SECTION 1

RUNNING DEFECTS

SECTION 1 - RUNNING DEFECTS

CONTENTS

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TABLES

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1. Introduction

A. This section deals with the tracing and rectifying of defects which may occur in-service. The information is supplied in chart form which briefly relates the symptoms to the components or system which may be faulty. The charts also refer to the body of the section, where the practical remedial actions are described.

B. To limit work to a minimum and prevent unnecessary changing of units, it is important to pursue a logical line of thought. The charts in this section have been compiled along such lines and, should any defect arise which is not specifically covered, the following approach should be used:

(1) Reported symptom

(2) What other information would help, e.g. other instrument readings or prevailing flight conditions?

(3) Which system(s) could cause this fault?

(4) Can any system be isolated or checked?

(5) Which component could cause this fault?

(6) Can any component be isolated or adjusted?

(7) Which component can be changed first?

C. When defects are indicated only by instruments, the instrument should be checked first. Defective units should not be dismantled in the process of rectification; the extent of permissible repair is specified in Vol.6A, Part 1.

CAUTION: (1) IN THE EVENT OF AN AIRCRAFT FUEL SYSTEM FAULT CAUSING INADEQUATE OR UNACCEPTABLY LOW DELIVERY PRESSURE AT INLET TO THE ENGINE FUEL SYSTEM, THE METERING BLOCK TO OIL COOLER PIPE MUST BE EXAMINED FOR SECURITY. IF ANY DEFECT (CRACKING/DISTORTION) IS FOUND IN THE CLIPS, THE PIPE AND CLIPS MUST BE CHANGED.

(2) IF FUEL PUMP CAVITATION HAS OCCURRED, REFER TO PARA.11, SUB-PARA.B.(1) AND (2).

(3) IF A FUEL SYSTEM UNIT IS REMOVED OR A PIPE DISCONNECTED, IT WILL BE NECESSARY TO BLEED THE SYSTEM AS DESCRIBED IN VOL. 6A, PART 1, SECT.2, CHAP.6, BEFORE MAKING A GROUND RUN. AIR TRAPPED IN THE SYSTEM WILL CAUSE ERRATIC RUNNING.

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D. If it is necessary to disconnect pipes in the fuel and oil systems, all possible precautions must be taken to prevent foreign matter from entering the systems. Similarly, all apertures resulting from the removal of components must be immediately and adequately blanked.

E. It should be noted, particularly during fault diagnosis, that the jet pipe temperature (j.p.t.) and rev/min may vary with ambient temperature. Under low temperature conditions governed engine speed, as quoted in Operating Limitations, may not be obtainable on the ground and the engine may underspeed by as much as 200 rev/min below the required maximum at full throttle, but maximum thrust will be maintained.

F. Finally, it is assumed, throughout, that the engine has been handled correctly (Part 1, Sect.2), and that the aircraft systems which serve the engine are serviceable. If a defect is traced to the aircraft services or to the starting system, refer to the appropriate Air Publication.

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2. Starting faults

WARNING: A. BEFORE ATTEMPTING TO DIAGNOSE STARTER FAULTS, TURN OFF THE ELECTRICAL SUPPLY AT THE MASTER SWITCH AND DISCONNECT THE ELECTRICAL LEAD TO THE STARTER. THE BREECH CAP MUST NOT BE REMOVED WITHIN 60 SECONDS OF AN UNSUCCESSFUL ATTEMPT TO FIRE A CARTRIDGE. THE CARTRIDGE MAY THEN BE REMOVED AND, IF FAULTY, DISPOSED OF IN ACCORDANCE WITH THE SAFETY PRECAUTIONS LAID DOWN FOR HANDLING OF HIGH EXPLOSIVE.

B. DO NOT HANDLE THE IGNITER UNITS, PLUGS OR HIGH TENSION (H.T.) LEADS WITHIN ONE MINUTE OF DISCONNECTING THE LOW TENSION (L.T.) SUPPLY; THEY MAY RETAIN A LETHAL CHARGE. BEFORE WORKING ON THE ENGINE SEE THAT THE SWITCHES AND CONTROL ARE OFF.

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TRIPLE BREECH STARTER - CARTRIDGE(S) NOT FIRING

Attempt one re-start with remaining breeches

IF

- **NOT OK**

  Select new batch of cartridges and attempt re-start

  IF

  - **NOT OK**

    Check current input/output at time switch and a/c system

- **OK**

  Substitute cap from firing breech and attempt a restart

  OR

  Remove cartridge and fit dummy breech cap with test bulb to non-firing breech

  IF

  - **NOT OK**

    Check condition and correct operation of the electrical contact blade

    IF

    - **NOT OK**

      Clean or change contact blade as required

    - **OK**

      Check current output from a/c firing lead

      IF

      - **NOT OK**

        Check input/output at time switch and a/c electrical system

      - **OK**

        Change starter motor. Check unserviceable starter wiring for continuity. Rectify or reject starter motor as required

