

Chapter 4

FAULT DIAGNOSIS AND RECTIFICATION

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GENERALMALFUNCTION OF GTS/APU WITHIN AIRCRAFT ENGINE STARTING SYSTEM

1. In all cases of GTS/APU malfunction in actual service within the aircraft engine starting system, reference is made to fault diagnosis and rectification chart contained in AP (NAVAIR) 101B-0601(2)-1D & 1E, Chapter 48-11, Table 5.

MALFUNCTION OF GTS/APU ON TEST RIG

2. All GTS/APU's forwarded for bay servicing due to a complaint which could not be remedied in situ shall be subjected to a functional test 2nd series (See Chapter 3, para.26) to verify the complaint.
3. If the complaint is not verified or if the unit functions satisfactorily after some minor adjustment, carry out oil inhibition of fuel system as laid down in Chapter 3, para.27, and re-despatch the GTS/APU with an explanatory note pointing to some other causes of malfunction of the aircraft starting system.
4. If the complaint is verified, refer to fault diagnosis and rectification chart as tabulated in following paragraphs.

5. This chart has been compiled on the assumption that all action has been taken to rectify the fault in situ and that all slave items of the test rig are checked at regular intervals to ensure their faultless function.

FAULT DIAGNOSIS AND RECTIFICATION

INTRODUCTION

6. The following paragraphs give possible causes and corresponding rectifying actions for the various complaints (faults) as verified by the functional test 2nd series carried out in accordance with paragraph 2.

CAUTION...

After the fault diagnosis and rectification procedure each GTS/APU shall again be subjected to a functional test 2nd series (proof test) to ensure that the malfunction which constituted a specific complaint has been eliminated, followed by oil inhibition procedure as detailed in Chapter 3, paragraph 27, prior to removal from the test rig for despatch.

FAULT	POSSIBLE CAUSE	ACTION
7. Electrical starter motor runs but:		
(1) is cut off almost immediately	Starter motor clutch unserviceable and/or auxiliary gearbox gear train unserviceable	Introducing special inspection tool 'INTRASCOPE' (slightly magnifying small mirror hinged at a variable angle at the end of about 3ft long tubular rod containing an illuminating electric bulb) down the air intake, check whether compressor rotates when starter motor is running. If irregular or no rotation, dismantle GTS/APU to check sprag clutch and auxiliary gear train. Refer to Chap.2, para.52 for dismantling/assembling. Rectify by changing components found defective. Observe shimming procedure as per Chap.2, para.92.
(2) the GTS/APU fails to 'light up'.	Insufficient or no fuel due to:-	Remove sprayer fuel pressure tapping plug (Chapter 1, fig. 1) and check fuel flow at this point. If fuel is satisfactory, the fault is downstream.
	(a) Fuel leaks downstream	Inspect fuel pipe, HP filter and sprayer manifold to locate and remedy any leaks.
	(b) HP filter blocked	Remove, clean and re-fit.

