*TM 1-1520-236-MTF

TECHNICAL MANUAL

MAINTENANCE TEST FLIGHT MANUAL

FOR

ARMY MODEL
AH–1F ATTACK HELICOPTER

***This manual supersedes TM 55-1520-236-MTF, 8 December 1987, including all changes.**

HEADQUARTERS, DEPARTMENT OF THE ARMY

26 JANUARY 2001

WARNING

A maintenance test flight is an exceptionally demanding flight and requires a thorough flight readiness inspection (preflight). Procedures for the flight readiness inspection are prescribed in TM 1-1520-236-10 Operator's Manual and must be completed prior to the maintenance test flight. Emergency procedures are found in TM 1-1520-236-10 and/or TM 1-1520-236-CL and are not duplicated in this publication. Prior to each maintenance test flight, the pilot will contact maintenance/quality control personnel to determine the maintenance that has been performed. This manual should be used only by qualified maintenance test flight pilots as required in AR 95-1.

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your DA Form 2028-2 directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-LS-LP, Redstone Arsenal, AL 35898-5230. A reply will be furnished directly to you. You may also submit your recommended changes by E-mail directly to ls-lp@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. Instructions for sending an electronic 2028 may be found at the back of TM 1-1520-236-10.

Section I. INTRODUCTION

1. Purpose. The purpose of this manual is to provide complete instructions for performing a maintenance test flight of AH-1F aircraft. For the specific conditions which require a general or limited maintenance test flight, refer to TM 1-1500-328-23 and TM 55-1520-236-23.

2. Definitions.

a. Maintenance Test Flight. A functional test flight for which the primary purpose is to determine whether the airframe, powerplant, accessories, and other equipment are functioning in accordance with predetermined requirements while subjected to the intended environment.

b. Warnings, Cautions, and Notes. Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure, practice, etc., which if not correctly followed, could result in personnel injury or loss of life.

CAUTION

An operating procedure, practice, etc., which if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., which it is essential to highlight.

3. General Information

a. This manual covers only maintenance test flight of the AH-1F aircraft and in no way supersedes any information contained in TM 1-1520-236-10 or TM 1-1520-236-CL, but is used in conjunction with the -10 or -CL. For the purpose of maintenance test flights only, this manual satisfies all the requirements of the -CL from Interior Check through Engine Shutdown.

b. Crew requirements will be as specified in TM 55-1500-328-23 and TM 1-1520-236-10.

c. The duration of the general or limited test flight will be in accordance with the requirements of TM 55-1500-328-23.

4. Special Instructions.

a. Cargo and Passengers. Cargo and passengers are prohibited on maintenance test flights.

b. Forms and Records. Forms and records will be checked prior to the maintenance test flight to determine what maintenance has been performed and the type of maintenance test flight required (i.e., general or limited).

c. Configuration. The configuration of the aircraft should be determined prior to each maintenance test flight in order to determine performance parameters.

d. Post-Test Flight Inspection. A thorough visual inspection will be performed to the extent necessary to assure that deficiencies or shortcomings that may have developed as a result of the test flight are detected.

e. References. When a maintenance test flight is required to assure proper operation of a specific system(s), refer to TM 55-1520-236-23 for the limits of that system.

f. Asterisked Checks. An asterisk (*) prior to a check requires that the Test Flight Check Sheet be annotated with a specific reading. Also, a check mark (√) for satisfactory performance or an (X) for problem detected, will be recorded and a short statement entered in the remarks block of the check sheet.

g. Maintenance Test Flight Check Sheet. The check sheet contained in Section V will be used for all test flights. When a test is performed to determine if specific equipment or systems are operating properly, completion of only that portion of the maintenance test flight check sheet applicable to the specific equipment or systems being tested is required. The aircraft test flight check sheets may be locally reproduced. Continuation sheets may be used when necessary. Items that prove to be unsatisfactory during the test flight and require corrective action, shall be listed in the remarks block during flight and transferred to DA Form 2408-13-1 immediately after termination of the flight. The sheet will be attached to DA Form 2408-13-1 upon completion. After accumulation of two or more sheets, the data should be reviewed to determine if trends are developing.

CODE SYSTEM

CN	**C-NITE system**
B540	**Bell main rotor blade**
K747	**Kaman main rotor blade**
O	**If installed**

Section II. MAINTENANCE TEST FLIGHT CHECKLIST

General. This section contains the maintenance test flight requirements peculiar to the AH-1F aircraft. Conditions requiring accomplishment of test flights shall be in accordance with TM 1-1500-328-23. The requirements contained herein are established to assure a thorough inspection of the aircraft before flight, during flight and upon completion of the maintenance test flight. A dash between references indicates “through”; a comma indicates “and”. The references list the possible abnormal conditions, indications or malfunctions which could be encountered while performing the procedure.

PROCEDURE	TROUBLESHOOTING REFERENCE

PRIOR TO MAINTENANCE TEST FLIGHT

1. Forms and records — Check for completion and accuracy.
2. Weight and balance — Compute for actual aircraft configuration.
3. Flight readiness inspection — Complete in accordance with TM 1-1520-236-10 or TM 1-1520-236-CL.
4. Special pre-test flight requirements — Complete as applicable.
   a. Engine flush — Complete.
   b. FOD inspection — Complete.
   c. Engine vibration meter — Install pick-ups as required.

PROCEDURE	TROUBLESHOOTING REFERENCE

PRIOR TO MAINTENANCE TEST FLIGHT (CONT)

d. Pre TEAC checks — Perform as required in TM 55-2840-229-23.

e. Vibrex — Install if needed.

LIGHTING SYSTEM CHECKS

NOTE

These checks should be performed prior to removing aircraft from hangar, while using external power source to preclude unnecessary drain of battery power. For detailed check, refer to Section IV.

INTERIOR CHECK (GUNNER)

CAUTION

An open canopy is susceptible to possible damage from helicopters operating nearby.

1. Pedals — Check adjuster operation, set as required.

2. Shoulder harness lock — Check proper operation.

NOTE

All switches should be checked for condition, security operation and installation. Turn off unless indicated as in following steps.

PROCEDURE	TROUBLESHOOTING REFERENCE

INTERIOR CHECK (GUNNER) (CONT)

3. GUNNERS MISC control panel switch — Set.
   a. ELEC PWR switch — ELEC PWR.
   b. GOV switch — AUTO.
4. Vents — Check unobstructed.
5. EMER HYDR PUMP switch — OFF
6. JTSN SEL — BOTH.
7. WING STORES JETTISON switch — Check off, cover down, and safe-tied.
8. Avionics — OFF.
9. COMM CONT panel — Set as required.
10. TCP switches — Set.
11. Left hand grip — Check.
12. SHC ACQ/TRK/STOW switch — STOW.
13. Instruments — Check condition, security, and static indications. Cage the attitude indicator.

CAUTION

Do not set AIMS type altimeter without electric power applied.

INTERIOR CHECK (GUNNER) (CONT)

14. Standby compass — Check security, fluid level and current calibration.

15. Mirror — Check security, cleanliness, adjust as required.

16. Gunner armament control panel — Set.
    a. TUR SLEW switch — NORM.
    b. TSU/GUN SLEW RATE — HIGH.
    c. WING STORE select switch — RKT.
    d. LASER SAFE/TURRET DEPR LIMIT switch — DEPR LIMIT.

17. All NVG flip filters — Ensure open (master caution, armament panel).

18. Cyclic — Check.

INTERIOR CHECK (PILOT)

CAUTION

An open canopy is susceptible to damage from helicopters operating nearby.

1. Seat — Check freedom of travel, positive locking; set as required.

2. Pedals — Check adjuster operation, freedom of travel through full range; set as required. Check correlation of gunner and pilot pedals.

PROCEDURE	TROUBLESHOOTING REFERENCE

INTERIOR CHECK (PILOT) (CONT)

3. Shoulder harness lock — Check operation; release.

NOTE

All switches should be checked for condition, security, operation and installation. Turn off unless indicated as in following steps.

4. Cyclic — Check.

5. AC/armament circuit breakers — Set.

   a. FCC switch — OFF.

   b. TURRET POWER — OFF.

   c. ADS POWER circuit breaker — OUT.

6. Collective — Remove downlock, friction — OFF and check.

7. Free air temperature gauge — Check.

8. PWR panel switches — Set.

   NON-ESNTL BUS switch — NORMAL.

9. ENGINE panel switches — Set.

   a. FORCE TRIM — FORCE TRIM.

   b. HYD TEST switch — BOTH.

   c. RPM WARNING switch — RPM WARNING.

PROCEDURE	TROUBLESHOOTING REFERENCE

INTERIOR CHECK (PILOT) (CONT)

d. ENG OIL BYP switch — AUTO.

e. GOV switch — AUTO.

10. SCAS control panel — Set.

11. Rocket management system display unit — Check.

12. ARMT control panel — Set.

a. WING STORE switch — RKT.

b. WPN CONTR switch — GUNNER.

c. RANGE switches — As desired.

13. Pilot miscellaneous control panel — Set.

14. COMM CONT panel switches — As required.

15. IGNITION switch — ON.

16. Pilot light control panel — Set.

17. Instrument panel — Check condition, security, and static indications.

CAUTION

Do not set altimeter without electrical power applied.

PROCEDURE	TROUBLESHOOTING REFERENCE

INTERIOR CHECK (PILOT) (CONT)

18. Clock — Check wound and operational.

19. HEAT or VENT knob — Check smooth operation; set as required.

20. Vents — Check unobstructed, controls operate smoothly; set as required.

21. Defog controls — Check operation; set as required.

22. GPS — Set.

23. HUD — Check condition, security; OFF.

24. RDCM and IRCM control panel — Set.

25. ALT control panel — Set.

26. VHF radio — OFF.

27. HSI CONT panel — DPLR - ADF - DPLR.

28. RECOIL COMP switch — As desired.

29. ADF radio — Set.

30. UHF radio — Set.

31. VOR radio — Set.

32. COMPASS switch — MAG.

PROCEDURE	TROUBLESHOOTING REFERENCE

INTERIOR CHECK (PILOT) (CONT)

33. Transponder — Check and set.

34. Voice security set — OFF.

35. Radar warning — Check.

36. LTG panel switches — Set.

37. ANTI-COLL light switch — ON.

38. ECS control panel — Set.

39. DC circuit breakers — Check condition; IN.

STARTING ENGINE

WARNING

Aircraft armed with rocket and/or missile ordnance must be started by battery only.

1.	BATTERY switch — START (Off for GPU start).	C36
2.	GPU — Connect as required.	C37
3.	Voltmeter — Check for minimum 22 volts for battery start; 28 volts for GPU start.	
4.	RPM warning system — Check RPM warning light illuminated, audible audio, audio switch OFF.	C38

PROCEDURE	TROUBLESHOOTING REFERENCE

STARTING ENGINE (CONT)

5. FIRE DET switch — Test. C34,C35

6. Altimeter — Adjust to field elevation.

7. Caution panel checks: C16, D1-D28

   a. Pilots caution panel — Note required caution segments illuminated; test, note all segments illuminated, master caution and overtorque light illuminated. Check gunner's master caution light; test dim function; reset master caution.

   b. Gunners caution panel — Note required caution segments illuminated; test, note all caution segments illuminated; test dim function.

8. Emergency hydraulics system checks: G4

CAUTION

The emergency hydraulics pump requires a large amount of power for operation. If using battery power, this check should be done in a minimum amount of time to preclude depleting battery power.

PROCEDURE	TROUBLESHOOTING REFERENCE
STARTING ENGINE (CONT)	
a. Gunners EMER HYDR PUMP switch — EMER HYDR PUMP; note illumination of EMER HYDR PUMP ON advisory segment; pilot moves collective full up; check for smooth operation and no binding.	
b. Gunners EMER HYDR PUMP switch — OFF; note EMER HYDR PUMP ON advisory segment extinguishes after a short period of time; collective should not move once light extinguishes.	
c. Pilot's EMER HYDR PUMP switch — EMER HYDR PUMP; note illumination of EMER HYDR PUMP ON advisory segment; pilot move collective full down; check for smooth operation and no binding.	
d. Pilot's EMER HYDR PUMP switch — OFF; note EMER HYDR PUMP ON advisory segment extinguishes after a short period of time; collective should not move once light extinguishes.	
9. FUEL switch — ON; note FWD FUEL BOOST and AFT FUEL BOOST caution segment lights extinguish.	D6
10. Increase/decrease switch — Decrease for 10 seconds.	

PROCEDURE	TROUBLESHOOTING REFERENCE

STARTING ENGINE (CONT)

11. Throttle system checks:

CAUTION

Use of excessive force may cause damage to throttle linkage or bellcranks.

* a.	Full open cushion check — Note additional cushion at full open position with slight pressure is 5 ± 2 degrees.	E41

NOTE

Ridge to ridge travel on the knurled throttle friction knob represents 10 degrees for purposes of this check.

b.	Idle stop check — Note presence of mechanical stop.	C33
c.	Gunners IDLE STOP RELEASE switch — Check operation allows throttle to be rolled below idle.	
* d.	Full closed cushion check — Note additional cushion at full closed position with slight additional pressure, is 5 ± 2 degrees.	E41

PROCEDURE		TROUBLESHOOTING REFERENCE
STARTING ENGINE (CONT)		
	e. Freedom of travel check — Note free travel of throttle through entire range; check proper operation of throttle friction; set as required.	E9
	f. Pilots idle stop release — Check proper operation; set throttle slightly below idle stop for start.	
12.	Rotor blades — Note displaced, clear and untied.	
13.	Fireguard — Briefed and posted.	
14.	Intercom check — As required.	K1
15.	Instruments — Check for normal prestart indications.	E7,F7
	a. Engine and transmission oil temp indicates approximately ambient.	
	b. MASTER CAUTION and OVER TORQUE lights extinguished.	
	c. Fire light extinguished.	
	d. Check for proper caution panel lights illuminated.	
16.	Volt/ammeter — Note indications; 22 volts is minimum allowable for battery start.	

PROCEDURE	TROUBLESHOOTING REFERENCE

STARTING ENGINE (CONT)

17. Engine start: A1-A3

CAUTION

To preclude engine hot start, abort start if less than 14 volts is indicated at 10% gas producer speed. In the event any condition necessitating shutdown becomes evident during start, corrective action must be taken immediately in accordance with TM 1-1520-236-10, Chapter 9.

a.	Start trigger — Energize and hold.	
b.	Clock — Start.	
c.	Voltage — Note initial decrease; should increase as gas producer accelerates.	C1,C2 C36,C37
d.	Gas producer — Note normal acceleration; 14 volt minimum indicated voltage at 10% gas producer speed.	A2-A6
e.	TGT — Note normal increase.	A5,A7,A12
f.	IGNITION switch — Off at 750° TGT.	
g.	Rotor blades — Note turning normally.	A11
h.	Cyclic — Center.	
i.	Collective — Ensure full down.	

PROCEDURE	TROUBLESHOOTING REFERENCE

STARTING ENGINE (CONT)

	j. Engine oil pressure — Note increasing normally; ENG OIL PRESS caution segment should extinguish as pressure passes 25 PSI.	D2, E1-E25
	k. Transmission oil pressure — Note increasing.	F1-F5

NOTE

Transmission oil pressure may indicate below minimum until last portion of start.

	l. Start trigger — Release at 40% N1 speed or 35 seconds; note gas producer continues normal acceleration.	A10,A12, A13
	m. Transmission oil pressure — Note pressure increasing; TRANS OIL PRESS and TRANS OIL BYPASS caution segments should extinguish as pressure increases past 38 PSI.	F1-F5
	n. Torquemeter — Note some torque indicated.	B10,B11, B13
	o. IGNITION switch — ON.	
18.	GEN switch — ON; note generator voltage indicated, amperage should begin decreasing after short period of time; note DC GEN caution segment extinguished.	C6-C11
19.	GPU — Disconnect.	

PROCEDURE		TROUBLESHOOTING REFERENCE
20.	BATTERY switch — RUN; note AC power present; note ALT and RECT caution light not extinguished.	C39
21.	NON-ESNTL bus switch — NORMAL.	
22.	Caution panels — Note all caution segments extinguished (except ALTER and RECT lights).	D1-D28
23.	Fire detect light — Extinguished.	C34
*24.	Throttle — Slowly advance past idle stop; then manually check stop to prevent inadvertent shutdown; record indicated gas producer speed (68 to 72%) while maintaining slight pressure against idle stop.	A10,A12, A13,E10, E11

ENGINE RUNUP

CAUTION

Oil pressure may exceed maximum on low ambient temperature starts. Do not exceed engine idle until engine oil pressure is below 100 PSI. Extreme caution should be used during throttle advance. Initial throttle rigging may be improper causing the possibility of overspeed at maximum throttle settings.

1.	Instruments — Check normal indications; note fuel quantity gauge indicating correctly.	B1-B7

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

2. Engine deice system check: E23-E25

   a. Pilots ENG DEICE switch — ENG DEICE position; note 5 to 40° rise in TGT.

   b. Gunners ENG DEICE switch — DEICE position; note no change in TGT.

   c. Pilots ENG DEICE switch — OFF; note no change in TGT.

   d. Gunners ENG DEICE switch — OFF; note TGT decreases to nearly original indication.

3. Environmental control system check: C28-C32

   a. ECU/RAIN RMV switch — ECU; note TGT increase 5 to 40°. Check rheostat operation (heat and cool settings). Set as desired. ECU/RAIN RMV switch — OFF; verify 5 to 40° TGT decrease.

NOTE

Operation of rain removal for long periods of time over a dry canopy or with a malfunctioning thermoswitch will cause melting or deformation of forward windshield.

   b. ECU/RAIN RMV switch — RAIN RMV position; verify air delivery to front windscreen. ECU/RAIN RMV switch — OFF.

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

4. Variable inlet guide vane check

NOTE

The begin-to-open check is a recommended starting point for adjustment of the VIGVs. If the begin-to-open point, as plotted on the VIGV chart, is not within the chart limits, perform a complete VIGV check in accordance with TM 55-2840-229-23 before continuing.

   a. Brief and post observer alongside engine right side (if VIGV test set is not installed).

   b. Slowly increase throttle until VIGV actuator rod begins to move; note N1 speed and FAT. Add +3°C to FAT.

   c. Compare data with VIGV chart.