  - **OK**

    Check original breech cap slip ring for cleanliness

    IF

    - **NOT OK**

      Clean slip ring

      IF

      FAULT PERSISTS

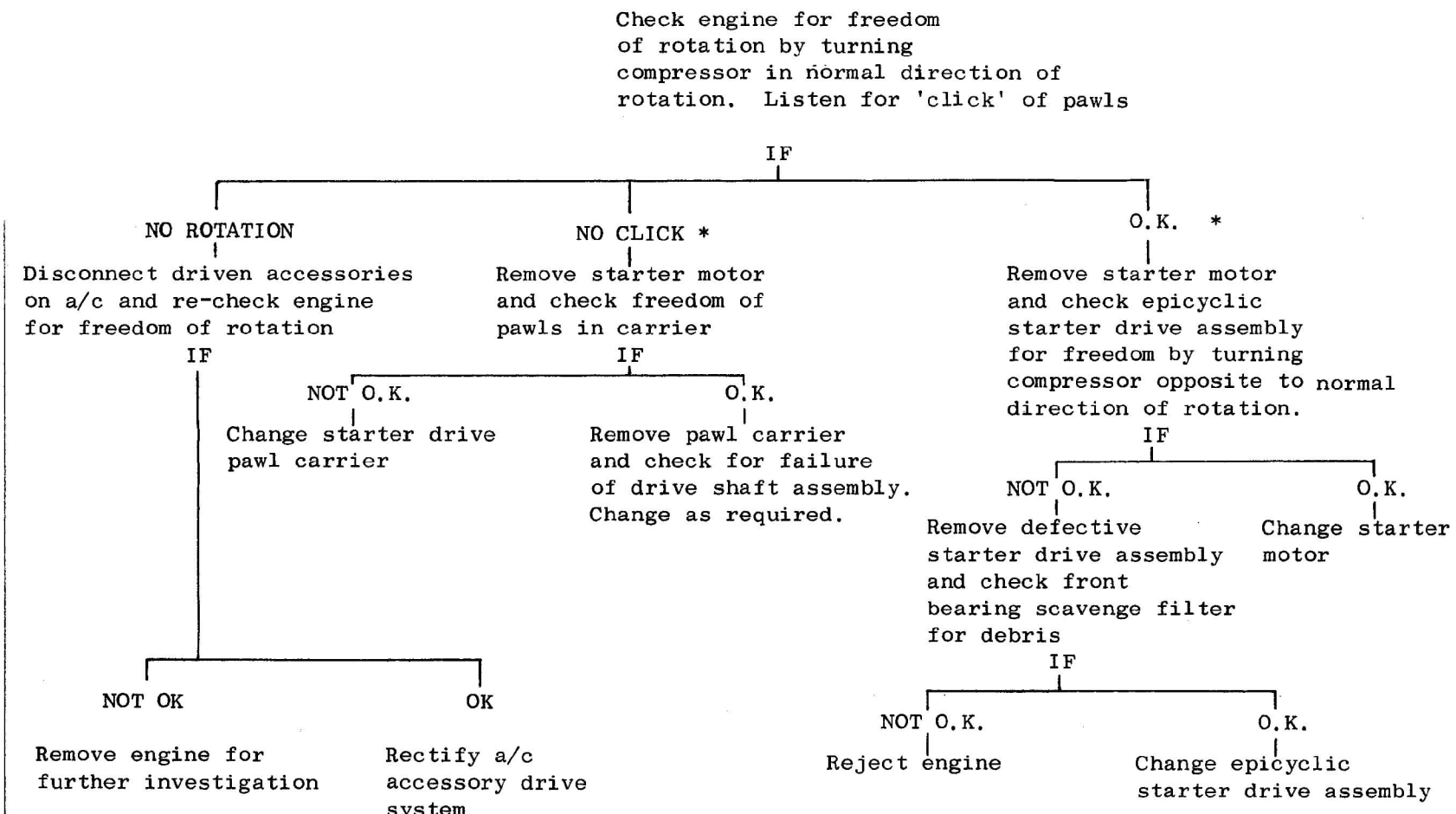
      Change breech cap

    - **OK**

      Change breech cap

CARTRIDGE FIRES - ENGINE FAILS TO ROTATE

NOTE: On Mk.122 engines, checks marked thus * entail removal of engine.



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ENGINE ROTATES BUT FAILS TO ACHIEVE LIGHT-UP SPEED

CAUTION: IF THREE BREECHES ARE LOADED, TWO FURTHER ATTEMPTS TO START MAY BE MADE IMMEDIATELY THE STARTER BUTTON RESETS AND THE COMPRESSOR STOPS TURNING.

NOTE: On Mk.122 engines, checks marked thus * entail removal of the engine.