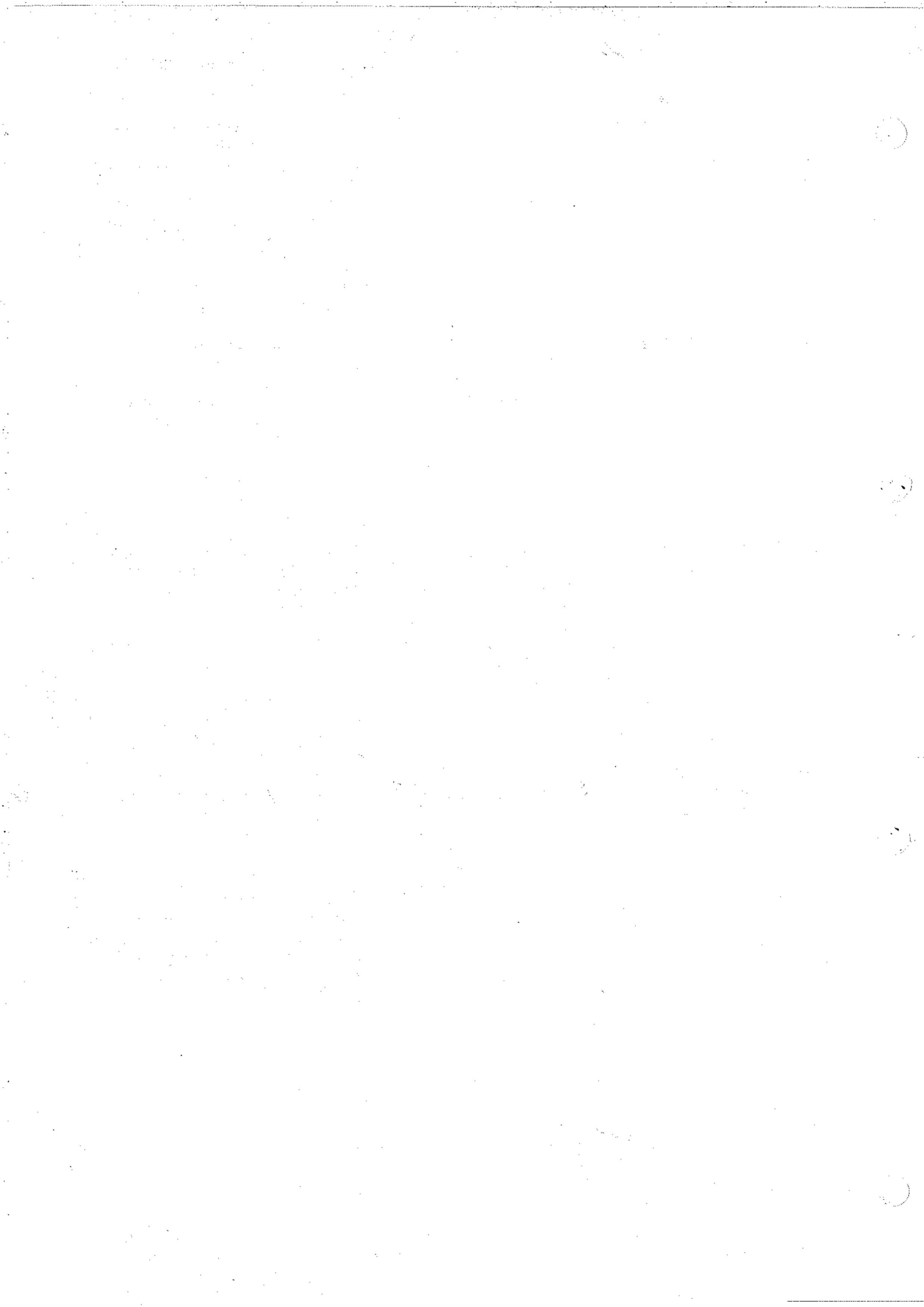
FAULT	POSSIBLE CAUSE	ACTION
7. (2) the GTS/APU fails to 'light up' (cont.)	(c) blocked sprayers	<p>Measure fuel flow and fuel pressure at sprayer fuel pressure tapping point and use diagram in fig.9, Chapter 3 to calculate the Flow Number.</p> <p>If the value is outside the limits, test individual sprayers in accordance with Chapter 3, paragraph 11; change faulty sprayers and re-check FN against curves in fig.9, Chapter 3.</p> <p>If no fuel or weak fuel flow, the fault is upstream.</p>
	(d) fuel leaks upstream	Locate and remedy.
	(e) shut-off cock and dump valve malfunctioning	<p>Check electrical supply to SOC and rectify as necessary.</p> <p>If still no or weak fuel flow, remove SOC and test it according to Chapter 3, paragraph 10.</p> <p>If unsatisfactory, change SOC</p> <p>If test satisfactory, refit SOC and look for further possible cause.</p>
	(f) fuel pump defect	<p>Remove end plug in LP fuel filter housing, operate the starter motor and observe whether fuel pump shaft is rotating. If it is not, remove pump unit and check the drive.</p> <p>If pump shaft defective, change whole Lucas fuel system (matched set) and carry out relevant test and adjustment as laid down in Chapter 3, paragraph 28 (1) (b).</p> <p>If auxiliary gear train defective, rectify by changing defective items.</p> <p>If drive correct, yet the fault persists, remove whole Lucas matched set, test and adjust as detailed in Chapter 3, paragraph 6.</p>

FAULT	POSSIBLE CAUSE	ACTION
7. (2) the GTS/APU fails to 'light up' (cont.)	(f) fuel pump defect (cont.)	If no remedy can be achieved, refer to Chapter 3, sub-sub-paragraph 23 (7), (h), change whole Lucas matched set and carry out relevant preliminary operations as detailed in Chapter 3, paragraph 28 (1) (b).
	Compressor inefficient	Dismantle GTS/APU and inspect compressor housing, pre-whirl vanes, compressor rotor, diffuser vanes, compressor turbine nozzle, and turbine blades for any sign of distortion, damage or erosion. Rectify by changing defective components. Rectification to turbine rotor, compressor rotor and RGV assembly to be carried out in accordance with LRS2155 ref AP103D-0304-6 Chapter 1 para. 60.
▶ 8. GTS/APU runs up in START mode but at low power indicated by low rev/min of inertia rig. (Dead crank of Pegasus engine should reach 18÷20% LP compressor rev/min.	Lack of fuel and/or high drift on top speed governor	Referring to fault para.7, clean both the LP and the HP filters and carry out relevant fuel checks and rectifying actions.
	Idling control valve defective	Remove and test idling control valve as detailed in Chapter 3, paragraph 9.
	Compressor low speed	If unsatisfactory, install a new idling control valve and adjust as laid down in Chapter 3, sub-paragraph 24 (9). Remove circlip and plug at speed probe mounting point (Chapter 1, fig.1), insert speed probe (Transducer NTS. 13941) as detailed in Chapter 3, sub-sub-sub-paragraph 23 (3) (f) (viii) and measure compressor speed.
		If the resulting rev/min is below the START mode value, carry out inspection and rectification of compressor as detailed in FAULT paragraph 7 for compressor inefficiency.