5. Bleed band operation check — Note closing speed falls within required range of bleed band chart (figure 2). E26

   a. Bleed air (ENG DEICE and ECS) switches — OFF.

   * b. Closing speed check — Smoothly advance throttle while monitoring TGT for sudden 5 to 40° decrease (indicating bleed band closure); note gas producer speed at closure. Bleed band must remain closed at all higher N1 speeds.

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

*c. Opening speed check — Smoothly retard throttle while monitoring TGT for sudden 5 to 40° increase (indicating bleed band opening); note gas producer speed at opening.

*d. Free air temperature — Note actual indication. Add 3° for inlet temperature rise. Compare actual bleed band closing speed with required range from bleed band chart.

e. Throttle — Idle.

CAUTION

If bleed band closing speed does not meet required range or if any evidence of deice or bleed air malfunction becomes evident during runup, repeat bleed band check after correcting the abnormal condition.

NOTE

Certain combinations of operating conditions and/or pilot techniques may preclude detection of TGT changes as bleed band operates. In these instances, a visual and/or audible confirmation of actual operation is necessary.

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

6. Pitot heat check — ADS ANTI-ICE circuit breaker — OUT; PITOT/ADS HTR switch — HTR; note slight rise in amperage; ADS ANTI-ICE circuit breaker — IN; note further rise in amperage; PITOT/ADS HTR switch — OFF; note amp decrease. — C12

CAUTION

Minimize movement of the cyclic during ground run-up to preclude damage to input quill and/or main driveshaft.

7. Force trim system check — Note immediate force trim resistance to cyclic and pedal inputs and nearly equal force is required to move cyclic in all directions; note momentary interrupt buttons (gunner and pilot) release all magnetic brakes and hold controls in selected positions. — H20,H21, H23,H24

8. Flight control check — Turn FORCE TRIM switch OFF; note all controls free; main rotor tip path plane corresponds to cyclic input; aircraft tends to move in correlation to pedal pressures; note any tendency of flight controls to creep or motor. — H1-H5

PROCEDURE	TROUBLESHOOTING REFERENCE
ENGINE RUNUP (CONT)	
*9. Cyclic friction check — Using a suitable spring scale, note cyclic begins to move at 2 ± 1/4 pounds breakaway force in all quadrants.	H22,H23
NOTE **All quadrant breakaways should be initiated from neutral cyclic position.**	
10. Collective friction check: Move collective 1/2” off bottom stop.	H12-H17
* a. Minimum friction breakaway force required is 9 to 11 pounds in both directions of movement; breakaway force must be equal to within one pound.	
*b. Maximum friction breakaway force required is 14 to 16 pounds. With maximum friction applied, insure gunner can move his collective.	
c. Collective friction — Set as required.	

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

11. Hydraulic systems check:

WARNING

Pilot/gunner coordination during this check is imperative as the gunner will have control of the collective. Should any un-commanded control inputs be noted, the gunner must IMMEDIATELY roll throttle to idle and the pilot must IMMEDIATELY place the HYD TEST switch to the opposite system test position, then back to BOTH in order to regain control of the aircraft. Collective movement should be kept to a minimum to prevent inadvertent flight or yaw condition.

a. Hydraulic test switch — Place hydraulic test switch to SYS #1 test position, note illumination of master caution and No. 2 HYD PRESS caution segment lights; all controls should move freely; return hydraulic test switch to BOTH position; all caution segments should be extinguished. — C12, G1-G3, H7, H15-H17, H27

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

b. Hydraulic test switch — Place hydraulic test switch to SYS #2 test position, note illumination of master caution and No. 1 HYD PRESS caution segment lights; cyclic and collective should move freely, pedals should be stiff but moveable; return hydraulic test switch to BOTH position; all caution segments should be extinguished.

c. Hydraulic system #3 check: G4

WARNING

Any uncommanded motion of the collective during the next check requires turning the emergency hydraulic pump switch OFF.

(1) Gunners emergency hydraulic pump switch — EMER HYDR PUMP position.

(2) Note EMER HYDR PUMP ON segment light does not illuminate.

(3) Return EMER HYDR PUMP switch to OFF position.

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

12. FORCE TRIM switch — FORCE TRIM.

*13. Minimum beep check — Note N2 at full open throttle stabilizes at 91 ± 1%. — E18,E19

CAUTION

Do not exceed N2 operating limitations.

*14. Maximum beep check — Slowly increase N2 to maximum noting the following: — D20-D24, E16,E17, E20-E22

a. RPM warning system — RPM light extinguishes and audio switch snaps on at 94 ± 1% N2. Decrease slightly to assure light and audio operate at 94 ± 1%. Continue to increase.

b. N2 at full beep should be 101 ± 1%.

c. High RPM warning light — Note if illuminated.

*15. Linear actuator travel time check — Note actual time required for N2 to decrease from maximum beep, with RPM INCR/DECR switch in the full decrease position. Travel time should be from 5 to 10 seconds. — E22

NOTE

RPM light should illuminate and audio should be heard as N2 decreases below 94 ± 1%.

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

16. Gunners RPM switch — Check proper operation. — E22

17. High RPM warning system — Check as required.

NOTE

This check is required only if high RPM light setting was not verified during the maximum beep checks.

CAUTION

Throttle must be at flight idle prior to switching governor to emergency position. A maximum steady state N2 RPM of 104.5% is permissible provided the TGT is below 750°C. N2 RPM limit is 101.5 to 104.5% for 10 seconds with TGT above 750°C or a maximum of 104.5%.

Because automatic acceleration, deceleration, and overspeed control are not provided with the GOV switch in EMER position, control movements must be smooth to prevent overspeed, overtemp, or engine failure.

a. Throttle — Reduce to idle; note N1 speed.

b. Pilots GOV switch — Place in EMER position; stabilize N1 prior to N1 decreasing below 60%.

PROCEDURE	TROUBLESHOOTING REFERENCE
ENGINE RUNUP (CONT)	
c. Throttle — Smoothly increase throttle; do not exceed N2 limits.	
d. High RPM warning light — Light should illuminate at 103 ± 1% N2; audio should remain inactive.	C-38
e. Throttle — Smoothly reduce to idle stop, placing pilots GOV switch to AUTO after mechanical contact with idle stop and prior to N1 decreasing below 60%. Note N1 speed.	
f. Throttle — Increase to full open.	
18. RPM INCR/DECR switch — Increase to 100% N2 RPM.	
19. Tail rotor rigging check:	H-34

CAUTION

Insure gunner is aware of hydraulic malfunction procedure since he will have control of the collective during this check.

a. FORCE TRIM switch — OFF.

b. Place HYDR TEST switch to SYS #2 test position; note illumination of MASTER CAUTION and No. 1 HYD PRESS caution segment light.

PROCEDURE	TROUBLESHOOTING REFERENCE
ENGINE RUNUP (CONT)	
c. Relax pressure on pedals noting any tendency to creep or motor in either direction.	
d. Place HYDR TEST switch to BOTH position; note all caution segments extinguished.	
e. FORCE TRIM switch — ON.	
20. SCAS system check:	
a. SCAS POWER switch — ON; note pitch, roll, and yaw NO-GO lights illuminate and extinguish prior to 30 seconds.	C22-C24
b. Engage/disengage check — Engage each channel individually while noting tip path plane for any unusual deflections. Disengage SCAS using pilots SAS REL button; re-engage and disengage using gunners SAS REL button.	C25-C27
c. Pitch channel deflection check — Engage pitch switch only, deflect tip path down 8 to 12 inches leaving cyclic in deflected position; note the tip path tends to return to original position in a reasonable period of time. Disengage pitch switch.	H35

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

d. Roll channel deflection check — Engage roll switch only, deflect tip path down at 3 or 9 o'clock position, 8 to 12 inches leaving cyclic in deflected position; note tip path tends to return to original position in a reasonable period of time. — H35

e. Cyclic — Center.

f. SCAS — Engage all channel switches.

CAUTION

Ensure gunner is aware of hydraulic malfunction procedure since he will have control of the collective during this check.

g. HYD TEST switch — SYS #1 test; pitch and roll SCAS switches should disengage. — H39

h. HYD TEST switch — SYS #2 test; Yaw SCAS switch should disengage.

i. SCAS — Engage all channels.

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

21. Fuel system check:

WARNING

Should the fuel quantity gauge not indicate the approximate amount of fuel noted during the preflight (allowing for fuel burned during run-up) investigate before flight.

a. FWD FUEL BOOST circuit breaker — Pulled; note illumination of MASTER CAUTION and FWD FUEL BOOST caution segment lights; reset master caution.

b. AFT FUEL BOOST circuit breaker — Pulled; note illumination of MASTER CAUTION and AFT FUEL BOOST caution segment lights; reset master caution.

c. Engine fuel pump operation check — Engine should continue to run for a minimum of one minute without boost pump pressure. No change in indicated N1 or N2 speed should be noticed.

d. Fuel quantity indicator test — Press test button; note smooth operation to zero indication; release test button; fuel gauge should smoothly return to original quantity indicated.

PROCEDURE	TROUBLESHOOTING REFERENCE
ENGINE RUNUP (CONT)	
e. FWD FUEL BOOST circuit breaker - IN; note FWD FUEL BOOST caution segment extinguishes.	
f. AFT FUEL BOOST circuit breaker — IN; note AFT FUEL BOOST caution segment extinguishes.	
22. Electrical systems check:	C6-C44
* a. Check volt/ammeter — 27.5 ± .25 volts. Note some AMP indication.	
b. GEN switch — OFF; note battery voltage, 0 amps, MASTER CAUTION, DC GEN, AFT FUEL BOOST caution segment lights illuminated; AC power still applied.	
c. NON-ESNTL BUS switch — Manual; note AFT FUEL BOOST segment light extinguishes.	
d. BATTERY switch — START; note no AC power applied.	
e. ALTNR switch — ON; note ALT and RECT lights extinguished, AC power applied and 28 volts DC indicated.	C41-C44
f. NON-ESNTL BUS switch — NORMAL; note no changes.	

PROCEDURE	TROUBLESHOOTING REFERENCE
ENGINE RUNUP (CONT)	
g. GEN switch — ON; note amps indicated (may be a slight change in volts).	
h. BATTERY switch — RUN; note no changes.	C36
i. NON-ESNTL BUS switch — As required for flight.	
j. SCAS — Engage all channels.	C22-C27, H35,H38, H39
23. Radio and navigation equipment — ON.	K1,K6
24. Transponder — Standby.	
25. Instrument checks:	
a. Dual tachometer — N2 set at 100%, both needles steady and joined; pilot and gunner indicators agree within ± 1%.	B15-B21
b. Gas producer tachometer — Pilot and gunner indicators should agree within ± 1%.	
c. TGT gauge — Pilot and gunner indicators should agree within 20°.	B22

PROCEDURE	TROUBLESHOOTING REFERENCE
ENGINE RUNUP (CONT)	
d. Torquemeter — Pilot and gunner indicators should agree within 4%.	B12,B13
NOTE **Flat pitch torque indications relate to main rotor blade angle settings and autorotational RPM. Aircraft normally flown in high gross weight configurations may indicate as high as 32%. Light gross weight configurations may indicate as low as 25%.**	
e. Engine oil pressure and temperature — Record.	E3-E7
f. Transmission oil pressure temperature — Record.	F3-F6
26. Radios — Check as appropriate.	
27. Instrument/Nav aids — Check as follows:	
NOTE **Amplified checks may be found in Section IV.**	
a. Compass control panel — Null annunciator in conjunction with magnetic compass indication; note RMI and HSI indicates properly.	B32,K2-K5
b. Horizontal situation indicator — Check as required.	
c. Attitude direction indicator — Check as required.	

PROCEDURE	TROUBLESHOOTING REFERENCE
ENGINE RUNUP (CONT)	
d. Gunners attitude indicator — Set as required.	
e. Altimeters — Set; note indicated altitude within 70 feet of actual elevation.	B29
f. Radar altimeter — Check as required.	B35,B36
g. Radar warning display — Check as required.	
h. Transponder — Check as required; set.	
i. Doppler nav system — Check as required.	
j. GPS trimpack — Check as required.	
*28. TURRET DRIVE MOTOR switch — TURRET.	
*29. ADS PWR circuit breaker — IN.	
*30. FCC switch — FCC.	
*31. RMS control panel — Set.	
*32. MASTER ARM switch — STBY.	
33. WPNS CONTR switch — Gunner.	
34. RECOIL COMPEN switch OFF (ON for live fire).	

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE RUNUP (CONT)

*35. HUD PWR switch — STBY.

*36. TCP switch — STBY TOW.

*37. **CN** FLIR control panel OFF/ON/BIT switch — ON.

38. Canopy removal arming/firing mechanism safety pins — Remove & stow.

39. Hit check — Completed.

NOTE

HIT check may be deferred until arrival in test flight hover area if conditions in runup area preclude accurate and/or safe completion of check. HIT check must be completed prior to takeoff.

BEFORE TAKEOFF CHECKS

1. TOW launchers — Missile arming levers down.
2. Wing ejector rack jettison safety pins — Removed.
3. RPM — 100 percent.
4. Systems — Check engine, transmission, electrical, and fuel systems indications.
5. TCP switch — TSU/GUN.
6. TURRET DRIVE MOTOR switch — TURRET.

PROCEDURE	TROUBLESHOOTING REFERENCE

BEFORE TAKEOFF CHECKS (CONT)

NOTE

During hover checks TCP must be in STBY to prevent damage to SCA and TURRET. The TURRET DRIVE MOTOR switch should be off to prevent ground contact with 20 MM gun.

7. Avionics, armament and other mission equipment — Set as desired.

HOVER CHECKS

WARNING

Any binding or lack of proper control/aircraft response is cause to terminate flight immediately. Excessive control displacement requires a control rigging check.

1. Takeoff to hover check — As collective is increased, note smooth power response; torque within limits; normal control response and position; normal aircraft vibrations; normal instrument response; N2 stabilizes within 0.6% of flat pitch RPM. Validation factor check. — E28,H15, H16,H18, H19

2. Instruments — Check normal response and indications. Check flight instruments respond normally.

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

NOTE

Observe runup area for any condition that would indicate abnormal leakage or functioning of aircraft.

3. Hover to test area — HIT check should be completed if deferred.
4. Torquemeter check — Stabilize aircraft at a five foot hover into the wind and note that torque indication is correct within ± 4%, as predetermined from performance charts in TM 1-1520-236-10.
5. Pedal authority check: H8,H9,H11, H25,H26

WARNING

Improper pedal rigging may result in momentary loss of heading control.

a. Place aircraft into prevailing wind.

b. Make pedal turns 90° to prevailing wind (each direction); note any lack of response or control authority; note any change in vibration levels.

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

6. Yaw channel response check: H36

NOTE

A comparison of SCAS functioning may be made as necessary by disengaging the yaw channel switch and repeating check.

a. Face aircraft into wind.

b. Without moving pedals, increase collective slightly; note SCAS tends to maintain nearly original heading.

7. Sideward hover flight check — Perform sideward hovering flight in each direction noting proper response, control rigging, and remaining control authority. Hover speed should be consistent with autorotation requirements, yet be sufficient to determine aircraft response and control reaction. H1-H3, H6 H22, H28, H29

8. Forward hovering flight check — Accelerate into translational lift; note proper aircraft response, vibration levels, and instrument response. Return to normal hovering flight. H1-H3, H6, H28,H29

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

9. Pylon mount check:

CAUTION

Should pylon rock intensify or fail to dampen out, disengage all SCAS channels.

NOTE

Generally, 4 to 5 cycles are normal: however, new mounts may result in less and older mounts may result in more oscillations. Pylon rocking should not become evident in forward flight.

a.	SCAS ON — Move cyclic fore and aft as required to induce pylon rocking, stabilize cyclic, then note the number of oscillations required for rocking to subside. Note any abnormal engine responses.	H37,J1
b.	SCAS OFF — Disengage all SCAS channel switches and repeat pylon mount check. No significant variation between SCAS ON and SCAS OFF. Check should be evident. Land aircraft and reengage SCAS.	J1,J7

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

10. Engine response check — Increase collective as required to obtain a noticeable drop in N2 RPM; without further collective movement, note the overspeed governor tends to increase N2; then abort the maneuver by a smooth reduction of collective before excessive altitude is gained. — E27,E28, E31,E37

11. Low RPM hover: — E17,E22, H15,H26, H29,J2

NOTE

Be aware of reduced tail rotor efficiency and effectiveness at low RPM.

a. Slowly decrease N2 RPM using RPM INCR/DECR switch until a stable hover is achieved at 91% RPM.

b. Perform 45° turns out of prevailing wind, noting any lack of response attributable to tail rotor pitch settings or rigging. Note any one per revolution type vibrations.

c. Increase RPM to 100% N2.

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

12. Emergency governor system check:

CAUTION

Because automatic acceleration, deceleration, and overspeed control are not provided with the governor switch in the emergency position, control movements must be smooth and precise to prevent overspeed, overtemp, or engine failure.

NOTE

Ambient temperatures in excess of 29°C may prevent maintaining 97% N2 during hover due to reduced fuel flow in emergency mode.

a. Land aircraft.

b. Bleed air switches — OFF.

c. Reduce throttle to engine idle; note N1 speed.

d. Place pilots GOV switch to EMERG GOV position. Apply throttle as necessary to minimize N1 change. Note illumination of GOV EMERG segment light and MASTER CAUTION. Reset MASTER CAUTION. — E14

e. Smoothly increase throttle to 97% N2.