Check engine for freedom to rotate by turning compressor in normal direction of rotation

IF

NOT OK

Disconnect driven accessories on a/c and re-check engine for freedom of rotation

IF

NOT OK

Remove engine for further investigation

OK

Rectify a/c accessory drive system

OK

Check engine for freedom to rotate by turning compressor opposite to normal direction of rotation

IF

NOT OK

Change starter motor *

OK

Select new batch of cartridges and attempt a re-start

IF

FAULT PERSISTS

Change starter motor *

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ENGINE FAILS TO LIGHT UP

Close h.p. and l.p. cocks. Confirm pre-start checks are all correct. Press re-light button and check for audible evidence of both H.E. igniter units working

IF

NOT OK

Check l.t. fuses

IF

NOT OK

Renew l.t. fuse(s). Re-check for ignition

IF

NOT OK

OK

NO IGNITION

ONLY ONE H.E. IGNITER UNIT WORKING

Remove any one l.t. fuse OR disconnect any one l.t. lead from its h.e. igniter unit. Press re-light button to identify faulty igniter system

Check l.t. supply to h.e. igniter unit(s)

IF

NOT OK

Check a/c l.t. electrical system

OK

Change h.e. igniter unit(s) Re-check igniter operation

IF

NOT OK

Remove h.t. lead(s), clean contacts, re-connect and check igniter operation.

IF

NOT OK

Change plug(s)

IF

NOT OK

Change lead(s)

OK

Mk.122

Re-start and check for incorrect opening of gun dip air bleed valves

IF

NOT OK

OK

Ensure correct operation of a/c electrical system

IF

NOT OK

Change air dip solenoid

Mk.109

Refer to para.2 'Engine lights up but fails to achieve self-sustaining or ground idle speed'

ENGINE LIGHTS UP BUT FAILS TO ACHIEVE SELF-SUSTAINING OR GROUND IDLE SPEED

Check l.p. fuel pressure warning light indication and close h.p. cock. Confirm pre-start checks are all correct. Ensure cockpit throttle lever is fully closed and l.p. cock lever fully open. During start, if warning light was

- **ON (OR FLICKERING)**
  - Change l.p. fuel filter. Ensure correct l.p. fuel supply and operation of warning light system as instructed in a/c AP
  - IF
- **OUT**
  - Restart engine
  - IF
  - NOT OK
  - Check if fault is accompanied by high JPT and/or excessive amount of black smoke.
  - IF
  - **NO**
    - Change l.p. fuel filter. Ensure correct l.p. fuel supply and operation of warning light system as instructed in a/c AP
    - IF
  - **YES**
    - Ensure a/c is not 'tail into wind'. Check c.f.c.u. throttle valve is on 'closed' stop.
    - IF
    - **NOT OK**
      - Rectify as required
    - **OK**
      - Check for pressurizing valve operating freely
      - IF
      - **NOT OK**
        - Polish pressurizing valve (one only)
      - **OK**
        - Select new batch of cartridges and re-start engine
        - IF

FAULT PERSISTS

ENGINES WITH IGV RAM GOVERNOR PUMP

Check for metallic debris in governor pump filter

IF

Debris is sufficient to cover approx. 0.5 sq.in., change all fuel units, including i.g.v. ram and burners. Refit oil cooler and all pipes after reverse flushing.

ENGINES WITHOUT GOVERNOR PUMP

Check i.g.v. ram for metallic debris in h.p. filter

IF

Filter contains an insignificant amount of debris, isolate b.p.c. and re-start.

IF

- **NOT OK**
  - Isolate a.c.u. and re-start * (see CAUTION)
  - IF
  - **NOT OK**
    - **Mk.109**
      - Change h.p. fuel pump
    - **Mk.122**
      - Isolate gun fuel dip unit and re-start
      - IF
      - **NOT OK**
        - Change h.p. fuel pump
      - **OK**
        - Ensure correct operation of a/c electrical system
        - IF
        - OK
        - Change gun fuel dip unit and solenoid
  - **OK**
    - Change a.c.u. and m.b.
- **OK**
  - Change c.f.c.u.

* CAUTION: WHEN A.C.U. IS ISOLATED, THROTTLE MUST BE OPENED SLOWLY. DO NOT ALLOW J.P.T. TO APPROACH MAXIMUM LIMIT

3. Rev/min faults

GROUND IDLING REV/MIN INCORRECT

Ensure cockpit throttle lever is fully closed and h.p. cock lever is fully open. Soak engine at 7500 rev/min for two minutes

IF

FAULT PERSISTS

Check c.f.c.u. throttle lever is on 'closed' stop, and c.f.c.u. h.p. cock is fully open

IF

NOT OK — OK

Rectify control rigging

Adjust idle rev/min

IF

Engine fails to respond to adjustment check indicating system as instructed in a/c AP

IF

FAULT PERSISTS

Bleed fuel system

IF

FAULT PERSISTS

Check for debris in governor pump or i.g.v. ram h.p. filter and isolate fuel control servo pressure system, refer to para.2, 'Engine lights up but fails to achieve self-sustaining or ground idle speed'

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MAXIMUM REV/MIN INCORRECT

NOTE: If malfunction in flight is experienced, refer to para.13A.

Check: (1) Consistency of full and free c.f.c.u. throttle travel when operated from cockpit

(2) If ground idle speed is correct

IF

NOT OK — Refer to para.3 'Ground Idling Rev/Min Incorrect'

OK — Adjust h.p. fuel pump governor, allowing for a.i.t. and s.g. variations

IF

Engine fails to respond to adjustment, bleed fuel system

IF

FAULT PERSISTS

Mk.122 — Check resistance between actuator pins on t.t.c. socket as specified in A. below

IF

FAULT PERSISTS

Mk.109 — Check for debris in governor pump or i.g.v. ram h.p. filter and isolate fuel control servo pressure system, refer to para.2 'Engine lights up but fails to achieve self-sustaining or ground idle speed'

A. Remove the 4-pin socket and measure the resistance between the actuator pins; the results obtained should conform with the figures given in the following table.