FAULT	POSSIBLE CAUSE	ACTION
8. (Cont.)	Power turbine low speed	<p>Dismantle GTS/APU and inspect power turbine nozzle and turbine blades for any sign of distortion damage or erosion. Rectify by changing defective components.</p> <p>If turbine wheel needs changing, the complete power turbine rotor shaft assembly must be changed as a unit.</p> <p>Also, change carbon bush and seal assembly in seal support assembly (Chapter 1, fig.11, item 16) in accordance with instructions in Chap.2, para. 134. After re-assembling GTS/APU carry out preliminary operations as detailed in Chapter 3, sub-paragraphs 24 (1) (2) and (5).</p>
	Oil churning	<p>Drain both gearboxes and measure volume drained from accessory gearbox. Check and clean scavenge filter and non-return valve assembly in accordance with Chapter 3, paragraph 18. If measured volume exceeds 400 cm³, check other components of the oil system as detailed in Chapter 3, paragraphs 13 to 17.</p> <p>Change components found faulty and after re-assembling into GTS/APU carry out oil priming procedure as detailed in Chapter 3, sub-paragraph 24(1).</p>
▶ 9. GTS/APU runs up in START mode but fails to simulate engine crank start and automatically shuts down within 5-6 seconds.	Disconnect solenoids failing to operate	<p>Dismantle GTS/APU and subject the disconnect mechanism to test procedure laid down in Chapter 3, paragraph 19.</p>
	Output shaft serrated parts or fixed jaw or mobile jaw serrations sheared off	<p>If unsatisfactory, change solenoid mounting plate assembly.</p> <p>If satisfactory yet the fault still persists, check serrations on output shaft and on both jaws.</p> <p>Rectify by changing defective components and carry out oil priming after reassembly as per Chapter 3, paragraph 24 (1).</p>

FAULT	POSSIBLE CAUSE	ACTION
10. GTS/APU running in APU mode; a.c. generator fails to come ON line at 15 seconds after initiating cycle	Lack of fuel	Inspect and clean both fuel filters and carry out relevant fuel checks and rectifications as per fault in paragraph 7. Also, check APU solenoid valve and carry out APU governor adjustment as detailed in Chapter 3, paragraph 7 and sub-paragraphs 24 (6) and (7) respectively.
11. GTS/APU runs up in APU mode but shuts down after a.c. generator has come ON line	APU governor drift or failure	Check and adjust APU governor as per Chapter 3, sub-paragraphs 24 (6) and (7) to decrease APU mode rev/min to correct value. If impossible to obtain correct governing, refer to Chapter 3, sub-sub-paragraph 23 (7) (h), change whole Lucas matched set and carry out relevant preliminary operations as per Chapter 3, sub-paragraph 28 (1) (b).
12. GTS/APU running in APU mode; fails to translate to START mode and runs at idling speed	Starter push-button switch operated later than 15 seconds after selecting ◀ TRANSITION start ▶	Terminate the cycle and observe CAUTION in Chapter 1, paragraph 76.
	Disc brake slip indicated by failure to accelerate after 15 seconds in 'idling' conditions	Visually check whether a.c. generator comes to rest. If it does not, dismantle disc brake assembly. Inspect bellows, brake pads and seal assembly (Chapter 1, fig.11, item 44) for damage, oil contamination or wear, and rectify by cleaning, and/or changing defective components as necessary.
	Brake solenoid valve not operating correctly	Remove brake solenoid valve and carry out test as detailed in Chapter 3, paragraph 17.
	Low brake oil pressure	Check brake oil pressure at oil inlet into brake cover housing.

FAULT	POSSIBLE CAUSE	ACTION
12. (Cont.)	Low brake oil pressure (cont.)	If below the limit stated in Chapter 3, Table 3, remove oil pump unit and carry out test as laid down in Chapter 3, paragraph 13 and 15. Rectify by changing faulty item as necessary.
13. Compressor surge	Blocked air intake	Locate and remedy.
	Gas generator over-fuelled	Refer to acceleration check as detailed in Chapter 3, sub-paragraph 24 (5).
	Oil churning	Refer to fault in paragraph 8 for action as per 'oil churning'.
14. Abnormal sounds or 'rough' running	Damage to gas generator rotating assembly or power turbine rotor or gears in either or both gearboxes, or insufficient lubrication	Dismantle GTS/APU, thoroughly inspect both rotating assemblies, gears in both gearboxes and check oil system. Rectify by changing defective components as necessary. After reassembling, carry out preliminary operations as per Chapter 3, paragraph 24.
15. Continuous flames and/or excessive smoke in exhaust duct	Failure of labyrinth seal in main gearbox, or dislocation or failure of seal oil seal in compressor rotating assembly, or both	Dismantle GTS/APU, inspect seals in both rotating assemblies, look for carbon deposit in combustion chamber and check forward lifting eye breathing passage. Rectify by cleaning and/or changing faulty components as necessary. After re-assembling, carry out preliminary operations as per Chapter 3, paragraph 24.



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