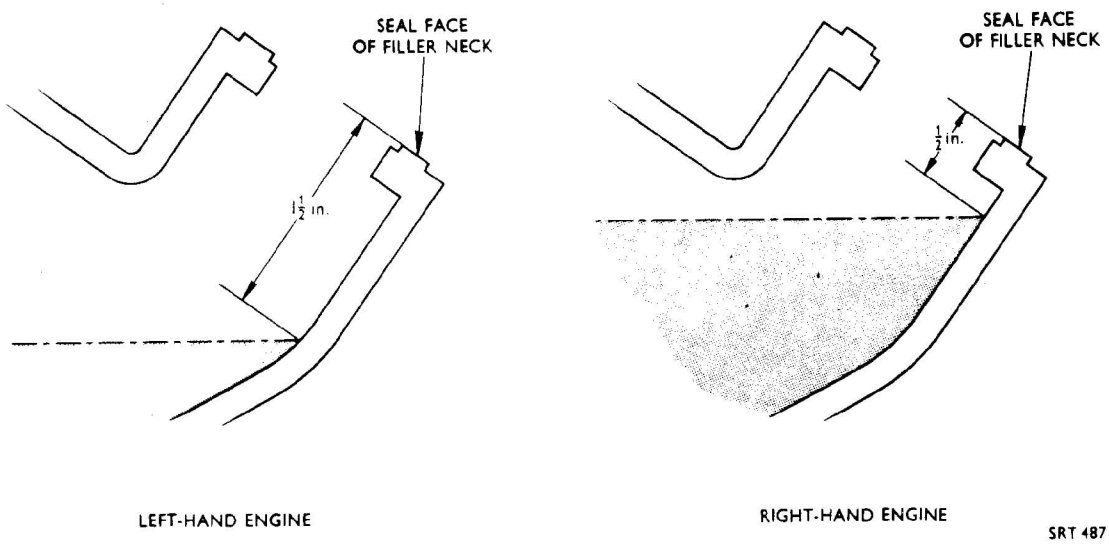
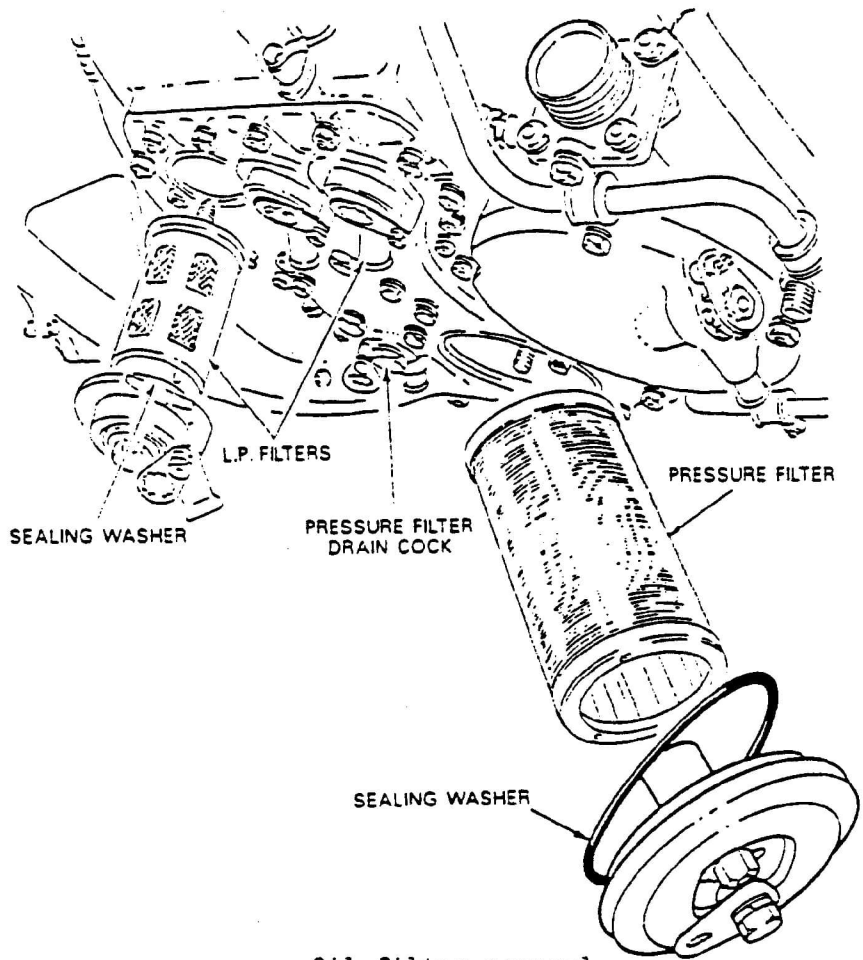


Fig.2 Sump oil levels - Mk.109



Oil filter removal
Fig.1

bolts, the filters can be removed, as illustrated in Fig.1.

32. When replacing the oil filter, lightly coat the retaining bolts with engine oil and tighten the bolts to the torque load specified in AP 102C-1512 to 1517-6A, Sect.2, Chap.1. Refill the sump as instructed in para.34, 35 and 36 and wipe away any excess oil. Ground run the engine and check the filter cover joints and drain outlets for leaks.

33. Oil sump replenishment

Note ...

1. To prevent the oil filter cap sealing washer coming out of its location, the washer is fixed in position using adhesive.