Pin Letters	Mid Travel (ohm)	Fully extended (ohm)	Fully retracted (ohm)
A to B	5.5 to 7.0	Infinity	5.5. to 7.0
A to C	5.5 to 7.0	5.5 to 7.0	Infinity
A to D	1.0 to 1.2	1.0 to 1.2	1.0 to 1.2
B to C	5.5 to 7.0	Infinity	Infinity

T.T.C. Actuator shaft position
Table 1

If the resistance of the unit agrees approximately with the figures given in the table, connect a 24V electrical supply between pins A and B, or A and C, and note the shaft movement. With pins A and B supplied, the shaft should move to the fully extended position; with pins A and C supplied the shaft should be fully retracted. The actuator stroke should be 1.000 ± 0.020 in. and when the shaft is fully extended there should be a clearance of 0.062 in. between the shaft and the over-run guard, refer to Vol.6A, Sect.2, Chap.6, Fig.9. The unit insulation resistance should be 100000 ohms measured with a 500V megger. If the control fails to meet these requirements, change the unit as instructed in Vol.6A, Part 1, Sect.2, Chap.6.

REV/MIN LOSS OR DROP

NOTE: (1) If malfunction in flight is experienced, refer to para.13C.

(2) On Mk.122 engines, checks marked thus *, entail removal of the engine.

Check compressor for damage

IF

NOT OK

Check turbine for damage
Rectify or reject as per AP

OK

Check: (1) Indicating system if there is no feeling of power loss.

(2) Fuel suppply for water and other forms of contamination.

(3) Consistency of l.p. fuel supply as instructed in a/c AP.

(4) Consistency of full and free c.f.c.u. throttle travel when operated from cockpit.

IF

NOT OK

Rectify as required

OK

Bleed fuel system

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Set isolating switch to ISOLATE (refer to Part 2, Sect.2, Chap.2 para.18).

IF

NOT OK

Change h.p. fuel pump *

OK

Reset isolating switch to NORMAL then, check top temperature control unit for correct operation. Refer to chart for 'Maximum rev/min incorrect'.

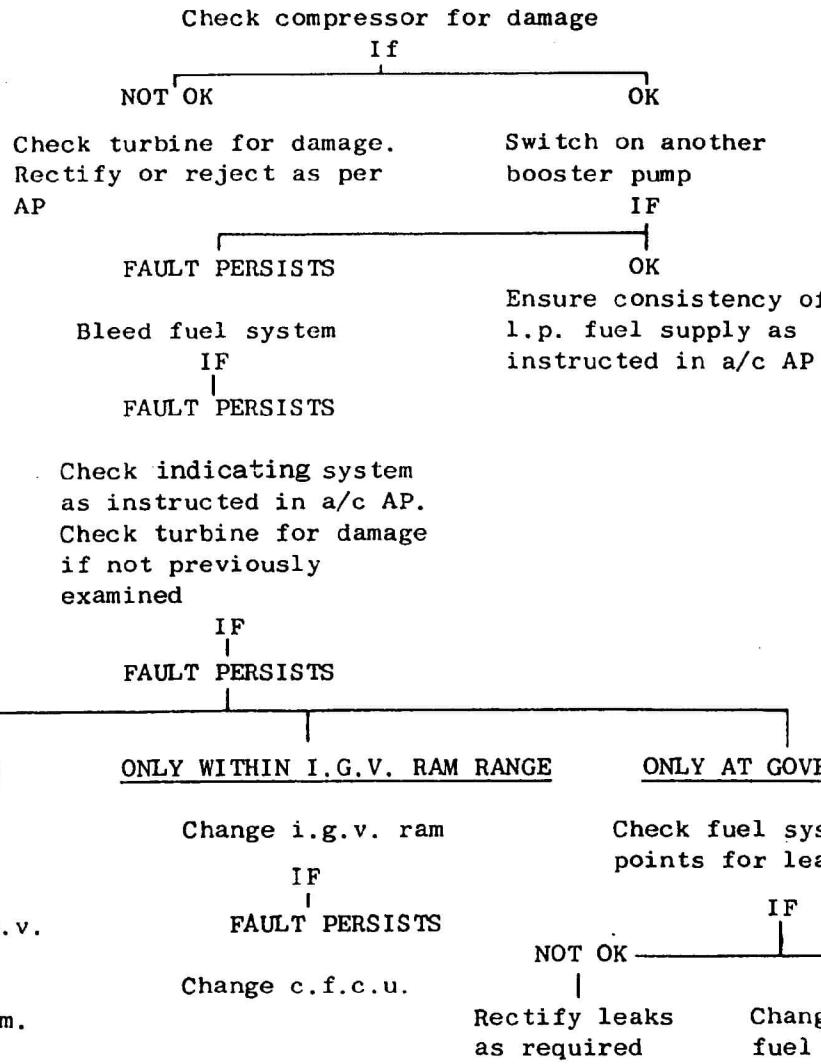
MK.109

IF

FAULT PERSISTS

Isolate fuel control servo pressure system. Refer to chart for 'Engine lights up but fails to achieve self-sustaining or ground idle speed'.