PROCEDURE	TROUBLESHOOTING REFERENCE
HOVER CHECKS (CONT)	
f. Hover aircraft in EMERG GOV mode maintaining 97% N2. Aircraft should be capable of 97% N2 while maintaining a 3 foot stabilized hover. Land aircraft.	E29,E30
g. Smoothly reduce throttle to idle, placing pilots GOV switch to AUTO as soon as the idle stop is contacted. Note N1 stabilizes at or near previously noted N1 speed.	E15
h. With throttle at idle, have gunner place his GOV switch momentarily to EMERG GOV position noting a decrease in N1, immediately place switch back to AUTO position. Pilot must be prepared to cycle his GOV switch to EMERG and take manual control. N1 should return to previously noted indication; all caution lights extinguished.	
i. Confirm all cockpit indications are normal. Smoothly increase throttle to 100% N2.	

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

13. Power cylinder check: G1,G2,H1, H2,H6,H7

WARNING

Should the flight controls become abnormally stiff or jam during this check, immediately recycle HYD TEST switch to both. Land aircraft and do not continue until correcting cause of abnormal condition.

This check requires two rated pilots since the gunner must maintain hovering altitude of the aircraft and be prepared to cope with any possible emergency that may arise. A qualified ME/MP or IP/SP is recommended in the gunner's seat.

Cyclic input must be timed with aircraft responses to minimize aircraft movement.

a. Increase hovering altitude to 10 to 15 feet; transfer control of collective to gunner.

b. Dual system check:

(1) Fore and aft check — Smoothly move cyclic fore and aft through 6 to 8 inches of cyclic travel. Note smooth operation of controls and aircraft response. Stabilize aircraft.

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

(2) Lateral check — Smoothly move cyclic laterally through 6 to 8 inches of cyclic travel. Note smooth operation of controls and aircraft response. Stabilize aircraft.

c. Hydraulic system #1 check:

(1) Place HYD TEST switch to SYS #1 test position; note illumination of MASTER CAUTION and No. 2 HYD PRESS caution segment lights; stabilize aircraft.

(2) Fore and aft check — Smoothly move cyclic fore and aft through 6 to 8 inches of cyclic travel. Note smooth operation of controls and aircraft response. Stabilize aircraft.

(3) Lateral check — Smoothly move cyclic laterally through 6 to 8 inches of cyclic travel. Note smooth operation of controls and aircraft response. Stabilize aircraft.

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

d. Hydraulic system #2 check:

(1) Place HYD TEST switch to SYS #2 test position; note illumination of MASTER CAUTION and No. 1 HYD PRESS caution segment lights; stabilize aircraft.

(2) Fore and aft check — Smoothly move cyclic fore and aft through 6 to 8 inches of cyclic travel. Note smooth operation of controls and aircraft response. Stabilize aircraft.

(3) Lateral check — Smoothly move cyclic laterally through 6 to 8 inches of cyclic travel. Note smooth operation of controls and aircraft response. Stabilize aircraft.

(4) Land aircraft and re-engage SCAS.

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

14. Collective servo authority check: G3

CAUTION

Due to requirement for gunner to control aircraft during the most critical parts of this maneuver, a qualified pilot is required in the gunner's seat. A qualified ME/MP or IP/SP is recommended.

Conduct this maneuver in an area that permits a run-on landing at 50 KIAS. If a collective lock-up, jam, or control limitation occurs, note indicated torque value, and return hydraulic test switch to the center (both) position and land the aircraft.

NOTE

This check is required only if K747 blades are installed. During accomplishment of this check do not exceed 50 feet AGL. The intercom system (ICS) should be in the hot MIC position. The rate of collective movement should not exceed a rate necessary to produce a smooth controlled ascent. If up collective cannot be applied above that required to hover, land aircraft and begin the check on the ground at flat pitch, collective full down.

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

a. Transfer controls to gunner, and have him bring the aircraft to a 5-foot hover.

b. Dual system check — Have gunner smoothly increase the collective until reaching a torque of 85%. Gunner returns aircraft to a stable 5-foot hover.

c. Hydraulic system No. 1 check — Place HYD TEST switch to SYS #1 test position; note illumination of MASTER CAUTION and #2 HYD PRESS caution light and SCAS disengage (roll and pitch).

d. Gunner smoothly raises collective control until reaching a torque of 85% or until a restriction is felt. Note torque value; relax pressure on controls; pilot returns hydraulic test switch to both position; gunner lands aircraft.

e. Re-engage SCAS.

f. Have gunner return aircraft to a 5-foot hover.

g. Hydraulic system No. 2 check — Place HYD TEST switch to SYS #2 test position; note illumination of MASTER CAUTION and #1 HYD PRESS light and SCAS disengage (YAW).

PROCEDURE	TROUBLESHOOTING REFERENCE

HOVER CHECKS (CONT)

h. Gunner smoothly raises collective control until reaching a torque of 85% or until a restriction is felt. Note torque value; relax pressure on controls; pilot returns hydraulic test switch to both position.

i. Re-engage SCAS.

NOTE

Aircraft may be released for normal flight operations with less than 85 percent torque or above. Aircraft with less than 85 percent torque but more than 70 percent torque may be operated with restrictions IAW operator's manual. Aircraft with less than 70 percent torque may not be released for normal flight operations.

BEFORE TAKEOFF CHECK

1. TOW launchers — Missile arming levers down.
2. Wing ejector rack jettison safety pins — Removed.
3. RPM — 100 percent.
4. Systems — Check engine, transmission, electrical, and fuel systems indications.
5. TCP switch — TSU/GUN.
6. TURRET DRIVE MOTOR switch — TURRET.

PROCEDURE	TROUBLESHOOTING REFERENCE

BEFORE TAKEOFF CHECK (CONT)

NOTE

For multiple takeoffs and landings crewmembers may leave the TURRET DRIVE MOTOR switch in the OFF position (training only).

7. Avionics, armament and other mission equipment — Set as desired.

8. Fuel quantity and time — Record.

FLIGHT CHECKS

NOTE

A normal takeoff is recommended because it provides the most desirable flight profile in the event of an actual emergency.

1. Takeoff/climbout checks — Perform normal takeoff and climbout to initial test altitude; note proper aircraft response, vibration levels, vibration entry airspeeds, and instrument operation. — H1-H3, H6, H26-H29

2. Instrument operation/correlation checks — Fly in different attitudes as necessary to check instrument operation.

   a. Attitude indicators — Note nearly correct indication; indicators should agree within ±1° roll attitude; pitch attitude will vary with adjustment. — B32

PROCEDURE		TROUBLESHOOTING REFERENCE
FLIGHT CHECKS (CONT)		
b.	Airspeed indicators — Note nearly correct indicated airspeed; indicators should agree within ±5 knots.	B24
c.	Altimeters — Note nearly correct indication; indicators should agree within ±50 feet.	B29
d.	Compasses — Note nearly correct heading; RMIs should agree within ±1° and indicate nearly the same as the standby compass.	B31
e.	VSI/IVSI — Note nearly correct response.	B26
f.	Torquemeters — Indicators should be nearly identical.	B12,B13
g.	Dual tachometers — Indicators should be nearly identical.	B15-B20
h.	TGT gauges — Should indicate nearly identical.	E13,E23, E33
*i.	Engine oil pressure and temperature — Note normal indications.	E3-E7

PROCEDURE	TROUBLESHOOTING REFERENCE
FLIGHT CHECKS (CONT)	
***j.** Transmission oil pressure and temperature — Note normal indications.	F3-F6
k. Fuel quantity — Note indication.	
3. Flight control rigging check — At selected test altitude, establish 100 knots IAS at 45% torque.	H26,H28, H33
NOTE **A slight climb or descent may be required to maintain 100 knots IAS at 45% torque.**	
a. Control positions — Note cyclic nearly centered; pedals neutral with in ±1/2 inch.	
b. Force trim check — Place FORCE TRIM switch to FORCE TRIM; note force trim tends to hold aircraft attitude; FORCE TRIM switch OFF.	
c. SCAS check — Disengage all SCAS channel switches; note any abnormal aircraft attitude changes or control displacement; re-engage SCAS channels.	H20-22, H28

PROCEDURE	TROUBLESHOOTING REFERENCE

FLIGHT CHECKS (CONT)

4. Autorotation check: H26,H31

WARNING

Autorotational RPM will vary significantly with gross weight and ambient conditions. Ensure rotor RPM does not increase or decrease drastically as collective is decreased to full down; if so, abort maneuver and take corrective action prior to continuing.

NOTE

Alternator will drop off line as rotor RPM decreases below 91%.

a. Bleed air — OFF.

b. Straight and level — 80 KIAS.

c. Establish autorotational descent at 80 knots IAS.

d. Throttle — Idle

e. Check gas producer speed — 68 to 72% N1.

f. Torque — Zero.

*g. Rotor RPM — 95 to 98%.

h. Vibrations — Note any abnormal vibrations.

i. Pedal authority — Note sufficient right pedal remains.

j. Power recovery — Complete.

PROCEDURE	TROUBLESHOOTING REFERENCE

FLIGHT CHECKS (CONT)

5. Vibration analysis checks:

NOTE

Establish an 80 knot IAS straight and level cruise noting vibration levels. Lateral vibrations must be corrected by balance of the rotor and hub assembly prior to further smoothing operations. Cruise/descent and acceleration checks are not required when using vibration detection and analysis equipment.

a. B540 Cruise/descent check — Smoothly reduce collective to 15% - 18% torque. Note any change in vibrations as collective is reduced, or during descent. Any abnormal change in vibration notes is attributed to trim tab effect on the rotor system. — J3–J8

PROCEDURE	TROUBLESHOOTING REFERENCE

FLIGHT CHECKS (CONT)

b. Acceleration check: J3–J8

NOTE

Vertical vibrations that remain nearly constant through entire speed range are due to pitch change link positioning. Vibrations that change with airspeed are normally caused by (B540 trim tab positioning) or possible weak blade condition (blade climb). B540 In some cases, combination adjustments will be required for smoothing.

(1) Smoothly increase airspeed, in level flight if possible, to 150 KIAS (unless vibration intensity becomes excessive).

(2) Note any one per revolution vibrations and their entry airspeed. Two per revolution vibrations will normally increase but should not become excessive.

c. G loading check — Perform normal dive and moderate G pullout noting any abnormal pylon rocking or excessive two per revolution type vibrations. C25,H37

d. Airframe vibrations — Note any abnormal vibrations which may be present throughout aircraft during the course of the previous maneuvers. J6-J8

PROCEDURE	TROUBLESHOOTING REFERENCE

FLIGHT CHECKS (CONT)

6. Radio and nav aids — Check.

7. Perform topping check.

NOTE

Prior to performing topping check ensure that all required maintenance checks are completed IAW TM 55-2840-229-23-1, Chapter 1.

a. Bleed air — OFF.

b. Pilot's altimeter — Set to 29.92.

c. Airspeed — Adjust to 80 KIAS.

d. Climb at a normal rate until reaching 3500 feet PA or minimum 1000 feet AGL.

e. Monitor torque, N1 and TGT, throughout the maneuver to ensure no limits are exceeded.

f. Without exceeding any engine limits (i.e., max calibrated torque, N1, or TGT) increase collective until N2 decreases to 97%.

g. Maintain 97% N2 with collective.

PROCEDURE	TROUBLESHOOTING REFERENCE

FLIGHT CHECKS (CONT)

h. At the next whole thousand foot altitude record torque, N1, TGT, and PA.

i. Without exceeding any engine limits, further increase collective in order to decrease N2 to 94% noting N1 does not increase.

NOTE

If N1 increases as N2 decreases from 97% to 94%, the droop cam is probably worn or out of adjustment.

j. Reduce collective and descend to the topping altitude as recorded in step h. Fly at topping altitude for one minute and then read FAT.

k. Reset pilot's altimeter and resume normal flight.

NOTE

The T53-L-703 engine must meet required torque derived from the power adjustment chart within the limits of minus zero to plus five percent. For engines not within limits refer to proper troubleshooting/adjustment procedures IAW TM 55-2840-229-23, Chapter 1.

PROCEDURE	TROUBLESHOOTING REFERENCE

BEFORE LANDING CHECK

1. MASTER ARM switch — STBY. Verify STBY light is illuminated.
2. TURRET DRIVE MOTOR switch — OFF. Verify GUN ELEV STOWED light is illuminated.

NOTE

For multiple landings and takeoffs crewmembers may leave the TURRET DRIVE MOTOR switch in the OFF position (training only).

3. Avionics and mission equipment — Set as required.

ENGINE SHUTDOWN CHECKS

1. FORCE TRIM switch — FORCE TRIM.
2. ECS/deice switches — OFF.
3. TCP switch — OFF.
4. HUD filter — Day position.
5. HUD PWR switch — OFF.
6. FCC switch — OFF.
7. ADS PWR circuit breaker — Out.
8. TURRET STOW circuit breaker — Out.
9. Throttle — Reduce to idle. Allow TGT to stabilize for two minutes.

PROCEDURE		TROUBLESHOOTING REFERENCE
ENGINE SHUTDOWN CHECKS (CONT)		
10.	MASTER ARM switch — OFF.	
11.	TUR SLEW switch — GND TEST.	
12.	LASER SAFE/TURRET DEPR LIMIT switch.	
13.	Fuel system — Check.	
*14.	Engine oil pressure and temperature — Record.	E3-E6
*15.	Transmission oil pressure and temperature — Record.	F3-F6
*16.	Fuel quantity — Record quantity indicated and time.	B1-B6
17.	Throttle — Retard to engine idle; note gas producer speed.	E9-E11
18.	SCAS POWER switch — OFF.	
19.	Copilots attitude indicator — Caged.	
20.	Avionics — OFF.	
21.	Battery condition check — Place BATTERY switch to OFF noting change in indicated amperage; return BATTERY switch to ON (RUN). Less than 5 amps change indicates a fully charged battery.	C1,C2, C6

NOTE

BATTERY switch should be placed to START, pause for a moment, then to OFF to receive proper information.

PROCEDURE	TROUBLESHOOTING REFERENCE

ENGINE SHUTDOWN CHECKS (CONT)

22. Throttle — Off.
23. Fuel — OFF.
24. ALTNR switch — OFF.
25. GEN switch — OFF.
26. BATTERY switch — START.
27. IGNITION switch — As required.
28. Canopy removal arming/firing mechanism safety pins — IN.
29. Collective friction and lock — ON.
30. BATTERY switch — OFF.

BEFORE LEAVING HELICOPTER

1. Post test flight inspection — Perform. E8,J8,J9
2. Armament systems — Safe.
3. Chaff dispenser — Safe.
4. Forms and records — Complete.
5. Helicopter — Secure.
6. Required computations — Complete.
7. Maintenance personnel — Debrief.

Section III. TROUBLESHOOTING GUIDE

General. This section contains troubleshooting information that has been referenced in Section II checklists. This section lists possible conditions, abnormal conditions and indications and probable causes. The information is to be used only as a quick reference and may not be all encompassing.

TROUBLESHOOTING GUIDE A — STARTING

CONDITION

PROBABLE CAUSE

A1. No starter action.

a. Circuit breaker out.

b. Battery dead.

c. Battery cable connector not connected.

d. GPU polarity reversed (if used).

e. Starter switch inoperative.

f. Faulty starter relay.

g. Starter failure.

h. Wiring to starter open or shorted.

i. Internal seizing of compressor of gas producer turbine.

A2. No N1 indication, but starter turns.

a. Faulty N1 tachometer transmitter or instrument.

b. Wiring open or shorted.

c. Starter drive failed.

d. N1 gear box internal failure.

A3. Failure to start.

a. Key off or open circuit in key system.

b. Low input voltage to ignition unit.

c. Faulty ignitor plugs.

d. Faulty ignition unit.

e. Faulty coil and lead assembly.

f. No electric power to starting fuel solenoid valve.

g. Starting fuel nozzles clogged or damaged.

h. Faulty starting fuel solenoid valve.

i. Starting fuel filter or hoses clogged.

j. Faulty fuel control.

k. Low fuel pressure.

A4. Unable to get sufficient rpm for start.

a. Weak battery.

b. GPU under rated (if used).

c. Throttle not open.

d. Too much electrical drain on battery.

e. Engine scavenge oil line quick disconnect loose or line clogged.

f. Internal failure in the engine.

A5. N1 hangs at about 15%, TGT holds at about 100°C.

a. Main fuel hose clogged.

b. Flow divider assembly inoperative.

c. Main fuel control inlet screen installed backwards.

d. Faulty fuel control.

e. Faulty supply system malfunction.

A6. Normal start except TGT rises too rapidly or exceeds limits.

a. Wind blowing up tail pipe.

b. TGT high when start initiated.

c. Extremely high ambient temperature.

d. Wrong starting procedure.

e. Battery weak.

f. Wrong type fuel.

g. Air intake obstructed.

h. Faulty fuel control scheduling.

i. Dirty compressor.

j. GPU — Under rated (if used).

k. Fuel control malfunction.

A7. Torching start (flames shoot from exhaust).

a. Improper starting procedure.

b. Accumulation of fuel inside tail pipe or combustion chamber.

A8. Normal start, rotor turns, but no N2 indication.

a. Faulty tachometer instrument, transmitter or wiring.

b. N2 gearbox internal failure.

A9. N1, TGT indication, but main rotor doesn't turn as soon as normal. No N2 indication.

a. Main or tail rotor still tied down.

b. Extremely cold ambient conditions.

c. Foreign object(s) binding tail rotor drive.

d. Transmission or gearbox failure.

A10. Start quits, N1 fails.

a. Starter switch released too soon.

b. Fuel valve shut off.

c. Main fuel quick disconnect not connected tightly.

d. Air in fuel control.

e. Circuit breaker pops (starter or ignition).

f. Starter failure (electrical or mechanical).

g. Ignition system failure (exciter or ignitor).

h. Fuel control malfunction.

i. Flow divider malfunction.

A11. N1, TGT indication but main rotor doesn't turn. N2 tachometer engine indicating.

a. Engine drive shaft failed.

b. Freewheeling unit failure.

c. Transmission failure.

A12. N1 continues to accelerate above 72%.

a. Throttle positioned above idle.

b. Idle stop misrigged.

c. Power lever controls misrigged.

d. Fuel control malfunction.