2. Special precautions are necessary when handling the synthetic oil used in these engines, refer to para.2.

(1) The oil sump has a total capacity of 16 pints; oil to the specification instructed in Part 1 Leading Particulars must always be used, Provision is made for gravity filling, and a filler neck is located on either the left-hand or right-hand side of the sump. Check that the filler cap sealing washer is clean, undamaged and secure. If the sealing washer is damaged or loose, fit a new sealing washer as instructed in para.33A.

33A. Oil filler cap sealing washer replacement.

(1) Remove the existing sealing washer. Ensure that the washer locating groove is clean, dry, and that all washer remains have been removed.

(2) Obtain a new sealing washer and apply adhesive (Bostic 1777) at four equidistant positions on the face of the washer which will be in contact with sump casing or filler body.

(3) Fit the washer into its locating groove.

(4) Lightly lubricate the face of the washer which will be in contact with the filler cap, using engine oil.

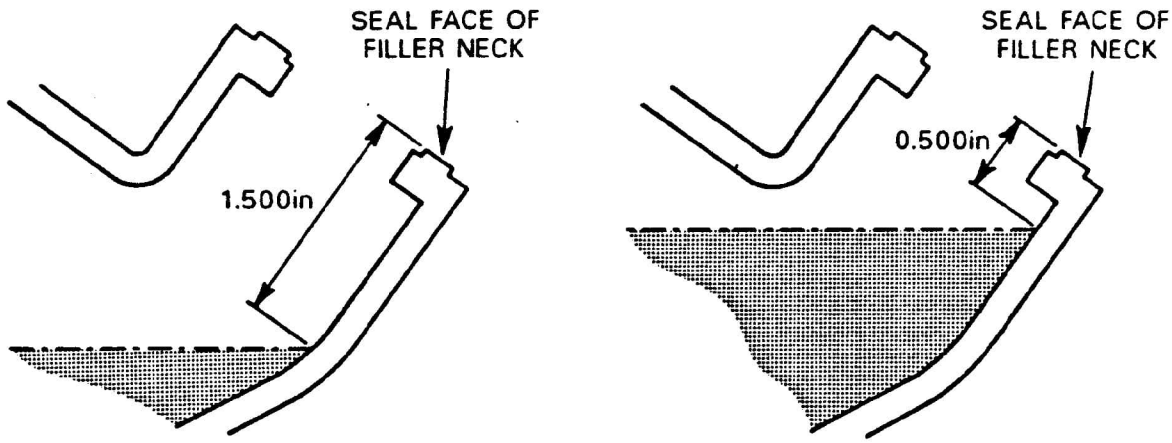
(5) Replace the oil filler cap and ensure that the self-locking wingnut is tightened down securely.

34. The oil level should be checked with the aircraft on the level ground and with the engine cold. The level is indicated on all engines except Mk.109, by a graduated sight window in the sump wall.

Oil sump replenishment Blr

35. To obtain the correct level after the system has been drained, fill the sump to the appropriate level, then run the engine for two minutes at idling rev/min. to circulate the oil. Stop the engine, then wait for ten minutes to allow the oil in the system to drain back into the sump, then recheck the level and 'top up' as required.

36. On installed Mk.109 engines the sump oil level of the left-hand engine should be approximately 1.50 in. below the seal face of the filler neck (Fig.2); the sump oil level on the right-hand engine should be approximately 0.50 in. below the seal face of the filler neck (Fig.2).



Sump oil levels - Mk.109
Fig.2

37. When replenishing, if the amount of oil needed suggests consumption in excess of that specified in Part 1 Leading Particulars, or if the sump level tends to increase after flight, refer to Part 3, Sect.1.

CHAPTER 2

This chapter supersedes that issued with A.L.5

INSPECTION FOR DAMAGE AFTER SHOCK LOADING

Note.—*This chapter applies to Avon Mk. 10701, 10901, 11301, 11501, 12101 and 12201 Engine Change Units and Associated Jet Pipes*

LIST OF CONTENTS

GENERAL

1. Shock loading of an engine may arise from two sources:—

(1) Crash damage.

(2) Damage in transit.

The following paragraphs are intended to serve as a guide in deciding whether an engine is fit for further service; the final decision as to serviceability must, of course, depend on the nature of the damage and the particular circumstances.

2. Damage to accessories or external parts of the engine may be accepted provided these parts can be replaced (*Vol.* 6, *Part* 1, *Sect.* 2), and that no damage has been transmitted through them to parts of the main engine structure.

3. A check should be made of all pipes and electrical leads for damage and ingress of dirt, particularly the ram pressure pipe to the B.P.C. and the stand pipe for the Bleed Valve Control Unit.

4. Provided that debris has not entered the engine to such an extent that it has damaged the intake guide vanes or compressor blades, it need not be stripped unless the main structure has been affected.

5. The intake guide vanes should be checked for full and free movement and the engine for freedom of rotation.

GROUND RUN

6. The engine must be given a ground run to check handling and performance; during the 'run down' at the end of the ground run listen for any unusual noise such as gear whine or compressor or turbine rub, as these will indicate distortion or malalignment. Part 3, Sect. 1, 'Running defects' should be consulted if any faults are noted during the ground run.

7. Finally, examine all filters for traces of foreign matter.

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CHAPTER 3 - FIELD ACCEPTANCE STANDARDS

This chapter is deleted. Refer to A.P.102C-1512 to 1517-6A, Sect.2, Chap.10 for the acceptance standards to be applied to damaged intake guide vanes, and compressor rotor and stator blades.