REV/MIN FLUCTUATION



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4. ACCELERATION FAULTS

NOTE: (1) If malfunction in flight is experienced, refer to para.13A.

(2) On Mk.122 engines, checks marked thus * entail removal of the engine.

Check compressor for damage

IF

NOT OK — Check turbine for damage Rectify or reject as per engine AP

OK — Check operating points, consistency and smoothness of operation of i.g.v. ram and bleed valves

IF

NOT OK — Bleed fuel system and i.g.v. ram, ensuring that i.g.v. ram h.p. and half ball valve filters are clear of obstruction and that i.g.v. movement is unrestricted. Re-check ram and bleed valve operating points

IF

I.g.v. ram or bleed valves fail to adjust or operation is inconsistent change units as required *

OK — and problem persists check if engine

Accels Fast

Adjust a.c.u. to increase accel. times (slow down)

IF

Accels Slow

If r.p.m. and j.p.t. rise progressively adjust a.c.u. to reduce accel times (speed up)

IF

If rev/min hesitates at 5500 rev/min with rising j.p.t. increase a.c.u. control (slow down)

IF

Fails to Accel

Check if j.p.t. rises abnormally fast.

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A.c.u. does not respond to adjustment, change a.c.u. and m.b.

NO — Attempt a slow manual acceleration

IF

OK — NOT OK — Reduce a.c.u. control (speed up)

IF

YES — Check metering block for debris from h.p. pump non-return valve or plunger spring

IF

OK — Mk.109

Check gap (0.150 in) between guide vane operating lever and its adjacent datum point if not checked previously. Check guide vane angles at closed (40°) position

IF

NOT OK — Adjust bleed valves to upper limit

IF

FAULT PERSISTS

Adjust a.c.u. to upper limit (slow)

IF

OK — Mk.122

Adjust bleed valves to upper limit

IF

FAULT PERSISTS

Adjust a.c.u. to upper limit (slow)

IF

NOT OK — Change all fuel units including burners, governor pump and i.g.v. ram. Refit all pipes and oil cooler after reverse flushing

OK — IF

FAULT PERSISTS

Mk.109 — Bleed fuel system (including i.g.v. ram) if not bled previously

IF

FAULT PERSISTS

Change a.c.u. and m.b.

Mk.122 — Check bleed valve/a.c.u. air transfer tube for internal and external obstruction. Check T-piece connection for deterioration of seal rings. Clear obstruction and renew seals as required. Check gap (0.150 in) between guide vane operating lever and its adjacent datum point if not checked previously. Check guide vane angles at closed (40°) position.

IF

NOT OK — Bleed fuel system (including i.g.v. ram) if not bled previously

IF

FAULT PERSISTS

Change a.c.u. and m.b.

OK

CONDITION			RECTIFICATION
Datum Gap	Closed I.G.V. Angles		
	Mean of 12 follower vanes	Lower master vane	
Greater than 0.150 in	38° minimum	No more than 3° different from all 12 follower vanes	Change both master vane quill shafts
		OR	
		Lower than any of 12 follower vanes by more than 3°	Change master guide vanes and quill shafts
0.150 in	Less than 38°	No more than 3° different from all 12 follower vanes	Change both master vane quill shafts
		OR	
		Lower than any of 12 follower vanes by more than 3°	Change master guide vanes and quill shafts
Greater than 0.150 in	Less than 38°	No more than 3° different from all 12 follower vanes	Restore correct datum gap

Table 2

FIXED THROTTLE SURGE ON GROUND OR IN FLIGHT (Mk.109 ONLY)

Check:-

(1) Inadvertent selection of anti-icing system.

(2) Nose cowl and starter fairing for indentations.

(3) Correct alignment between nose cowl and engine intake extension (no bumps/steps).

(4) Deterioration of cowl/intake seal, and protrusion into air stream.

(5) I.g.v.'s and visible compressor stages for impact damage.

(6) Visible compressor stages for blade tip rock (not seized).

(7) Correct alignment between engine front bearing housing and compressor casing joint face (no localised forward facing steps).

IF

NOT OK

Replace or rectify defective parts as required

OK

Check if surge occurred on ground or during creep climb to flight level 450 or cruise conditions. If so, ensure correct gap (0.150 in) between the guide vane operating lever and its adjacent datum point. Check i.g.v. angles at closed (40°) position.

IF

NOT OK

See chart for 'Faulty Acceleration'

OK

SURGE ON GROUND, CREEP CLIMB OR CRUISE CONDITIONS

Ensure h.p. fuel pump delivery pressure is within limit specified in AP 102C-1512 to 1517-6A, Sect.2 Chap.6 (see Vol.1,Part 3,Sect.1,para.11C)

IF

FAULT PERSISTS

Change c.f.c.u.