A13. N1 speed low in idle position.

a. Power control improperly rigged.

b. GOV switch in EMER position.

c. Fuel control in EMER mode (caution light out).

d. Fuel flow restricted.

TROUBLESHOOTING GUIDE B — INSTRUMENTS

CONDITION	PROBABLE CAUSE
B1. Fuel quantity gauge won't decrease when PRESS-TO-TEST button pressed.	
	a. Inverter not on.
	b. FUEL GAGE TEST button faulty.
	c. AC power failure.
	d. Fuel gauge stuck.
	e. Break or short in wiring.
	f. Connections loose.
B2. Fuel quantity gauge reads low.	
	a. Out of adjustment.
	b. Tank unit capacitance high.
	c. Defective indicator.
	d. Compensator capacitance too high.
B3. Fuel quantity gauge reads high.	
	a. System out of adjustment.
	b. Tank unit has low capacitance.

c. Open lead on compensator circuit.

d. Compensator section of tank unit open.

B4. Fuel quantity gauge remains at one point on scale.

a. No power.

b. Defective indicator.

c. Coaxial lead grounded.

d. 400 cycle lead grounded.

B5. Fuel quantity gauge remains at zero or below.

Open wiring.

B6. Fuel quantity gauge operation sluggish.

Low insulation resistance of the circuit.

B7. Fuel quantity gauge indicates one-half to two-thirds actual fuel level.

One tank capacitance unit inoperative.

B8. FUEL BOOST light not on when CB out.

a. Faulty pressure switches.

b. Faulty check valve manifold.

B9. No torquemeter indication after start.

a. Faulty indicator circuit or no DC power.

b. Restricted pressure line.

c. Disconnected or broken pressure line.

d. No oil in system.

e. Faulty indicator or transmitter.

f. Torquemeter internal system malfunction.

g. Faulty torquemeter boost pump.

h. N2 gearbox internal failure.

B10. Torquemeter indication rises rapidly after start, or pegged.

a. Open torquemeter poppet valve.

b. Faulty indicator or transmitter.

c. Main drive shaft binding.

d. Instrument clamped too tight in panel.

e. Plugged meter and bleed valve.

B11. Torquemeter response slow.

a. Restricted torquemeter strainer.

b. Faulty indicator or transmitter.

c. Incorrect in-line restrictors (0.025 to 0.027).

d. Stuck rings in nose case.

e. Low DC power.

B12. Low torquemeter indication.

a. Faulty indicator or transmitter.

b. Low torquemeter boost pressure (adjustment or malfunction).

c. Restricted boost pump screen.

d. Damaged torquemeter sealing ring.

e. Improper restrictor (0.025 to 0.027).

f. Tolerance ± 4% diff.

B13. High torquemeter indication.

a. Improper restrictor (0.025 to 0.027).

b. Torquemeter internal system malfunction.

c. Engine scavenger pump malfunction.

d. Minimum blade angle set too high.

B14. N2 needles not joined.

a. May be normal unless not joined at operating RPM.

b. Instrument tachometer generator malfunction.

c. Wrong instrument installed.

d. 1% diff between seats.

e. ± 0.5% from actual RPM.

B15. N2 tachometer fluctuates, all other instruments steady.

a. Some fluctuation ± 0.5% normal with some instruments.

b. Instrument or tachometer generator malfunction.

c. Wiring malfunction.

B16. Excessive tachometer error.

a. Faulty instrument or tachometer generator.

b. Wrong instrument or tachometer generator installed.

B17. Tachometer no indication.

a. Leads reversed at generator.

b. Generator shaft sheared.

B18. Tachometer indicates only half actual speed.

a. Leads have excessive resistance.

b. Faulty instrument or generator.

B19. Low N2 tachometer reading, either constant or intermittent.

a. Poor connections.

b. Indicator resistance out of adjustment.

c. Faulty wiring.

d. Wrong instrument installed.

B20. High N2 tachometer reading, either constant or intermittent.

a. Indicator resistance out of adjustment.

b. Wrong instrument installed.

B21. TGT fluctuating, all other engine instruments steady.

a. Faulty indicating system.

b. Loose connection.

c. Resistance box wiring damage.

B22. Airspeed indicator reads incorrectly or fluctuates excessively.

a. Pitot tube restricted.

b. Line not completely connected.

c. Static port or line clogged by water or dirt.

d. Leak in line.

e. Defective indicator.

B23. Vertical velocity indicator not zeroed (on ground).

Mechanism shifted (adjustment off).

B24. Vertical velocity indicator inaccurate.

a. Loose connections in static line.

b. Static port or line clogged.

B25. Torquemeter fluctuates. all other instruments steady.

a. No in-line restrictor (0.025 to 0.027).

b. Indicator transmitter malfunction.

c. Instrument clamped too tight in panels.

d. Indicator case leaks.

e. Defective indicator.

B26. Vertical velocity indicator fluctuates excessively.

a. Loose connections in static line.

b. Leak in static line.

c. Defective indicator.

B27. Turn and slip indicator needle erratic or inoperative.

a. Sticking gyro.

b. No electric power to indicator.

c. Loose connections.

B28. Turn and slip indicator ball too sensitive.

Dampening fluid leaked out.

B29. Altimeter reads incorrectly or fluctuates excessively.

a. Out of adjustment.

b. Leak in static line.

c. Static port or line clogged by dirt or water.

d. Defective instrument.

B30. Standby compass inaccurate, sluggish or erratic.

a. Improper compensation (compass swing).

b. Mounting brackets loose.

c. External magnetic interference.

d. Insufficient liquid.

e. Defective instrument.

B31. Gyro compass inaccurate or erratic.

a. Compass slaving switch in DG position.

b. Improper adjustment of transmitter unit.

c. External magnetic interference.

d. Indicating system malfunction.

e. Gyro compass control malfunction.

B32. Attitude indicator inoperative.

a. 115 VAC circuit breaker out.

b. Faulty capacitors.

c. 115 VAC power failure.

d. Defective indicator.

e. Faulty wiring.

B33. Radios inoperative.

a. Circuit breaker out.

b. Headset not plugged in completely.

c. Improper radio switch position.

d. COMM CONT panel malfunction.

B34. Radar altimeter inoperative.

a. RADAR ALTM circuit breaker (C/B) defective.

b. Antennas, one or both, faulty or poor connection.

c. Altimeter turned off.

d. Digital readout rheostat turned off.

B35. Radar altimeter improperly reading.

a. Indicator improperly adjusted (reference TM 11-1520-236-20).

b. Connectors at antennas loose or dirty.

TROUBLESHOOTING GUIDE C — ELECTRICAL

CONDITION

PROBABLE CAUSE

C1. Battery will not hold charge.

a. Demand too great.

b. Charging rate too low.

c. Electrolyte level too low.

d. Impurities in electrolyte.

e. Broken cell partitions.

f. Dirty cell tops.

C2. Excessive loss of electrolyte.

a. Poor servicing.

b. Charging rate too high.

c. Cracked case.

d. Faulty cells or cell.

C3. Inverter voltage output not correct.

a. Voltage set improperly.

b. Low input voltage.

c. Inverter defective.

d. Power factor correction circuit breakers out.

e. Faulty voltage regulator.

f. Faulty inverter RCCB (3CB7).

C4. AC voltage varies from time to time.

a. Faulty system components.

b. Adjustment loose.

c. Connection loose.

d. Bad bearings in inverter (motorized).

e. Power factor correction failure.

C5. No generator output.

a. Open circuit, switch, relay or generator field.

b. No residual magnetism in field.

c. Generator armature burned out.

d. Generator shaft sheared.

e. Brushes worn.

f. Faulty field control relay (2K6).

g. Faulty connections to voltage regulator.

h. Faulty voltage regulator (2VR1).

i. Commutator dirty or pitted.

C6. Generator produces voltage but ammeter reads zero.

a. Circuit breaker(s) out aft battery area.

b. Faulty reverse current relay.

c. Faulty ammeter or circuit.

d. Faulty generator control relay.

e. Faulty reverse current control relay (2K14).

C7. Generator voltage low.

a. Regulator adjusted improperly or faulty.

b. Generator field circuit connections faulty.

c. Defective voltmeter.

C8. Generator voltage high.

a. Regulator adjusted improperly.

b. Faulty regulator.

c. Faulty voltmeter.

d. Faulty wiring between generator and voltmeter.

C9. Ammeter or voltmeter fluctuates rapidly under steady loads.

a. Faulty voltage regulator.

b. Faulty RCR case ground.

C10. Voltage varies excessively with changes in engine speed or electrical load.

a. Voltage regulator out of adjustment or defective.

b. Faulty RCR case ground.

c. Faulty RCR control relay (2K5).

C11. Hydraulic control switch ineffective.

a. Circuit breaker out or faulty.

b. Faulty switch.

c. Faulty connections or wiring.

d. Faulty solenoid valve.

e. Electrical failure.

C12. No ammeter indication when pitot heat turned on.

a. Heater inoperative.

b. Circuit breaker out.

c. Faulty switch or wiring.

d. Ammeter malfunction.

C13. Non-essential bus remains energized with generator switch off.

a. Faulty non-essential bus relay.

b. TRU left on-line.

C14. Non-essential bus not energized with switch in manual position.

a. Faulty switch or wiring.

b. Faulty TRU non-ess bus relay (2K11).

c. Faulty non-ess bus relay (2K4).

d. Faulty RCR control relay (2K5).

C15. Caution panel lights dim when they should stay bright, fail to dim or brighten.

a. Faulty bright/dim switch.

b. Faulty pilot instrument light rheostat.

c. Faulty wiring.

d. Faulty 5 VDC power supply.

C16. Interior lights fail to illuminate or brighten.

a. Faulty switch or rheostat.

b. Faulty or broken wiring.

C17. One or several lights operate dim or intermittent.

a. Faulty ground.

b. Moisture in light.

c. Failure of one or more rheostats.

C18. Navigation lights fail to operate.

a. One or more bulbs burned out.

b. Faulty switch.

c. Loose connections.

d. Poor ground.

C19. Navigation lights fail to dim or flash.

a. Faulty dimmer resistor.

b. Faulty flasher.

c. Faulty switch.

WARNING

Do not view searchlight with the naked eye. Eye damage may result.

C20. Search light fails to illuminate, extend, retract.

a. Circuit breaker open.

b. Faulty switch.

c. Faulty light relay.

d. Broken or shorted wiring.

e. Poor ground connection.

f. Bulb burned out or socket corroded.

g. Faulty motors, gears.

C21. Skid light fails to illuminate.

a. Circuit breaker open.

b. Faulty switch.

c. Broken or shorted wiring.

d. Poor ground connection.

e. Bulb burned out or socket corroded.

C22. SCAS NO-GO lights do not illuminate.

a. Faulty bulbs.

b. SCAS PWR 28 VAC circuit breaker out or faulty.

c. SCAS PWR 115 VAC circuit breaker out or faulty.

d. Power switch faulty.

e. Faulty 28 VDC fuse.

f. Faulty wiring or connections in power circuits.

g. Faulty SCAS relay (2K18).

C23. One or two NO-GO lights do not illuminate.

a. Faulty bulbs.

b. Faulty control channel assembly.

c. Bulb turned to dim position.

d. Faulty sensor amplifier unit.

e. Faulty wiring or connections.

C24. One or more NO-GO lights remain illuminated after approx 30-second warmup period (controls not moved).

a. Faulty control motion transducer.

b. Faulty servo actuator.

c. Faulty rate gyro.

d. Faulty pylon compensation system.

e. Faulty or out-of-balance control channel assembly.

f. Faulty sensor amplifier unit.

g. Faulty wiring.

C25. SCAS will not engage or remain engaged.

a. Faulty wiring or connections.

b. Pilot or gunner emergency disengage switch faulty.

c. Faulty control panel.

C26. Rotor tip path plane moves excessively when SCAS engaged (cyclic centered, held steady).

a. Control channel assembly out-of-balance.

b. Faulty servo actuator.

c. Faulty amplifier unit.

d. Faulty transducers.

C27. SCAS will not disengage.

a. Faulty disengage switch.

b. Faulty or shorted wiring.

C28. ECS will not operate in cold position.

a. Temp control valve stuck open.

b. Thermostat rheostat malfunction.

c. Flapper valve above ammo bay closed.

d. Temp control sensor malfunction.

C29. ECS gives air but not cool enough.

a. Flapper valve in hydraulic compartment stuck open.

b. Temp control valve stuck part open.

c. ECU core burst internally.

d. Turbine in ECU binding.

e. Ram air inlet clogged (grass).

C30. No heated air from registers or insufficient amount of warm air.

a. RAIN RMV switch in wrong position.

b. Cabin heater switch inoperative.

c. Mixing valve malfunctioning.

d. Ducting obstructed.

C31. Insufficient air from registers.

a. Manually operated flapper valve closed.

b. Leaking or obstructed ducts.

c. Malfunctioning mixing valve.

C32. Excessive hot air from registers.

a. Manually operated flapping valve malfunctioning.

b. Mixing valve malfunctioning.

c. Prove thermal switch malfunctioning in addition to above causes.

C33. Unable to go to idle cutoff.

a. Idle stop solenoid stuck.

b. Solenoid electrical failure.

C34. Fire warning light on, no actual fire.

a. Moisture or foreign matter in cannon plug.

b. Wiring frayed, chaffed, shorted, or grounded out.

c. Fire detect relay faulty.

d. Fire sensing wire damaged or has been or is kinked.

e. Faulty test button.

C35. Fire warning light inoperative.

a. Bulbs burned out or missing.

b. Break in circuit wiring or cannon plug disconnected.

c. Fire detector relay faulty, not installed, or incorrectly wired.

d. Faulty test button.

C36. Battery does not come on.

a. Switch or switch wiring faulty.

b. Battery relay faulty or incorrectly wired (2K2).

c. Battery voltage low.

d. Internal failure of battery or faulty connection.

e. Gunners ELEC PWR switch failed.

f. Failure of essential relay (2K9).

C37. GPU does not provide current to aircraft.

a. External power relay 2K1 or wiring faulty.

b. Polarity of GPU reversed.

c. APU voltage low.

d. Diode incorrectly installed or faulty (2CR5).

e. External power plug faulty or wiring faulty.

f. External power control relay faulty (2K16).

C38. RPM warning light and/or audio inoperative.

a. Bulbs burned out or missing.

b. Break in circuit wiring or cannon plugs disconnected.

c. RPM warning box faulty, disconnected, or not installed.

d. RPM warning box not adjusted properly (did not follow published procedures).

e. Tachometer generator faulty.

C39. Inverter fails to provide AC power.

a. Open circuit breaker.

b. Faulty wiring.

c. Poor ground.

d. Faulty inverter.

e. Faulty AC control relay (3K2).

f. Faulty battery switch (terminals 2 to 3).

g. Faulty inverter RCCB (3CB7).

C40. Alternator does not come on-line when switch is turned on.

a. N2 below 91%.

b. Alternator control relay faulty (3VR1).

c. Faulty switch.

C41. Rectifier does not come on-line when alternator power applied.

a. Faulty TRU (3PS2).

b. Faulty TRU control relay (2K15).

c. Faulty TRU circuit breaker (1 amp).

C42. TRU does not pick up non-essential bus.

a. Faulty non-essential bus control relay (2K4).

b. Faulty non-essential bus control relay (2K11).

C43. TRU does not power aircraft systems. Rectifier caution light out.

a. Faulty TRU essential bus relay (2K10).

b. Faulty essential bus relay (2K9).

TROUBLESHOOTING GUIDE D — CAUTION PANEL

CONDITION	PROBABLE CAUSE
D1. All or many caution lights illuminated.	
	a. Moisture in cannon plug.
	b. Caution panel malfunction.
	c. Caution panel circuit breaker inoperative.
D2. ENG OIL PRESS light on.	
	a. Check gauge. If pressure is up and changes with power change, trouble is faulty caution panel or pressure switch.
	b. If pressure is not correct, see E2.
D3. DC GEN caution light not on prior to engine start.	
	a. Defective bus control relay.
	b. Faulty caution panel circuit.
	c. Lamp faulty.
D4. DC GEN caution light on after engine start.	
	a. Faulty bus control relay (voltmeter and ammeter will have indications).
	b. Faulty GEN control relay.
	c. Faulty reverse current relay.

d. Faulty GEN switch or circuit breaker.

e. Faulty or maladjusted regulator.

f. Defective generator.

g. Faulty field control relay.

h. Faulty caution panel.

i. Faulty RCR control relay (2K14).

D5. HYD PRESS caution light on.

a. Solenoid malfunction.

b. Leakage in system.

c. Faulty system pressure relief valve.

d. Relief pressure set too low.

e. Oil level too low.

f. Faulty pump.

g. Check valve in pump pressure line installed backwards.

h. Faulty pressure switch or wiring.

i. Faulty caution panel.

D6. FUEL BOOST caution light on.

a. Circuit breaker out.

b. Boost pump malfunction.

c. Pump inlet restricted.

d. Faulty pressure switch.

e. Faulty fuel switch.

f. Faulty caution panel or wiring.

g. Fuel line clogged.

D7. ENG FUEL PUMP caution light on.

a. One or both sides of pump producing low pressure.

b. One or both sides of pump failed.

c. Faulty caution panel or wiring.

d. Faulty pressure switch.

D8. FUEL LOW caution light on.

a. Low fuel supply.

b. Faulty float switch.

c. Faulty caution panel or wiring.

D9. FUEL FILTER caution light on.

a. Fuel filter restricted.

b. Faulty fuel filter pressure switch.

c. Faulty caution panel or wiring.

D10. GOV EMERG caution light on.

a. GOV switch in EMERG.

b. Faulty caution panel.

c. Faulty switch or wired in reverse.

D11. TRANS OIL BYPASS light on.

a. Oil cooler leak.

b. Oil leak in cooler lines.

c. Faulty caution panel or wiring.

d. Bypass valve malfunction.

D12. TRANS OIL PRESS caution light on.

Check gauge, if pressure is up and pres sure changes slightly with RPM changes, trouble is faulty caution panel, pressure switch or wiring. If pressure is not correct, see F2.