Check if surge occurred during high altitude limiting rev/min test. If so, check -

1. Security of o.a.t. indicator bulb
2. Accuracy of o.a.t. gauge
3. Accuracy of i.a.s. gauge
4. Accuracy of rev/min gauge

IF

NOT OK

Rectify or replace defective units as required

OK

Ensure correct gap (0.150 in) between the guide vane operating lever and its adjacent datum point. Check i.g.v. angles at closed (40°) position

IF

SURGE DURING HIGH ALTITUDE LIMITING REV/MIN TEST

Ensure correct alignment of engine in airframe

IF

FAULT PERSISTS

Install engine in another a/c

ACCEL/DECEL SURGE

NOTE: On Mk.122 engines, checks marked thus *, entail removal of the engine.

Check:

(1) Inadvertent selection of anti-icing system

(2) Nose cowl and starter fairing for indentations (Mk.109)

(3) Correct alignment between nose cowl and engine intake extension (no bumps/steps) (Mk.109).

(4) Deterioration of cowl/intake seal and protrusion into airstream (Mk.109)

(5) I.g.v's and visible compressor stages for impact damage

(6) Correct alignment between engine front bearing housing and compressor casing joint face (no localised forward facing steps), (Mk.109).

(7) Bleed valve outlet ducts for obstructions.

IF

NOT OK — Replace or rectify defective parts and/or clear bleed valve ducts

OK — Check operating points, consistency and smoothness of operation of i.g.v. ram and bleed valves

IF

NOT OK — Bleed fuel system and i.g.v. ram, ensuring that i.g.v. ram h.p. and half ball valve filters are clear of obstruction and that i.g.v. movement is unrestricted. Re-check ram and bleed valve operating points and adjust as required

IF

I.g.v. ram or bleed valves fail to adjust or operation is inconsistent, change units as required.

OK — Check fuel pump delivery pressure at 3,000 rev/min (see para.11C)

IF

NOT OK — Mk.109, adjust within limits of AP 102C-1512 to 1517-6 Chap.6. Mk.122, adjust to nominal pressure of 1250 lbf/in^2

IF

Correct pressure cannot be achieved, change c.f.c.u.

OK — and surge persists check if surge is accompanied by a rapid j.p.t. rise

IF

YES — Increase a.c.u. control (slow down)

IF

ACU DOES NOT RESPOND TO ADJUSTMENT OR ACCEL. TIMES ARE INCONSISTENT

Mk.122 * — Ensure bleed valve/a.c.u. air transfer tube is free of internal and external obstruction. Ensure satisfactory condition of T-piece connection seal rings.

IF

FAULT PERSISTS

Mk.109 — Change a.c.u. and m.b.

ACU RESPONDS TO ADJUSTMENT BUT SURGE PERSISTS

NO

* Check gap (0.150 in) between guide vane operating lever and its adjacent datum point if not previously checked Check i.g.v. angles at closed (40°) position.

IF

NOT OK — See chart for 'Faulty Acceleration'

OK — Raise bleed valve and i.g.v. ram settings to top limits

5. Rough running

A. Vibration

(1) Vibration can be caused by faulty combustion or by a mechanical failure. Vibration due to faulty combustion is usually caused by poor flame propagation, or flame extinction in one or more combustion chambers. Feel carefully each air casing in turn, any faulty casing will be relatively cool. The combustion chambers should be removed and replacement burners fitted as described in Vol.6A, Part 1, Sect.2, Chap.6.

(2) If combustion is satisfactory, make the following checks:-

(a) Ascertain that the j.p.t. and oil pressure were normal in flight.

(b) Examine the engine and jet pipe installation for fouling on the aircraft structure; check the security of engine bearers and all pipes and fittings connected between the engine and the airframe. Check the accessory gearbox drive and the gearbox and accessories for security.

(c) Examine the intake guide vane assembly for damage, twisting, or sticking in the bushes, and the compressor rotor and stator blades, as far as possible, for damage.

(d) Examine the turbine assembly and exhaust unit for damage and metal deposits. Before rejecting an engine for suspected compressor blade failure because aluminium deposits have been found in exhaust unit or jet pipe, identify an approximate 1gm sample of the deposit by placing it in a test tube containing approximately 20cm^3 of sodium hydroxide (caustic soda). If the aluminium dissolves leaving a bulky, black residue, the deposit originates in a failed compressor blade, but if there is only a negligible trace of residue, it originates in the protective coating on the combustion chambers and does not affect serviceability of the engine.

(e) Check that engine oil consumption is normal and for evidence of excessive breathing from the wheelcase, and a discharge of oil from the cooling air outlets.

(f) Remove the pressurising valve and check for freedom; refer to Vol.6A, Part 1, Sect.2, Chap.6.

(g) Examine the bleed valve gauzes for feathers or other foreign matter.

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(h) Examine all oil filters for metal. If small mounts of fine bronze particles are evident they may have originated from the cage pockets of the Duplex type centre bearing, and have been caused by the 'hammering' of the balls on the end faces of the cage pockets. Investigation has proved that there is little danger of the cage disintegrating and, therefore, if the deposit is small, the filters should be cleaned and refitted. The filters should thereafter be examined at approximately twenty-four periods of engine life, and if only small amounts of bronze are evident, the engine may be considered satisfactory. The engine should be rejected if there is a serious increase in the quantity of metal, or if actual pieces of the cage pocket dividing bars are found in the filters.