D13. TRANS OIL HOT caution light on.

a. Check gauge. If temperature is normal, trouble is faulty caution panel or thermo switch.

b. If gauge indicates hot, see F6.

D14. EXT PWR caution light on.

a. GPU connected.

b. External power door open.

c. Micro switch out of adjustment.

d. Faulty caution panel.

e. Faulty external power control relay.

D15. Chip detector caution light on.

a. Determine which system is showing warning.

b. Metal chips on detector.

c. Shorted wiring or plug.

d. Faulty caution panel.

D16. RECT caution light on.

a. TRU bus circuit breaker faulty.

b. TRU bus control relay faulty.

c. TRU RCCB faulty.

D17. ENG OIL BYPASS caution light on.

a. Low oil level in oil tank.

b. Faulty float switch.

c. Faulty bypass valve.

d. Faulty caution panel or wiring.

D18. Master caution panel press-to-test inoperative.

a. Faulty circuit or switch.

b. Bulbs burned out.

c. Master caution circuit breaker faulty.

D19. Low RPM warning light not on at 93 ±1% RPM or below.

a. Circuit breaker out.

b. Bulbs burned out.

c. Light not making electrical contact.

d. Warning system malfunction.

e. Loose connections.

f. Improper adjustment of warning system.

g. Tachometer generator malfunction.

D20. Low RPM warning light on when it should be off.

a. Improper adjustment of warning system.

b. Internal malfunction of warning box.

D21. Low RPM audio inoperative, warning light on.

a. Headset not plugged in completely.

b. Audio switch off.

c. Faulty audio switch.

d. Malfunction in warning system.

e. Wiring open or shorted.

D22. Low RPM audio too weak.

a. Malfunction in warning box.

b. High resistance in wiring.

D23. RPM warning indications at different rpm's on different flights.

a. Adjustment potentiometer vibrating to different settings.

b. Faulty wiring.

D24. Caution panel lights dim when they should be bright, fail to dim or brighten.

a. Faulty bright/dim switch.

b. Faulty dimming circuit.

c. Faulty dim resistor.

d. Faulty pilot's instrument light rheostat.

e. NVG system activated.

D25. RPM warning light off when it should be on.

a. Circuit breaker out.

b. Improperly adjusted.

c. Lamps burned out.

d. Light not making electrical contact.

e. Loose connection.

f. Tachometer generator malfunction.

g. Internal malfunction of warning box.

D26. MASTER CAUTION light on only.

a. Small resistance in a chip detector plug.

b. Caution panel malfunction.

D27. EMERG HYD PUMP ON light is on.

a. Pump inadvertently turned on.

b. Faulty pressure switch.

c. Faulty caution panel.

D28. ALTER caution light illuminated.

a. N2 below 91**%**.

b. Alternator circuit breaker faulty.

c. 115 volt 400 Hz sensor faulty.

d. Alternator switch malfunction.

e. Alternator control relay faulty.

TROUBLESHOOTING GUIDE E — ENGINE

CONDITION	PROBABLE CAUSE
E1. No engine oil pressure, caution panel light out.	a. Circuit breaker out. b. Instrument or transmitter failure. c. No 28 VDC. d. Instrument wiring shorted or open. e. Faulty caution panel combined with actual engine oil system problem.
E2. No engine oil pressure indication, caution panel light on.	a. Loose hose connection(s). b. No oil in system. c. Restriction in lines. d. Faulty transmitting system. e. Oil pump failure. f. Oil pump shaft sheared. g. Pressure relief valve not closing.

E3. Low engine oil pressure.

a. Low oil level.

b. Faulty indicating system.

c. Oil pump inlet restricted.

d. Clogged oil filter.

e. Oil pump improperly adjusted.

f. Oil leak.

E4. Fluctuating engine oil pressure.

a. Low oil supply.

b. Sticking pump relief valve.

c. Pump inlet restricted.

d. Faulty indicating system.

e. Gauge clamped too tight in panel.

f. Air in oil system.

E5. High engine oil pressure.

a. Faulty indicating system.

b. Oil pump relief valve setting wrong.

E6. High engine oil temperature.

a. Low oil supply.

b. Oil cooler blower inoperative or bleed air restriction.

c. Faulty or obstructed cooler.

d. Faulty thermal relief valve.

e. Restriction in oil system; clogged jets.

f. Scavenge pump inoperative.

g. Clogged oil filter.

h. Faulty indicating system.

E7. No engine oil temperature indication.

a. Faulty temperature bulb or connection.

b. Faulty indicating system.

E8. Excessive engine oil consumption.

a. Leakage at fittings and hose assemblies.

b. Output shaft seal damaged.

c. No. 3 main bearing seal leaking (check for smoke from tailpipe and oil stains on rear face of power turbine disc).

d. No. 2 main bearing forward seal leaking (check for smoke from tailpipe and oil stains on forward face of gas producer rotor and curl).

e. No. 1 main bearing seal leaking (check for indications of oil leakage on variable inlet guide vanes, compressor bleed band holes, or mating surfaces of compressor housings).

f. Cracked pressure or scavenge oil tubes in air diffuser (same indications as No. 2 bearing forward seal leaking).

E9. Throttle stiff or binding.

a. Idle stop misaligned or rough.

b. Wrong bolts installed at idle stop.

c. Deck firewall boot rubbing control tube.

d. Bearings dirty or worn.

e. Fuel control arm stiff.

f. Misalignment at base of gunner collective stick.

g. Throttle friction on or bound up.

h. Rod end at fuel control binding.

i. Sector gears (base of collective) worn, broken or dirty.

E10. N1 below 68% with throttle at idle.

a. Idle stop improperly positioned.

b. Power control improperly rigged.

c. Fuel control on emergency (switch position or wiring wrong).

d. Wrong military trim setting on fuel control.

e. Fuel control malfunction.

f. Throttle linkage bellcrank or support loose or broken.

g. Fuel flow restricted.

h. Tachometer system malfunction.

i. Wrong fuel.

E11. N1 speed above 72% with throttle at idle.

a. Idle stop improperly positioned.

b. Power lever controls improperly rigged.

c. Wrong military trim setting on fuel control.

d. Tachometer system malfunction.

e. Wrong fuel.

E12. TGT, N1, N2 torque fluctuating.

a. Faulty overspeed governor.

b. Faulty fuel control

c. Engine deterioration.

d. Inlet obstructed.

e. Contaminated fuel.

f. P3 airline to bleed band actuator loose or cracked.

E13. TGT fluctuating, other instrument steady.

a. Faulty indicating system.

b. Loose connections.

c. Resistance box wiring open.

d. 20°C difference between seats above 700°C.

e. 30°C difference between seats above 700°C.

E14. No decrease in N1 when switching to emergency.

a. Throttle position too high.

b. Solenoid malfunction.

c. Switch malfunction.

d. Fuel control misrigged.

e. Fuel control already in emergency.

E15. No increase in N1 when switching from emergency to automatic.

a. Solenoid stuck or faulty.

b. Switch malfunction.

c. Throttle inadvertently moved.

E16. Governor RPM increases when beep RPM switch decreased, or vice versa.

Faulty wiring (connected wrong).

E17. No change in governor RPM when (beep) RPM switch activated.

a. Circuit breaker out.

b. Actuator bound up.

c. Faulty wiring.

d. Switch failure.

e. Actuator failure.

f. Fuel control in emergency.

g. N2 governor failure.

E18. RPM too low at full open throttle and decreased (beep) RPM switch.

a. Governor misrigged.

b. Faulty overspeed governor.

c. Air in fuel control.

E19. RPM too high at full open throttle and decreased (beep) RPM switch.

a. Governor misrigged.

b. Faulty overspeed governor.

c. Droop compensator misrigged.

d. Bent control tubes.

e. Actuator malfunction.

f. Droop compensator shear pin sheared.

E20. Governor RPM too low at full open throttle and full (beep) RPM increase.

a. Droop compensator shear pin sheared.

b. Governor misrigged.

c. Faulty overspeed governor.

d. Air in fuel control.

e. Engine not developing sufficient power.

E21. Governor RPM too high at full open throttle and full (beep) RPM increase.

a. Governor misrigged.

b. Faulty overspeed governor.

c. Droop compensator misrigged.

E22. Excessive time for governor actuator to complete travel one way.

a. Actuator binding.

b. Actuator malfunction.

c. N2 governor binding.

d. Primary bus voltage low.

e. Wiring malfunction.

E23. No increase in TGT when ENG DE-ICE circuit breaker pulled.

a. Power failure to valve solenoid.

b. Faulty wiring.

c. Switch in ENG DE-ICE position.

d. Malfunction in circuit breaker.

e. Hot air valve stuck.

f. Faulty temperature indicating system.

E24. No increase in TGT when engine de-ice switch in ENG DE-ICE position.

a. ENG DE-ICE circuit breaker out or faulty.

b. Faulty switch or wiring.

c. Hot air valve stuck.

d. Bleed air leakage.

e. Power failure to valve solenoid.

f. Faulty de-ice valve solenoid.

g. Faulty temperature indicating system.

E25. No decrease in TGT when ENG DE-ICE turned off.

a. ENG DE-ICE circuit breaker out.

b. Hot air valve stuck.

c. Switch malfunction.

d. Power failure to valve solenoid.

E26. Bleed band opening/closing abnormal.

a. Leaks or obstructions in hoses or fittings.

b. Adjustment not correct.

c. Clogged strainer in actuator valve.

d. Actuator piston sticking.

e. Fuel control airbleed valve dirty, sticking.

f. Faulty fuel control.

E27. Engine surge (compressor stall) during acceleration, fluctuating instruments, high TGT.

a. Air inlet dirty.

b. Compressor dirty.

c. Bleed band maladjusted or malfunctioning.

d. Engine deterioration.

e. Improper inlet guide vane operation.

f. Fuel control in EMER GOV mode.

g. Damaged P3 fitting on air diffuser.

h. Faulty de-ice valve.

i. Faulty fuel control.

E28. Engine acceleration time slower than normal.

a. Restricted fuel flow.

b. Compressor dirty.

c. Engine deterioration.

d. Faulty fuel control

E29. Unable to attain hover power on emergency fuel control.

a. Fuel control maladjusted.

b. Throttle rigging.

c. Faulty fuel control.

d. FAT gauge above 85°F (29°C).

E30. Engine surges (compressor stall) during operation on emergency fuel control.

a. Throttle movements too rapid.

b. Engine deterioration.

c. Air inlet dirty.

d. Faulty fuel control.

e. One or two “pop” stalls on switchover emergency or back to automatic is normal on some engines. If more than two “pops” occur, accompanied by TGT rise, see also E27.

E31. Excessive overshooting of RPM or hunting by engine during collective application.

a. Droop compensator rigging for steady state.

b. Governor malfunction.

E32. TGT abnormally low for power indicated.

a. Faulty indicating system.

b. Not actually developing power indicated.

E33. TGT abnormally high during steady state operations.

a. Engine inlet dirty.

b. Air screen clogged.

c. De-ice valve open.

d. Combustion chamber drain open.

e. Faulty bleed band.

f. Inlet guide vanes malfunctioning.

g. Engine deterioration.

h. Dirty or damaged compressor.

i. Bleed air leakage.

j. Starting fuel valve fails to shut off.

k. Faulty indicating system.

l. Damaged gas producer turbine.

m. Damaged gas producer nozzle.

n. Damaged or broken sealing rings.

o. Faulty fuel control.

E34. N1 speed lower than computed at maximum throttle (more than 0.7%).

a. Computation error.

b. ENG DE-ICE on.

c. Fuel control in EMERG.

d. Droop compensator misrigged.

e. Throttle misrigged.

f. Fuel flow restricted.

g. Air loss from engine.

h. Engine deterioration.

i. Faulty tachometer system.

j. Faulty fuel control.

E35. N1 speed higher than computed at maximum throttle (by more than 0.7%).

a. Computation error.

b. Fuel control in emergency.

c. Fuel control adjustment.

d. Faulty tachometer system.

e. Faulty fuel control.

E36. Low N2 speed.

a. Governor arm travel restricted.

b. Faulty overspeed governor.

E37. Excessive droop of N2 speed.

a. Droop compensator out of adjustment.

b. Throttle not fully open.

c. Low N1 speed.

E38. N2 overspeed.

a. Selector switch in EMER GOV.

b. Faulty overspeed governor.

E39. Engine fails to shutdown

a. Linkage faulty or maladjusted.

b. Faulty fuel control.

E40. Engine coast down noisy or time too short.

Internal engine bginding.

E41. Too much or too little throttle cushion.

a. Incorrect throttle rigging.

b. Throttle linkage bellcrank or support loose or broken.

TROUBLESHOOTING GUIDE F — TRANSMISSION

CONDITION	PROBABLE CAUSE
F1. No transmission oil pressure indication, caution light out.	
	a. Circuit breaker out.
	b. Instrument or transmitter failure.
	c. No DC power.
	d. Instrument wiring open or shorted.
	e. Faulty caution panel combined with actual oil system problem.
F2. No transmission oil pressure indication, caution light on.	
	a. Loose hose connections.
	b. No oil in system or quick disconnect loose.
	c. Pressure relief valve malfunction.
	d. Pump inlet screen clogged.
	e. Faulty oil pump.
	f. Oil leak.
F3. Low transmission oil pressure.	
	a. Pressure relief valve adjustment or malfunction.
	b. Restricted pump inlet screen.

c. Faulty oil pump.

d. Leakage or restriction between pressure relief valve and transmitter.

e. Faulty indicating system.

F4. Fluctuating transmission oil pressure.

a. Faulty indicating system, gauge or transmitter.

b. Instrument clamped too tightly in panel.

c. Sticking pressure relief valve.

d. Restricted pump inlet screen.

e. Low oil level.

F5. High transmission oil pressure.

a. Faulty indicating system.

b. Pressure relief valve malfunction or set wrong.

c. Clogged sets.

F6. High transmission oil temperature on gauge and caution panel.

a. Faulty oil jets.

b. Seized bearings or other internal transmission failure.

c. Oil cooler obstructed.

d. Oil cooler bypass valve malfunction.

e. Oil cooler bypass due to leak in cooler or lines.

f. Oil cooler thermostatic valve malfunction.

g. Oil cooling blower malfunction.

h. Faulty indicating system.

F7. No transmission oil temperature indication.

a. Faulty temperature bulb or connection.

b. Faulty indicating system.

TROUBLESHOOTING GUIDE G — HYDRAULICS
(See H for FLIGHT CONTROLS)

CONDITION

PROBABLE CAUSE

G1. Excessive feedback in controls.

a. Air in hydraulic system.

b. Servo control head bolts too tight.

c. Internal leakage in power cylinder.

d. Power cylinder assembly faulty.

e. Hydraulic pump faulty.

G2. Cyclic gets hard to move with feed back.

a. Faulty servo pilot valve.

b. Faulty hydraulic pump.

c. Low hydraulic pressure.

d. Faulty check valve.

e. Restriction in pump outlet.

f. Low fluid level.

G3. Collective comes up easier than it goes down or vice versa.

a. Balance spring on servo pilot valve out of adjustment.

b. Balance spring on servo pilot valve missing.

G4. Collective will not move with emergency pump on.

a. Pump not energized.

b. Faulty switch.

c. Feather bearings sticking.

d. HYD CONT circuit breaker malfunction.

e. Emergency hydraulic pump overload relay faulty (1S24).

f. Emergency hydraulic pump relay faulty (1K4).

TROUBLESHOOTING GUIDE H — FLIGHT CONTROLS (See G for HYDRAULICS)

CONDITION

PROBABLE CAUSE

H1. Controls do not operate smoothly.

a. Servo valve sticking.

b. Bearings dirty or worn.

c. Bent or binding control tubes.

d. Misaligned power cylinders.

e. Relief valve malfunction.

f. Servo control head bolts too tight.

g. Worn servo valves.

h. Hydraulic pump malfunction.

H2. Cyclic chatters when being moved.

a. Air in hydraulic system.

b. Power cylinder mount uniball adjustment loose.

c. Misaligned power cylinders.

d. Power cylinder mounting loose.

e. System pressure low.

H3. Cyclic binding in certain areas with force trim off.

a. Hydraulic lines restricting movement.

b. Wiring harness binding in base of stick.

c. Foreign matter in base of stick.

d. Foreign matter under deck (ice).

e. Bearings worn or dirty.

f. Rough spot in friction device.

H4. Cyclic built-in friction too low or too high.

a. Improperly adjusted.

b. Foreign matter in base of stick.

c. Wiring harness binding in base of stick.

d. Bearings worn or dirty.

e. Magnetic brake unit stiff (dragging).

H5. With FORCE TRIM OFF, cyclic continues to move after small force applied or moves without force application.

a. Power cylinder control head bolts binding.

b. Collective pilot valve spring installed on cyclic cylinder(s).

c. Pilot valve centering spring missing or maladjusted.

d. Improperly rigged force gradient.

e. Rough bearings in linkage aft of SCAS actuator.

f. Hydraulic cylinder malfunction.

H6. Feedback in controls.

a. Low or no cyclic friction (SCAS ON).

b. Servo control head bolts too tight.

c. Air in hydraulic system.

d. Internal leakage in servo valve.

e. Power cylinder assembly malfunction.

H7. Feedback in controls with either hydraulic system off.

a. Control head bolts too tight.

b. Pilot valve malfunction.

c. Pump malfunction.

d. Low hydraulic pressure.

e. Tail rotor cylinder malfunction.

f. Check valve malfunction.

H8. Pedals chatter when being moved.

a. Air in hydraulic system.

b. Power cylinder mounting bearings loose or binding.

c. Cylinder misaligned.

d. Servo support assembly and /or mounting surface distorted.

H9. Pedals binding with force trim off.

a. Binding controls.

b. Worn or dirty pedal adjuster assembly.

c. Magnetic brake dragging.

H10. With force trim off, one or the other pedal creeps forward.

a. Hydraulic cylinder lines putting force on cylinder.

b. Hydraulic cylinder malfunction.

c. Power cylinder misaligned.

d. Servo support assembly and/or mounting surface distorted.