(j) Check the engine external wheelcase for security. Examine the external wheelcase/compressor outlet casing attachment lugs and shackle link attachment lugs for cracks. Cracking of attachment lugs is unacceptable.

(k) If the above checks do not reveal a defect, make the ground running checks described in Part 2, Sect.2, Chap.2. On completion of a satisfactory ground run, check that the engine runs down freely, and listen for signs of seal rub.

B. Accessories

(l) When vibration occurs on the ground as well as in flight and if there are no symptoms suggesting impending mechanical failure, the engine should be ground run with the accessory gearbox drive shaft disconnected from the engine. If vibration is not then evident, the fault is in the gearbox, gearbox drive shaft, or the driven units.

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6. Jet pipe temperature abnormal

A. General

(l) High j.p.t. may be due to external extraneous causes such as hot gases from the jet efflux of another aircraft, down wind ground running or inadvertent use of the anti-icing system. Consideration should also be given to the prevailing atmospheric conditions and to possible inaccuracy in the rev/min indicator and the pyrometric systems.

B. Faulty jet pipe temperature indication

(1) If the indicator registers abnormal j.p.t. and no extraneous causes are apparent, check the pyrometric system, as described in the aircraft Air Publication. Erratic or low j.p.t. may result from leakage of current from the thermocouples and be caused by moistured or a defect. A fault Voltage regulator may also give an incorrect temperature indication.

C. Low jet pipe temperature

(1) Low j.p.t. can result from failure of the intake guide vane ram governor pump; the engine will accelerate to governed speed, but the thrust will be considerably reduced. Before changing the governor pump, inspect the governor pump filter to check that failure was not induced by fuel contamination from a failed h.p. fuel pump, refer to para.2 'Engine lights up but fails to achieve self sustaining or ground idle speed'.

D. High jet pipe temperature

(1) An obstruction in the air intake can cause high j.p.t. During acceleration, a defect in the a.c.u. can cause transient high j.p.t. Check the operation of the intake guide vane ram as instructed in Part 2, Sect.2, Chap.2. If the ram operation is satisfactory, adjust the acceleration control unit (Vol.6, Part 1, Sect.2, Chap.6). Should this fail to cure the fault, check for h.p. fuel pump failure debris, refer to para.2, 'Engine lights up but fails to achieve self-sustaining or ground idling speed' and para.4. 'Faulty acceleration' before changing the acceleration control unit and metering block as described in Vol.6, Part 1, Sect.2, Chap.6.

(2) On engines fitted with a top temperature control, excessive j.p.t. at altitude, or under high atmopheric temperatures, may be due to the failure of the control in the 'rich' position (actuator shaft retracted).

(3) If the maximum jet pipe temperatures have been exceeded, examine the pyrometry system for damage and examine the engine and jet pipe as instructed in Part 2, Sect.3, Chap.1, paras. 13 and 14. If there are signs of damage or severe overheating, or if there is any doubt about the condition of the turbine, the engine must be removed for further examination. For instructions concerning pyrometry system rectification procedure and engine and jet pipe removal, refer to the instructions in the appropriate aircraft Air Publication.

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7. Oil pressure incorrect

A. Faulty oil pressure indication

(1) If oil pressure is low, check that the oil pressure transmitter and the oil pressure gauge are satisfactory by following the instructions in the appropriate aircraft Air Publication.

B. Oil pressure low

(1) Low oil pressure may be due to oil leakage, a faulty pressure relief valve, foreign matter on the valve seatings, or damaged seatings in the main relief valve or the oil cooler by-pass valve. These faults in the by-pass valve would allow an excessive amount of oil to by-pass the cooler, raising oil temperature and lowering its pressure. The valve loadings are pre-set and should not be disturbed. Remove and clean the valve assemblies as described in AP 102C-1512 to 1517-6A, Sect.2, Chap.7. If this does not rectify the defect, renew the complete assembly. If the oil pressure is still low, reject the engine.

8. Oil consumption excessive

A. General

(1) Internal or external leakage is the only cause of excessive oil consumption.

B. External oil leakage

(1) Inspect the engine for external oil leaks; they may result from a loose pipe or a faulty joint washer, which should be rectified.

(2) If oil leakage is evident at the engine external wheelcase drive outer sealing tube, oil feed connection to external wheelcase or oil drain connection from the external wheelcase to sump, check the external wheelcase for security as instructed in 5.A.(2),(j).

C. Internal oil leakage

(1) Internal leakage is indicated by an oily film deposited around the cooling air outlet ducts, or blue smoke issuing from the ducts.

(2) If inspection fails to reveal leakage, or if the leakage is internal, reject the engine.

NOTE: Excessive oil consumption indicated by an increased flow of oil from the combustion chamber drain valve on shut down, or after prolonged running at low rev/min (e.g. during compass swing) is acceptable, provided oil consumption is within limits during normal operation.

9. Sump level increase

A. Internal fuel leakage

(1) If the sump oil level tends to increase, or the oil consumption is considerably below normal, the oil system is probably contaminated by fuel leaking from defective fuel seals in the h.p. fuel pump and intake guide vane ram governor pump, or a defective oil cooler. The latter is the most probable source of contamination. To determine the location of the fault, disconnect each drain pipe from its unit and check the amount of spill from each (para.10). If the amount of spill exceeds the maximum (Table 3), change the unit.

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(2) Before assembling, blow through each drain pipe with compressed air and check that fuel will flow freely. Before running the engine, drain the oil, clean the filters, and refill the sump with fresh oil.

10. Fuel drainage excessive

A. Measurement of fuel spill

(1) If the overboard fuel drainage is excessive, disconnect in turn each drain pipe from its unit and fit a slave pipe to drain from the disconnected unit into a container. Run the engine at approach idling rev/min (Operating Limitations) for a timed period and measure the resulting spill from each unit. Measure the h.p. cock spill at maximum continuous rev/min and also with the engine static (booster pump running). If the spill from any unit is in excess of that given in the following table, the unit must be changed.

Unit	Max. spill $cm^3/hr.$	
	Avtur	Avtag
H.p. fuel pump	60	90
Intake guide vane ram governor pump	120	180
H.p. fuel cock (max. continuous rev/min)	12,000	16,800
H.p. fuel cock (engine static-booster pump ON)	3,000	4,000
Oil cooler	Nil	Nil

Permissible spill from fuel system units
Table 3

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11. High pressure fuel pump and intake guide vane ram governor pump 'run dry'

A. Dry running of the h.p. fuel pump and the governor pump may occur when an engine is windmilling, and in these circumstances the following limitations must be applied:-

(1) Provided that the engine has been stopped as detailed in the Operating Instructions Manual, i.e. h.p. cock closed before l.p. cock, the h.p. fuel pump and the governor pump may run for an unlimited period.

(2) The h.p. fuel pump and the governor pump may be considered serviceable if they have 'run dry' for a period not exceeding 30 minutes and 3 minutes respectively, under the following conditions:-

(a) With the h.p. cock OPEN and the l.p. cock CLOSED.

(b) If a failure of the l.p. fuel line prevents fuel reaching the h.p. fuel pump and the governor pump when the h.p. cock is open.

(3) If the h.p. fuel pump and the governor pump have 'run dry' for a greater period under the conditions given in sub-para.(b) they must be renewed.

(4) If contamination is suspected, change the fuel system as described in Vol.6A, Part 1, Sect.2, Chap.6.

12. Braiding failure of flexible fuel pipes after cavitation

A. When h.p. fuel pumps are subjected to conditions which cause cavitation, the maximum alternating stresses experienced in the pipe lines between the metering valve unit and the acceleration control unit are known to increase considerably, thereby hastening ultimate failure of the wire braiding reinforcement on pipes fitted to Avon Mk.109 (pre-Mod.1155), and Avon Mk.113, 115, 121 and 122 Series E.C.U.

B. Whenever the h.p. fuel pump has been subject to conditions which could lead to cavitation, for example due to incorrect operation, failure of fuel tank booster pumps or by running a tank dry, then both the flexible fuel pipes between the metering valve unit and the acceleration control unit must be replaced by new pipes.

13. Engine handling at altitude

A. If, at high altitude, rev/min creep, or lack of governed rev/min is experienced, or if engine handling proves difficult during acceleration, ground run the engine and make the full set of checks described in Part 2, Sect.2, Chap.2. After a satisfactory ground run, the engine should be flight-tested and the fuel pump delivery pressure adjusted, if necessary, as described in Vol.6, Part 1, Sect.3, Chap.6. EJ Blr

NOTE: Before attempting to correct engine handling defects by changing fuel system units, remove the ram air pipe between the air intake and b.p.c. and examine for blockage by foreign matter (e.g. grease and dirt); if blocked, flush the pipe with clean kerosine and blow through with clean, dry, compressed air. Examine the b.p.c. air filter and clean as required. Replace the pipe, renewing disturbed sealing rings.

B. Rev/min creep

(1) It is important to differentiate between rev/min creep and governor creep. Rev/min creep will be apparent during a fixed throttle climb at intermediate engine speed whereas governor creep will show as a rev/min increase at governed speed.

(a) If required, rev/min creep will respond to fuel flow (b.p.c.) adjustment. The effects of b.p.c. adjustment and the limits for h.p. fuel pump delivery pressure are instructed in AP 102C-1512 to 1517-6A, Part 1, Sect.2, Chap.6.

(b) The h.p. fuel pump has a fixed creep rate at altitude and cannot be altered by adjustment. If the indicated governed rev/min at altitude exceeds the value specified in Operating Limitations, the ground setting rev/min may be adjusted to a lower limit, corrected for temperature, as instructed in Part 2, Sect.2, Chap.2.

C. Rev/min loss or drop

(1) In addition to the checks listed in the chart for 'Rev/min loss or drop', ensure that the b.p.c. ram air pipe and filter are clear of blockage by foreign matter as instructed in para.13A. This should be accomplished before changing any fuel system units. Check the bleed valve/a.c.u. air transfer tube for internal and external obstruction and check the T-piece connection for deterioration of sealing rings. Clear any obstruction and renew seals as required.

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