H11. Excessive play in pedals.

a. Tension on tail rotor cables very low.

b. Worn pitch change mechanism.

c. Worn tube rod ends.

H12. Adjustable friction device will not increase friction on pilot collective.

a. Friction knob jammed.

b. Threads dirty.

c. Malfunction in base of stick.

H13. Collective built-in friction too light or too heavy.

a. Improper adjustment in base of stick.

b. Droop compensator.

c. Malfunction in base of stick.

d. On abnormally damp days friction may be less than normal. Friction adjusted on damp days may be too heavy on a dry day.

H14. Collective pitch maximum adjustable friction too high, friction full on.

a. Not adjusted properly at base of stick.

b. Malfunction at base of stick.

H15. Unable to get collective up sufficiently.

a. Controls fouled.

b. Top side N2 governor stop misadjusted.

c. Control rigging.

d. Hydraulic cylinder malfunction.

H16. Collective binds.

a. Friction device worn, rough, or adjusted tighter on one side than the other.

b. Electric harness at base of stick fouling.

c. Droop compensator sticking or pin sheared.

d. Power cylinder malfunction.

H17. Collective comes up easier than it goes down or vice versa.

a. Balance springs adjustment.

b. Balance springs missing.

H18. N2 increases more than 0.6% RPM when collective raised.

a. Droop compensator adjustment.

b. Wrong droop cam installed.

H19. N2 droops off more than 0.6% RPM when collective raised (Not to be confused with transient droop).

a. Droop compensator adjustment.

b. Wrong droop cam installed.

c. Droop compensator linkage sheared.

d. Fuel control on emergency.

e. Throttle not fully open.

f. Droop linkage out of rig.

g. Throttle out of rig.

h. Excessive play in linkage.

i. Excessive gross weight.

j. Engine not developing sufficient power.

H20. Force trim weak.

a. Magnetic brake not holding.

b. Wrong gradient spring assembly installed.

c. Spring tension adjustment.

d. Improperly rigged.

H21. Force trim stiff.

a. Wrong gradient spring assembly installed.

b. Spring tension adjustment.

H22. Excessive friction on cyclic with force trim off.

a. Built-in friction too high.

b. Foreign matter in base of stick.

c. Wiring harness binding in base of stick.

d. Magnetic brake unit stiff.

e. Bearings dirty or worn.

H23. Force trim holds in some positions with switch off.

a. Rough spots in brake travel.

b. Improperly rigged.

c. Magnetic brakes not completely releasing.

d. Residual magnetism in magnetic brake.

H24. Force trim inoperative.

a. Faulty switch.

b. Open circuit breaker.

c. Faulty magnetic brake.

d. Arm disconnected.

e. Open or shorted wiring.

H25. Ship tries to turn in wrong direction with pedal input.

Rigging error.

H26. Insufficient pedal travel or pedal position abnormal for flight condition.

a. Tail rotor rigging.

b. Fouled control tubes or control components.

c. SCAS actuator fully extended in one direction (hardover).

H27. Unable to get normal cyclic travel.

a. Rigging error.

b. Force trim misrigged.

c. Fouled controls.

d. Control components improperly installed.

H28. Cyclic position abnormal for flight condition.

a. Rigging error, swashplate or elevator.

b. CG (center of gravity) not as computed.

c. Airspeed indicator malfunction.

d. SCAS actuator fully extended in one direction (hardover).

H29. Rotor response to cyclic inputs slow or inconsistent.

a. Power cylinder leaking.

b. Rigging off.

c. Faulty hydraulic pump.

d. Faulty relief valve.

H30. Cyclic stick not centered instable hover.

a. Fore and aft CG off center.

b. Lateral CG off center.

c. Cyclic stick rigging.

d. SCAS actuator fully extended in one direction (hardover).

H31. Autorotation RPM too high or too low.

a. Gross weight different than computed.

b. Minimum blade angle set incorrect.

c. Airspeed not held steady.

d. Abnormal density altitude.

H32. Tip path appears wider than normal.

Blades out of track (if more than 6 or 8 inches, do not fly aircraft).

H33. Tailboom intermittently kicks left or right in normal flight.

Feedback form YAW SCAS.

H34. Tail rotor pedals creep or motor with NO. 1 HYD off.

a. TR (tail rotor) PC (pitch change) links misadjusted.

b. T/R crosshead build up incorrect.

c. T/R push-pull pitch control misrigged.

H35. No evidence of SAS correction for small control inputs.

a. Faulty SCAS actuator.

b. Faulty control motion transducer.

c. Faulty amplifier unit.

d. Pitch and roll actuator cannon plugs reversed.

e. SCAS solenoid valve not receiving power.

H36. Aircraft unstable in a hover (SCAS ON).

a. Cyclic friction too low.

b. AC voltage to SCAS rate gyro low.

c. Faulty pylon transducer.

d. Faulty rate gyro.

e. Faulty amplifier unit.

f. Amplifier unit base bolts loose.

g. Faulty control motion transducer.

h. Faulty actuator.

H37. Induces hardovers.

a. Faulty sensor amplifier unit.

b. Broken wires.

c. Faulty control motion transducer.

H38. SCAS channel switches remain on-line when HYD TEST switch is activated.

a. Faulty #1 or #2 HYD TEST switch.

b. Faulty sensor amplifier module relay circuit.

H39. SCAS power does not interrupt when hydraulic system checked.

SCAS relay faulty (2K18).

H40. Insufficient collective authority

a. Perform power cylinder check and trouble shoot accordingly.

b. Verify rotor blade to hub alignment (scope blades).

c. Check friction adjustment and friction collet.

d. Verify droop cam and linkage are not binding.

e. Trouble-shoot hydraulic system if this phenomenon is more pronounced in one system.

f. Check hydraulic system operating pressure.

g. Check main rotor feather bearings for sticking or binding.

h. Change rotor blades.

i. Test fly to verify if the problem is corrected prior to release for normal flight operations.

TROUBLESHOOTING GUIDE I — NOT APPLICABLE

TROUBLESHOOTING GUIDE J — VIBRATIONS

CONDITION	PROBABLE CAUSE
J1. Pylon rocking continues abnormally long or is present in forward flight.	
	a. Faulty transmission mount dampers.
	b. Wrong dampers installed.
	c. Pylon mounts worn.
	d. Defective fifth mount.
	e. Mount bolts bottomed, loose or stripped.
	f. Lift link loose.
J2. 1/rev vibration in hover.	
	a. Blade balance.
	b. Severe out of track.
	c. Excessively worn dynamic components.
J3. 1/rev vertical in forward flight.	
	a. Blade out of track.
	b. Pitch change rod end bearings worn.
	c. Grip bearings sticking.

d. Servo uniball torque incorrect.

e. Scissors bearings or bushings worn.

f. Trunnion bearings.

g. Undertorqued trunnion cap bolts.

J4. 1/rev vibration, intermittent.

a. Collective friction collet assembly loose or broken.

b. Collective sleeve bearings worn.

c. Collective lever pivot bearings worn.

d. Collective lever idle pivot bearings worn.

e. Anti-drive link worn.

f. Swashplate uniball preload incorrect.

g. Internal wear or damage in main rotor hub assembly.

h. Blade out of track.

i. B540 Excessive tab differential.

J5. 0.666 (2/3 per rev) intermittent vibration (resembles lateral but slower than 1/rev and faster than pylon rock).

a. Trunnion bearings worn or dirty.

b. Loose trunnion.

J6. Excessive 2/Rev vibration

a. Pylon mounts deteriorated.

b. Loose, worn or improperly shimmed drag braces.

c. Rod end bearings worn.

d. Excessive play in swashplate assembly.

e. Loose power cylinder mount.

f. Lift link bushing worn.

g. Undertorque trunnion cap bolts.

h. Trunnion cap bearing binding.

J7. Medium frequency vibration felt in airframe

a. Cross tubes loose.

b. Radio or electronic gear or antenna loose.

c. Unstowed loose equipment.

d. Excessive elevator play.

e. Airframe component loose.

f. Wing stores installation.

J8. Excessive high frequency vibration.

a. Tail rotor out of track.

b. Tail rotor out of balance.

c. Tail rotor pitch change link bearings loose.

d. Bent pitch change link.

e. Loose tail rotor retaining nut.

f. Worn or loose pitch change rod duplex bearings.

g. Worn or loose pitch change slider.

h. Oil cooler fan or mount loose.

i. Oil cooler blower, bearing assembly loose or dry of lubricant.

j. Engine alignment or mounts.

k. Cockpit air blower or ducts.

l. Inverter loose in mounts.

m. Generator bearing failure.

n. Tail rotor drive shaft balance.

o. Tail rotor drive shaft bent.

p. Tail rotor drive shaft alignment.

q. Hanger bearing failure.

r. Worn or loose tail rotor trunnion.

s. Hydraulic pumps.

t. Hydraulic modules.

u. Oil pump.

v. Loose equipment in cabin or ammo compartment.

w. Engine coupling shaft balance.

x. Drive shaft clamps not matched properly.

y. Drive shaft clamps not installed at 90°.

z. 42° gearbox alignment, shimming, or looseness.

aa. Lack of, or excessive lubrication of drive shaft couplings.

ab. Bad bearings in any quill assembly.

ac. Loose elevator linkage.

J9. Abnormal noises. Low pitched roar and grinding.

a. Engine vibrations.

b. Oil cooler fan blades dragging.

c. Heater ducts improperly fitted or leaking.

d. Faulty cockpit air blower.

e. Inverter loose in mounts.

f. Hydraulic pump failure.

g. Faulty hydraulic module.

h. Transmission drive quill(s) failing.

i. Internal gearbox failure.

j. Turret stow lock (no gun installed and master arm switch on).

k. Blade tape.

l. Canopy vibration.

m. Standby inverter.

n. Fuel boost pumps.

o. Air ducts.

TROUBLESHOOTING GUIDE K — COMMUNICATIONS/NAVIGATION EQUIPMENT

CONDITION	PROBABLE CAUSE
K1. High load meter indication when turning radio on, or radio inoperative.	
	a. Faulty wiring.
	b. Internal failure.
	c. Improperly turned.
	d. Improper radio switch position.
	e. Faulty COMM CONT panel.
	f. Headset not plugged in completely.
K2. HSI won't null.	
	a. Compass slaving switch in wrong position.
	b. Internal failure.
	c. Faulty wiring.
K3. Gyro operated instruments processing excessively.	
	a. AC power frequency output incorrect.
	b. Faulty inverter.
	c. Faulty power correction network or circuit breaker out.

K4. Gunner HSI inoperative, AC power on.

a. Faulty 28 VAC transformer.

b. 28 VAC transformer circuit breaker out.

c. AC voltage excessively high or low.

d. Faulty wiring.

K5. HSI inaccurate or erratic.

a. Improper position of compass slaving switch.

b. Improper adjustment of transmitting unit.

c. External magnetic interference.

d. Faulty components.

e. Faulty indicators.

K6. Communication and/or navigation equipment does not operate properly.

a. Faulty wiring.

b. Faulty impedance pad.

c. Internal failure of radio.

d. Faulty antenna or connection.

Section IV. SPECIAL PROCEDURES

General. This section contains special procedures which were referenced in Section II.

A. Health Indicator Test (HIT).

Refer to TM 55-2840-229-23, Chapter 1.

B. Avionics/Navigation Checks.

1. Gunner light checks:

   (a) CSL LT, INST LT, and ARMT LT rheostats — ON. Note illumination of all lights and operation of rheostats.

NOTE

Steps (c) through (g) below are not applicable after MWO 55-1520-236-50-4.

   (b) LT switch — NVG, note all lights dim except cockpit map light.

   (c) PLT ORIDE switch — PLT ORIDE, note all lights return to normal illumination.

   (d) GNRs cyclic lights switch — NVG, note all lights dim except cockpit map light.

   (e) PLT ORIDE switch — OFF, note all lights return to normal illumination.

   (f) GNRs cyclic lights switch — NORM.

(g) Cockpit map light — OFF.

(h) CSL LT, INST LT, and ARMT LT rheostats — OFF.

2. Pilot light checks:

(a) CONSOLE, ENGINE, FLIGHT, and TACTICAL rheostats — BRT. Note illumination of all lights and operation of rheostats.

(b) Cockpit map lights - Check operation; leave ON.

NOTE

Steps (c) through (e) below are not applicable after MWO 55-1520-236-50-4. Steps (f) through (h) are applicable after MWO 55-1520-236-50-4 and MWO 55-1520-236-50-5.

(c) NVG ENBL switch — ENBL.

(d) Night vision goggle cyclic switch — NVG, note all lights except cockpit map lights dim.

(e) NVG ENBL switch — OFF, note all lights return to normal illumination.

NOTE

Use night vision goggles to perform steps (f) and (g).

(f) NVG POS LTS — Check ON, 5 brightness levels.

WARNING

Do not view searchlight with the naked eye. Eye damage may result.

(g) SRCHLT — Check operation of light, control, stow and on.

(h) SKID LT — Check operation.

(i) Cockpit map lights — OFF.

(j) CONSOLE, ENGINE, FLIGHT, and TACTICAL rheostats — OFF.

3. Instrument/Nav aids — Check as follows:

(a) COMPASS control panel— Null annunciator; note horizontal situation indicator and gunner radio magnetic indicator display nearly correct heading.

(b) Horizontal situation indicator —

(1) Note heading flag not visible, NAV flag may or may not be visible depending on navigation equipment configuration.

(2) Range Warning Flag — May or may not be visible depending on doppler program and status.

(3) CRS SEL knob — Rotate to 315 degrees — Note COURSE display and center needle indicate 315 degrees.

(4) 0 VOR/MB switch — TEST; Note deviation indicator centers ±5 degrees.

NOTE

If deviation needle does not center, rotate course selector to obtain center indication - Note course display 310 to 320 degrees.

(5) HSI control panel — Set as required.

(c) Attitude direction indicator —

(1) FS and ATT flags — Not visible.

(2) Cyclic command bars — Not visible.

(3) Horizontal deviation indicator — Centered.

(4) Rate of turn indicator — Centered.

(5) Inclinometer — Ball centered (on level ground), fluid level full, no discoloration.

(6) Pitch trim — Rotate clockwise, note that horizontal reference line deflects 10 to 20 degrees upward from its zero trim position (indicating a dive). Rotate counterclockwise, note that the horizontal reference line deflects downward 5 to 10 degrees from its zero trim position (indicating a climb).

(7) Roll trim — Rotate; note approximately 15 degrees left and right deflection.

(d) Attitude indicator (gunner) —

(1) Power warning flag — Not visible.

(2) Display — Check approximately same as pilot's ADI display.

(3) Pitch trim — Return to its zero position.

(4) Pitch trim — Rotate clockwise, note horizontal line deflects 10 to 20 degrees upward from its zero trim position (indicating a dive). Rotate counterclockwise, note that horizontal line deflects downward 5 to 10 degrees from its zero trim position (indicating a climb).

(e) Altimeter — Set; altimeter setting note indicate altitude within ±170 feet of actual elevation.

(f) Radar altimeter — Check as follows:

(1) Rotate LO–Set knob clockwise to 50 feet for power on.

(2) Adjust radar altimeter light rheostat as required.

(3) Set high index to 800 feet.

(4) Hi and LO limit indexes — Set as desired.

(5) Push and hold HI–Set knob. Verify pointer indicates 1000 (±175) feet, digital display reads 1000 (±100) feet, HI level warning lamp is illuminated, and LO level warning lamp is extinguished.

(6) Release HI–Set knob. Verify pointer indicates 0 (+5) feet, digital display reads 0 to 3 feet, and LO level warning lamp is illuminated.

(g) Radar warning display — Check as follows:

(1) PWR switch — ON. Allow one minute warmup.

(2) DSCRM switch — OFF.

(3) SELF TEST switch — Press and hold. The forward and aft strobes appear and a 2.5 KHz audio tone is present in the headset. In approximately six seconds, the MA light will start flashing and the audio becomes intermittent.

(4) BRIL control — Rotate, check indicator illumination.

(5) AUDIO control — Adjust as required.

(6) DAY-NIGHT control — Adjust as required.

(7) SELF TEST switch — Release.

(8) DSCM switch — ON.

(9) SELF TEST switch — Press and hold. One of the strobes appear and a 1.2 KHz audio tone is present after approximately four seconds. Within approximately six seconds, the other strobe will appear and the audio tone will double.

(10) SELF TEST switch — Release.

(11) DSCM switch — As required.

(h) 0 Proximity warning system — Check as follows:

(1) POWER ON/OFF switch — ON.

(2) AUDIO control — Set as required.

(3) LIGHT INTENSITY — Set as required.

(4) RANGE SELECT switch — Set as required.

(5) TRANSPONDER GND TEST switch — Set as required.

(6) CONFIDENCE TEST switch — As required.

(i) APX-100 transponder — Check as follows:

(1) Modes 1 and 3A — Set as desired.

(2) Operate the press-to-test feature of the indicator lamps.

(3) ANT switch — BOT.

(4) MASTER switch — NORM.

(5) Hold the M-1 switch in the TEST position. Observe that the TEST-GO indicator lights.

(6) M-1 switch — ON.

(7) Repeat steps (5) and (6) for M-2, M-3A, and MC mode switches.

(8) ANT switch — TOP.

(9) Repeat steps (5), (6) and (7) above.

(10) ANT switch — DIV.

(11) Repeat steps (5), (6) and (7) above.

(12) Mode 4 rotary switch — A (if external computer is used, set a code in it).

(13) Mode 4 AUDIO/LIGHT/OUT — OUT.

(14) Mode 4 TEST/ON/OUT — Hold in TEST position.

(15) Computer installed — TEST-GO indicator lights. Computer not installed — TEST/MON NO-GO indicator lights and KIT status indicator lights.

(16) Mode 4 reply light and caution panel IF light does not illuminate.

(17) Mode 4 TEST/ON/OUT switch — ON with computer, OUT without computer.

(j) Doppler — Check as required in accordance with TM 11-5841-281-12.

(k) GPS trimpack — Set to STS. BITE performed.

NOTE

Hit check may be deferred until arrival in test flight hover area if conditions in run-up area preclude accurate and/or safe completion of check. HIT check must be completed prior to takeoff.

(l) HIT check — Perform.

(m) Clock — Set as required.

C. Turbine Engine Analysis Check (TEAC).

Refer to TM 55-2840-229-23, Chapter 1.

D. Main Rotor Tracking.

Refer to TM 55-1520-236-23-1, Chapter 5.

E. Tail Rotor Tracking.

Refer to TM 55-1520-236-23-1, Chapter 5.

Section V. CHARTS AND FORMS

1. General This section contains the necessary charts and forms required to ascertain that the aircraft is performing to established standards and to record readings, pressures, RPM, etc., obtained during maintenance test flight.

2. Table of Charts.

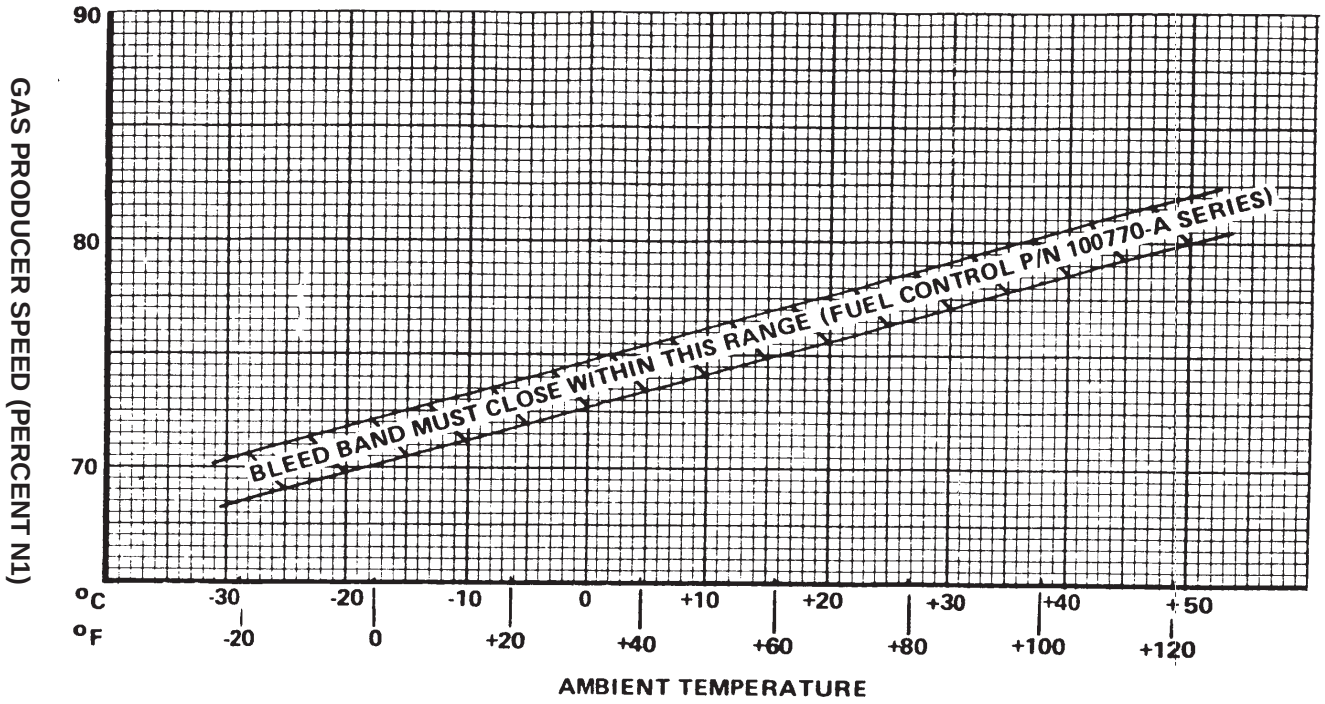


Figure 5-1. T53-L-703 Bleed Band Chart

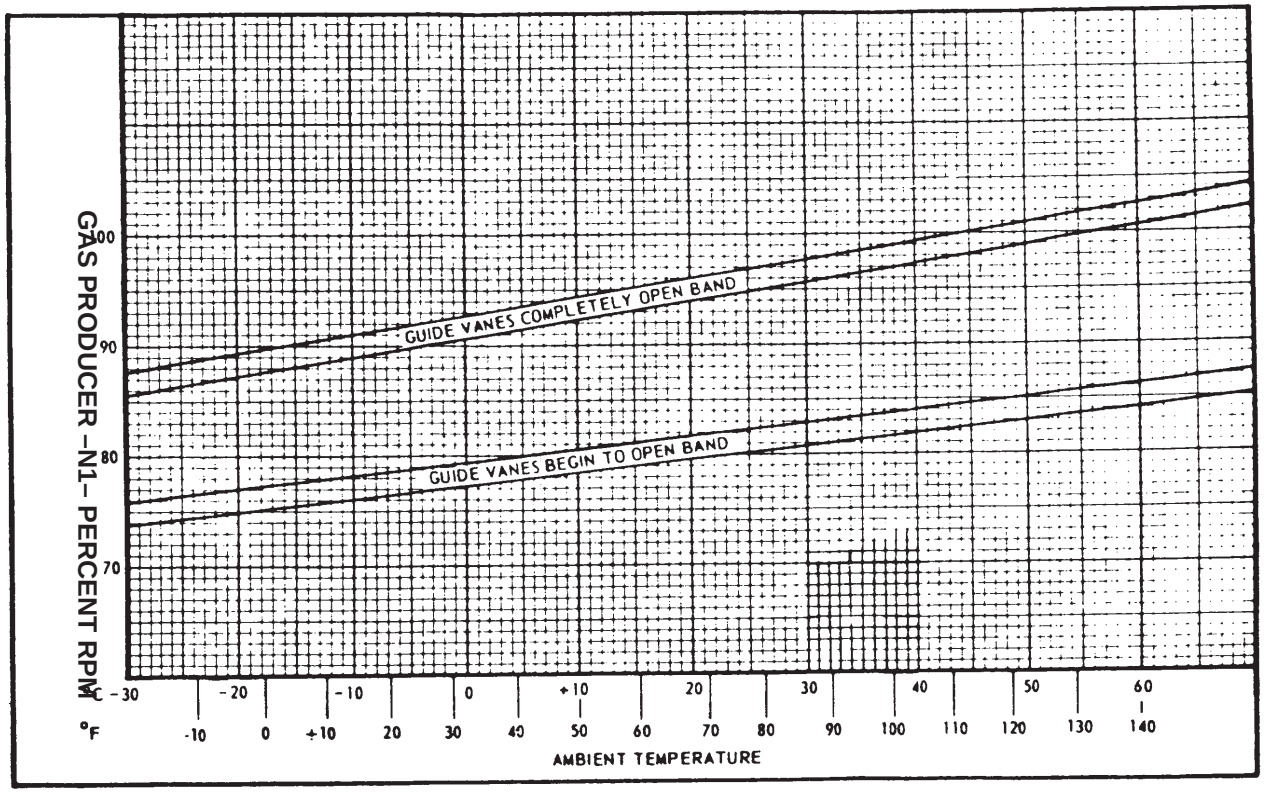
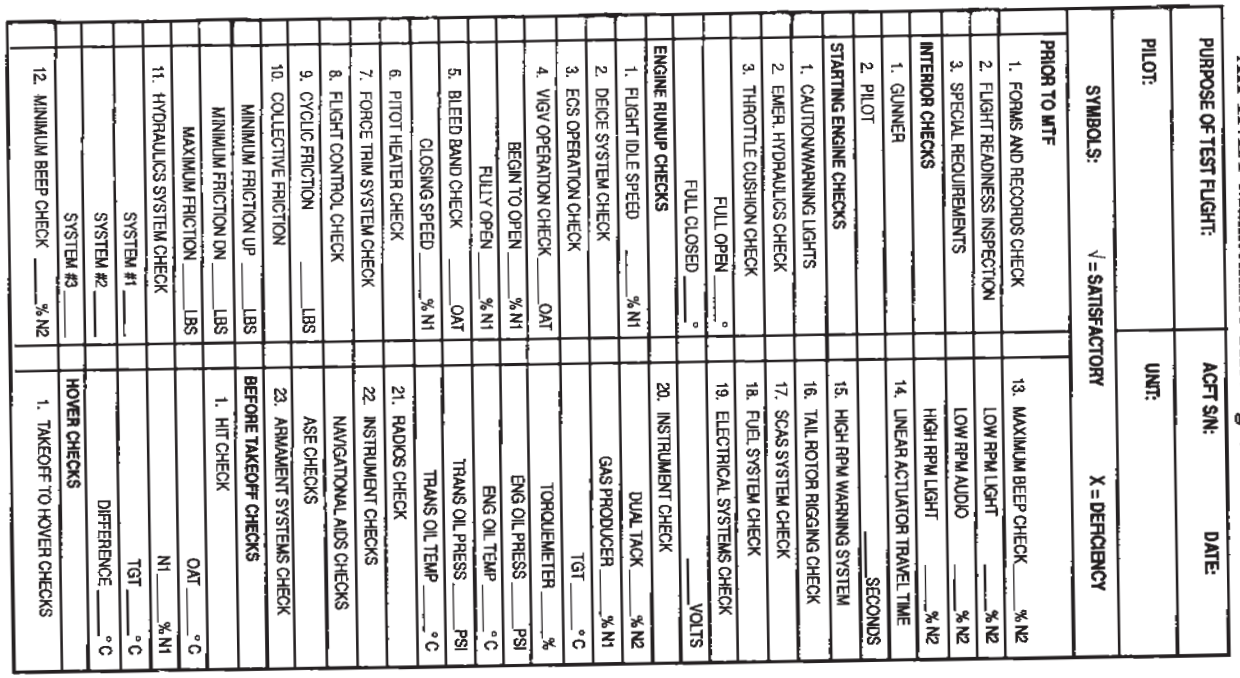


Figure 5-2. T53-L-703 Variable Inlet Guide Vane Chart



AH-1P/E/F Maintenance Test Flight Record Sheet.

PURPOSE OF TEST FLIGHT:	ACFT S/N:	DATE:
PILOT:	UNIT:	

SYMBOLS: √ = SATISFACTORY X = DEFICIENCY

PRIOR TO MTF		13. MAXIMUM BEEP CHECK ____% N2
1. FORMS AND RECORDS CHECK		LOW RPM LIGHT ____% N2
2. FLIGHT READINESS INSPECTION		LOW RPM AUDIO ____% N2
3. SPECIAL REQUIREMENTS		HIGH RPM LIGHT ____% N2
INTERIOR CHECKS		14. LINEAR ACTUATOR TRAVEL TIME
1. GUNNER		____SECONDS
2. PILOT		15. HIGH RPM WARNING SYSTEM
STARTING ENGINE CHECKS		16. TAIL ROTOR RIGGING CHECK
1. CAUTION/WARNING LIGHTS		17. SCAS SYSTEM CHECK
2. EMER. HYDRAULICS CHECK		18. FUEL SYSTEM CHECK
3. THROTTLE CUSHION CHECK		19. ELECTRICAL SYSTEMS CHECK
FULL OPEN ____°		____VOLTS
FULL CLOSED ____°		20. INSTRUMENT CHECK
ENGINE RUNUP CHECKS		DUAL TACK ____% N2
1. FLIGHT IDLE SPEED ____% N1		GAS PRODUCER ____% N1
2. DEICE SYSTEM CHECK		TGT ____ °C
3. ECS OPERATION CHECK		TORQUEMETER ____%
4. VIGV OPERATION CHECK ____OAT		ENG OIL PRESS ____PSI
BEGIN TO OPEN ____% N1		ENG OIL TEMP ____ °C
FULLY OPEN ____% N1		TRANS OIL PRESS ____PSI
5. BLEED BAND CHECK ____OAT		TRANS OIL TEMP ____ °C
CLOSING SPEED ____% N1		21. RADIOS CHECK
6. PITOT HEATER CHECK		22. INSTRUMENT CHECKS
7. FORCE TRIM SYSTEM CHECK		NAVIGATIONAL AIDS CHECKS
8. FLIGHT CONTROL CHECK		ASE CHECKS
9. CYCLIC FRICTION ____LBS		23. ARMAMENT SYSTEMS CHECK
10. COLLECTIVE FRICTION		**BEFORE TAKEOFF CHECKS**
MINIMUM FRICTION UP ____LBS		1. HIT CHECK
MINIMUM FRICTION DN ____LBS		OAT ____ °C
MAXIMUM FRICTION ____LBS		N1 ____% N1
11. HYDRAULICS SYSTEM CHECK		TGT ____ °C
SYSTEM #1 ____		DIFFERENCE ____ °C
SYSTEM #2 ____		**HOVER CHECKS**
SYSTEM #3 ____		1. TAKEOFF TO HOVER CHECKS
12. MINIMUM BEEP CHECK ____% N2		

Figure 5-3. Test Flight Record Sheet (sheet 1 of 2)

	2. INSTRUMENT CHECKS		4. AUTOROTATION CHECK
	3. TORQUEMETER CHECK		ROTOR RPM ______%
	4. PEDAL AUTHORITY CHECK		5. VIBRATION ANALYSIS CHECKS
	5. YAW CHANNEL RESPONSE CHECK		6. RADIO AND NAV AIDS CHECKS
	6. SIDEWARD HOVER FLIGHT CHECK		7. TOPPING CHECK
	7. FORWARD HOVER FLIGHT CHECK		TORQUE CHECK ______%
	8. PYLON MOUNT CHECK		N1 SPEED ______%
	9. ENGINE RESPONSE CHECK		TGT ______° C
	10. LOW RPM HOVER CHECK		OAT ______° C
	11. EMER. GOVERNOR SYSTEM CHECK		PRESSURE ALTITUDE ______FT
	12. POWER CYLINDER CHECK		**BEFORE LANDING CHECKS**
	13. COLLECTIVE SERVO AUTHORITY CK		**AFTER LANDING CHECKS**
	SYSTEM #1 ______% TORQUE		1. ENG OIL PRESS ______PSI
	SYSTEM #2 ______% TORQUE		2. ENG OIL TEMP ______° C
	14. BEFORE TAKEOFF CHECKS		3. TRANS OIL PRESS ______PSI
	15. FUEL ______LBS ______TIME		4. TRANS OIL TEMP ______° C
FLIGHT CHECKS			5. FUEL QUANTITY/TIME
	1. TAKEOFF/CLIMBOUT CHECKS		LBS______ TIME______
	2. INSTRUMENT CORRELATION CHECK		6. BATTERY CONDITION CHECK
	ENG OIL PRESS ______PSI		7. POST FLIGHT INSPECTION
	ENG OIL TEMP ______° C		8. FORMS AND RECORDS COMPLETED
	TRANS OIL PRESS ______PSI		9. PERSONNEL DEBRIEF
	TRANS OIL TEMP ______° C		10. AIRCRAFT RELEASED FOR FLIGHT
	3. FLIGHT CONTROL RIGGING CHECK		

REMARKS:

____
(SIGNATURE)

Figure 5-3. Test Flight Record Sheet (Sheet 2 of 2)

TEMPERATURE CONVERSION CHART

Look up reading in middle column; if in degrees Centigrade, read Fahrenheit equivalent in right-hand column; if in degrees Fahrenheit, read Centigrade equivalent in left-hand column.

C		F	C		F	C		F	C		F
-54	-65	-85	28.9	84	183.2	266	510	950	538	1000	1832
-51	-60	-76	30.0	86	186.8	271	520	968	543	1010	1850
-46	-50	-58	31.1	88	190.4	277	530	986	549	1021	1868
-40	-40	-40	32.2	90	194.0	282	540	1004	554	1031	1886
-34	-30	-22	33.3	92	197.6	288	550	1022	560	1040	1904
-29	-20	- 4	34.4	94	201.2	293	560	1040	566	1050	1922
-23	-10	14	35.6	96	204.8	299	570	1058	571	1060	1940
-17.8	0	32	36.7	98	208.4	304	580	1076	577	1070	1958
-16.7	2	35.6	37.8	100	212.0	310	590	1094	582	1080	1976
-15.6	4	39.2	43	110	230	316	600	1112	588	1090	1994
-14.4	6	42.8	49	120	248	321	610	1130	593	1100	2012
-13.3	8	46.4	54	130	266	327	620	1148	599	1110	2030
-12.2	10	50.0	60	140	284	332	630	1166	604	1120	2048
-11.1	12	53.6	66	150	302	338	640	1184	610	1130	2066
-10.0	14	57.2	71	160	320	343	650	1202	616	1140	2084
- 8.9	16	60.8	77	170	338	349	660	1220	621	1150	2102
- 7.8	18	64.4	82	180	356	354	670	1238	627	1160	2120
- 6.7	20	68.0	88	190	374	360	680	1256	632	1170	2138
- 5.6	22	71.6	93	200	392	366	690	1274	638	1180	2156
- 4.4	24	75.2	99	210	410	371	700	1292	643	1190	2174
- 3.3	26	78.8	104	220	428	377	710	1310	649	1200	2192
- 2.3	28	82.4	110	230	446	382	720	1328	654	1210	2210
- 1.1	30	86.0	116	240	464	388	730	1346	660	1220	2228
0.0	32	89.6	121	250	482	393	740	1364	666	1230	2246
1.1	34	93.2	127	260	500	399	750	1382	671	1240	2264
2.2	36	96.8	132	270	518	404	760	1400	677	1250	2282
3.3	38	100.4	138	280	536	410	770	1418	682	1260	2300
4.4	40	104.0	143	290	554	416	780	1436	668	1270	2318
5.6	42	107.6	149	300	572	421	790	1454	693	1280	2336
6.7	44	111.2	154	310	590	427	800	1472	699	1290	2254
7.8	46	114.3	160	320	608	432	810	1490	704	1300	2372
8.9	48	118.4	166	330	626	438	820	1508	710	1310	2390
10.0	50	122.0	171	340	644	463	830	1526	716	1320	2408
11.1	52	125.6	177	350	662	449	840	1544	721	1330	2426
12.2	54	129.2	182	360	680	454	850	1562	727	1340	2444
13.3	56	132.8	188	370	698	460	860	1580	732	1350	2462
14.4	58	136.4	193	380	716	466	870	1598	738	1360	2480
15.6	60	140.0	199	390	734	471	880	1616	743	1370	2498
16.7	62	143.6	204	400	752	477	890	1634	749	1380	2516
17.8	64	147.2	210	410	770	482	900	1652	754	1390	2534
18.9	66	150.8	216	420	788	488	910	1670	760	1400	2552
20.0	68	154.4	221	430	806	493	920	1688	766	1410	2570
21.1	70	158.0	227	440	824	499	930	1706	771	1420	2588
22.2	72	161.6	232	450	842	504	940	1724	777	1430	2606
23.3	71	165.2	238	460	860	510	950	1742	782	1440	2624
24.4	74	168.8	243	470	878	516	960	1760	788	1450	2642
25.6	78	172.4	249	480	896	521	970	1778	793	1460	2660
26.7	80	176.0	254	490	914	527	980	1796			
27.8	82	179.6	260	500	932	532	990	1814			

Figure 5-4. Temperature Conversion

TM 1-1520-236-MTF

REQUIRED TORQUE CHART
T53-L-703 ENGINE

PA: 5,000 FEET

DATA PLATE TORQUE

OAT	58	59	60	61	62	63	64
	REQUIRED TORQUE (% INDICATED)						
5	108.0	110.3	112.6	114.9	116.0	118.3	119.5
6	107.2	109.5	111.8	114.0	115.2	117.5	118.5
7	106.4	108.7	111.0	113.2	114.4	116.6	117.8
8	105.7	107.9	110.2	112.4	113.5	115.8	116.9
9	104.9	107.1	109.4	111.6	112.7	115.0	116.1
10	104.1	106.4	108.6	110.8	111.9	114.1	115.2
11	103.4	105.6	107.8	110.0	111.1	113.3	114.4
12	102.6	104.8	107.0	109.2	110.3	112.4	113.5
13	101.8	104.0	106.2	108.3	109.4	111.6	112.7
14	101.1	103.2	105.4	107.5	108.6	110.8	111.8
15	100.3	102.4	104.6	106.7	107.8	109.9	111.0
16	99.5	101.7	103.8	105.9	107.0	109.1	110.1
17	98.8	100.9	103.0	105.1	106.1	108.2	109.3
18	98.0	100.1	102.2	104.3	105.3	107.4	108.4
19	97.3	99.3	101.4	103.5	104.5	106.6	107.6
20	96.5	98.5	100.6	102.6	103.7	105.7	106.8
21	95.7	97.8	99.8	101.8	102.8	104.9	105.9
22	95.0	97.0	99.0	101.0	102.0	104.0	105.1
23	94.2	96.2	98.2	100.2	101.2	103.2	104.2
24	93.4	95.4	97.4	99.4	100.4	102.4	103.4
25	92.7	94.6	96.6	98.6	99.6	101.5	102.5
26	91.9	93.8	95.8	97.8	98.7	100.7	101.7
27	91.1	93.1	95.0	96.9	97.9	99.9	100.8
28	90.4	92.3	94.2	96.1	97.1	99.0	100.0
29	89.6	91.5	93.4	95.3	96.3	98.2	99.1
30	88.8	90.7	92.6	94.5	95.4	97.3	98.3
31	88.1	89.9	91.8	93.7	94.6	96.5	97.4
32	87.3	89.2	91.0	92.9	93.8	95.7	96.6
33	86.5	88.4	90.2	92.1	93.0	94.8	95.7
34	85.8	87.6	89.4	91.2	92.2	94.0	94.9
35	85.0	86.8	88.6	90.4	91.3	93.1	94.0
36	84.2	86.0	87.8	89.6	90.5	92.3	93.2
37	83.5	85.3	87.0	88.8	89.7	91.5	92.4
38	82.7	84.5	86.2	88.0	88.9	90.6	91.5
39	81.9	83.7	85.4	87.2	88.0	89.8	90.7
40	81.2	82.9	84.6	86.4	87.2	89.0	89.8

CAUTION: SHADED AREAS CONTAIN VALUES THAT EXCEED MAXIMUM CALIBRATED TORQUE.

Figure 5-5. Required Torque Chart (Sheet 1 of 7)

REQUIRED TORQUE CHART
T53-L-703 ENGINE

PA: 6,000 FEET

DATA PLATE TORQUE

OAT	58	59	60	61	62	63	64
	REQUIRED TORQUE (% INDICATED)						
5	104.3	106.6	108.8	111.0	112.1	114.3	115.4
6	103.6	105.8	108.0	110.2	111.3	113.5	114.6
7	102.8	105.0	107.2	109.4	110.5	112.7	113.8
8	102.1	104.3	106.4	108.6	109.7	111.9	112.9
9	101.3	103.5	105.6	107.8	108.9	111.0	112.1
10	100.6	102.7	104.9	107.0	108.1	110.2	111.3
11	99.8	102.0	104.1	106.2	107.3	109.4	110.4
12	99.1	101.2	103.3	105.4	106.5	108.6	109.6
13	98.3	100.4	102.5	104.6	105.6	107.7	108.8
14	97.6	99.6	101.7	103.8	104.8	106.9	108.0
15	96.8	98.9	100.9	103.0	104.0	106.1	107.1
16	96.1	98.1	100.2	102.2	103.2	105.3	106.3
17	95.3	97.3	99.4	101.4	102.4	104.4	105.5
18	94.6	96.6	98.6	100.6	101.6	103.6	104.6
19	93.8	95.8	97.8	99.8	100.8	102.8	103.8
20	93.1	95.0	97.0	99.0	100.0	102.0	103.0
21	92.3	94.3	96.2	98.2	99.2	101.1	102.1
22	91.6	93.5	95.5	97.4	98.4	100.3	101.3
23	90.8	92.7	94.7	96.6	97.6	99.5	100.5
24	90.1	92.0	93.9	95.8	96.8	98.7	99.6
25	89.3	91.2	93.1	95.0	96.0	97.9	98.8
26	88.5	90.4	92.3	94.2	95.1	97.0	98.0
27	87.8	89.7	91.5	93.4	94.3	96.2	97.1
28	87.0	88.9	90.7	92.6	93.5	95.4	96.3
29	86.3	88.1	90.0	91.8	92.7	94.6	95.5
30	85.5	87.4	89.2	91.0	91.9	93.7	94.6
31	84.8	86.6	88.4	90.2	91.1	92.9	93.8
32	84.0	85.8	87.6	89.4	90.3	92.1	93.0
33	83.3	85.1	86.8	88.6	89.5	91.3	92.1
34	82.5	84.3	86.0	87.8	88.7	90.4	91.3
35	81.8	83.5	85.3	87.0	87.9	89.6	90.5
36	81.0	82.8	84.5	86.2	87.1	88.8	89.6
37	80.3	82.0	83.7	85.4	86.3	88.0	88.8
38	79.5	81.2	82.9	84.6	85.4	87.1	88.0
39	78.8	80.4	82.1	83.8	84.6	86.3	87.2
40	78.0	79.7	81.3	83.0	83.8	85.5	86.3

CAUTION: SHADED AREAS CONTAIN VALUES THAT EXCEED MAXIMUM CALIBRATED TORQUE.

Figure 5-5. Required Torque Chart (Sheet 2 of 7)

REQUIRED TORQUE CHART
T53-L-703 ENGINE

PA: 7,000 FEET

DATA PLATE TORQUE

	58	59	60	61	62	63	64
OAT	REQUIRED TORQUE (% INDICATED)						
5	100.4	102.6	104.7	106.8	107.9	110.0	111.1
6	99.7	101.8	103.9	106.1	107.1	109.2	110.3
7	99.0	101.1	103.2	105.3	106.3	108.4	109.5
8	98.2	100.3	102.4	104.5	105.5	107.6	108.7
9	97.5	99.5	101.6	103.7	104.7	106.8	107.8
10	96.7	98.8	100.9	102.9	103.9	106.0	107.0
11	96.0	98.0	100.1	102.1	103.1	105.2	106.2
12	95.3	97.3	99.3	101.3	102.4	104.4	105.4
13	94.5	96.5	98.5	100.6	101.6	103.6	104.6
14	93.8	95.8	97.8	99.8	100.8	102.8	103.8
15	93.0	95.0	97.0	99.0	100.0	102.0	102.9
16	92.3	94.3	96.2	98.2	99.2	101.1	102.1
17	91.6	93.5	95.5	97.4	98.4	100.3	101.3
18	90.8	92.8	94.7	96.6	97.6	99.5	100.5
19	90.1	92.0	93.9	95.8	96.8	98.7	99.7
20	89.4	91.3	93.2	95.1	96.0	97.9	98.9
21	88.6	90.5	92.4	94.3	95.2	97.1	98.0
22	87.9	89.7	91.6	93.5	94.4	96.3	97.2
23	87.1	89.0	90.8	92.7	93.6	95.5	96.4
24	86.4	88.2	90.1	91.9	92.8	94.7	95.6
25	85.7	87.5	89.3	91.1	92.0	93.9	94.8
26	84.9	86.7	88.5	90.3	91.2	93.1	94.0
27	84.2	86.0	87.8	89.6	90.5	92.2	93.1
28	83.4	85.2	87.0	88.8	89.7	91.4	92.3
29	82.7	84.5	86.2	88.0	88.9	90.6	91.5
30	82.0	83.7	85.5	87.2	88.1	89.8	90.7
31	81.2	83.0	84.7	86.4	87.3	89.0	89.9
32	80.5	82.2	83.9	85.6	86.5	88.2	89.1
33	79.7	81.4	83.1	84.8	85.7	87.4	88.2
34	79.0	80.7	82.4	84.1	84.9	86.6	87.4
35	78.3	79.9	81.6	83.3	84.1	85.8	86.6
36	77.5	79.2	80.8	82.5	83.3	85.0	85.8
37	76.8	78.4	80.1	81.7	82.5	84.1	85.0
38	76.1	77.7	79.3	80.9	81.7	83.3	84.1
39	75.3	76.9	78.5	80.1	80.9	82.5	86.3
40	74.6	76.2	77.8	79.3	80.1	81.7	82.5

CAUTION: SHADED AREAS CONTAIN VALUES THAT EXCEED MAXIMUM CALIBRATED TORQUE.

Figure 5-5. Required Torque Chart (Sheet 3 of 7)

REQUIRED TORQUE CHART
T53-L-703 ENGINE

PA: 8,000 FEET

DATA PLATE TORQUE

OAT	58	59	60	61	62	63	64
	REQUIRED TORQUE (% INDICATED)						
5	96.8	98.8	100.9	102.9	104.0	106.0	107.0
6	96.0	98.1	100.1	102.2	103.2	105.2	106.3
7	95.3	97.4	99.4	101.4	102.4	104.5	105.5
8	94.6	96.6	98.6	100.7	101.7	103.7	104.7
9	93.9	95.9	97.9	99.9	100.9	102.9	103.9
10	93.2	95.2	97.2	99.1	100.1	102.1	103.1
11	92.5	94.5	96.4	98.4	99.4	101.3	102.3
12	91.8	93.7	95.7	97.6	98.6	100.6	101.5
13	91.1	93.0	94.9	96.9	97.8	99.8	100.7
14	90.3	92.3	94.2	96.1	97.1	99.0	100.0
15	89.6	91.5	93.5	95.4	96.3	98.2	99.2
16	88.9	90.8	92.7	94.6	95.5	97.4	98.4
17	88.2	90.1	92.0	93.8	94.8	96.7	97.6
18	87.5	89.4	91.2	93.1	94.0	95.9	96.8
19	86.8	88.6	90.5	92.3	93.3	95.1	96.0
20	86.1	87.9	89.7	91.6	92.5	94.3	95.2
21	85.4	87.2	89.0	90.8	91.7	93.5	94.4
22	84.7	86.5	88.3	90.1	91.0	92.8	93.7
23	83.9	85.7	87.5	89.3	90.2	92.0	92.9
24	83.2	85.0	86.8	88.5	89.4	91.2	92.1
25	82.5	84.3	86.0	87.8	88.7	90.4	91.3
26	81.8	83.5	85.3	87.0	87.9	89.6	90.5
27	81.1	82.8	84.5	86.3	87.1	88.9	89.7
28	80.4	82.1	83.8	85.5	86.4	88.1	88.9
29	79.7	81.4	83.1	84.8	85.6	87.3	88.1
30	79.0	80.6	82.3	84.0	84.8	86.5	87.4
31	78.3	79.9	81.6	83.2	84.1	85.7	86.6
32	77.5	79.2	80.8	82.5	83.3	85.0	85.8
33	76.8	78.5	80.1	81.7	82.5	84.2	85.0
34	76.1	77.7	79.4	81.0	81.8	83.4	84.2
35	75.4	77.0	78.6	80.2	81.0	82.6	83.4
36	74.7	76.3	77.9	79.5	80.3	81.8	82.6
37	74.0	75.6	77.1	78.7	79.5	81.1	81.9
38	73.3	74.8	76.4	77.9	78.7	80.3	81.1
39	72.6	74.1	75.6	77.2	78.0	79.5	80.3
40	71.8	73.4	74.9	76.4	77.2	78.7	79.5

CAUTION: SHADED AREAS CONTAIN VALUES THAT EXCEED MAXIMUM CALIBRATED TORQUE.

Figure 5-5. Required Torque Chart (Sheet 4 of 7)

REQUIRED TORQUE CHART
T53-L-703 ENGINE

PA: 9,000 FEET

DATA PLATE TORQUE

OAT	58	59	60	61	62	63	64
	REQUIRED TORQUE (% INDICATED)						
5	92.9	94.9	96.9	98.9	99.8	101.8	102.8
6	92.3	94.2	96.2	98.1	99.1	101.1	102.1
7	91.6	93.5	95.5	97.4	98.4	100.4	101.3
8	90.9	92.8	94.8	96.7	97.7	99.6	100.6
9	90.2	92.2	94.1	96.0	97.0	98.9	99.8
10	89.6	91.5	93.4	95.3	96.2	98.1	99.1
11	88.9	90.8	92.7	94.6	95.5	97.4	98.4
12	88.2	90.1	92.0	93.9	94.8	96.7	97.6
13	87.6	89.4	91.3	93.1	94.1	95.9	96.9
14	86.9	88.7	90.6	92.4	93.4	95.2	96.1
15	86.2	88.0	89.9	91.7	92.6	94.5	95.4
16	85.5	87.4	89.2	91.0	91.9	93.7	94.6
17	84.9	86.7	88.5	90.3	91.2	93.0	93.9
18	84.2	86.0	87.8	89.6	90.5	92.3	93.2
19	83.5	85.3	87.1	88.9	89.7	91.5	92.4
20	82.9	84.6	86.4	88.1	89.0	90.8	91.7
21	82.2	83.9	85.7	87.4	88.3	90.1	90.9
22	81.5	83.2	85.0	86.7	87.6	89.3	90.2
23	80.8	82.6	84.3	86.0	86.9	88.6	89.4
24	80.2	81.9	83.6	85.3	86.1	87.8	88.7
25	79.5	81.2	82.9	84.6	85.4	87.1	88.0
26	78.8	80.5	82.2	83.9	84.7	86.4	87.2
27	78.2	79.8	81.5	83.1	84.0	85.6	86.5
28	77.5	79.1	80.8	82.4	83.3	84.9	85.7
29	76.8	78.4	80.1	81.7	82.5	84.2	85.0
30	76.1	77.8	79.4	81.0	81.8	83.4	84.2
31	75.5	77.1	78.7	80.3	81.1	82.7	83.5
32	74.8	76.4	78.0	79.6	80.4	82.0	82.8
33	74.1	75.7	77.3	78.9	79.6	81.2	82.0
34	73.5	75.0	76.6	78.1	78.9	80.5	81.3
35	72.8	74.3	75.9	77.4	78.2	79.8	80.5
36	72.1	73.6	75.2	76.7	77.5	79.0	79.8
37	71.4	73.0	74.5	76.0	76.8	78.3	79.0
38	70.8	72.3	73.8	75.3	76.0	77.5	78.3
39	70.1	71.6	73.1	74.6	75.3	76.8	77.6
40	69.4	70.9	72.4	73.9	74.6	76.1	76.8

CAUTION: SHADED AREAS CONTAIN VALUES THAT EXCEED MAXIMUM CALIBRATED TORQUE.

Figure 5-5. Required Torque Chart (Sheet 5 of 7)

REQUIRED TORQUE CHART
T53–L–703 ENGINE

PA: 10,000 FEET

	DATA PLATE TORQUE						
	58	59	60	61	62	63	64
OAT	REQUIRED TORQUE (% INDICATED)						
5	89.4	91.3	93.2	95.1	96.1	98.0	98.9
6	88.8	90.7	92.6	94.5	95.4	97.3	98.2
7	88.1	90.0	91.9	93.8	94.7	96.6	97.5
8	87.5	89.4	91.2	93.1	94.0	95.9	96.8
9	86.9	88.7	90.5	92.4	93.3	95.2	96.1
10	86.2	88.0	89.9	91.7	92.6	94.5	95.4
11	85.6	87.4	89.2	91.0	91.9	93.8	94.7
12	84.9	86.7	88.5	90.3	91.2	93.1	94.0
13	84.3	86.1	87.9	89.7	90.6	92.3	93.2
14	83.6	85.4	87.2	89.0	89.9	91.6	92.5
15	83.0	84.8	86.5	88.3	89.2	90.9	91.8
16	82.3	84.1	85.8	87.6	88.5	90.2	91.1
17	81.7	83.4	85.2	86.9	87.8	89.5	90.4
18	81.1	82.8	84.5	86.2	87.1	88.8	89.7
19	80.4	82.1	83.8	85.5	86.4	88.1	89.0
20	79.8	81.5	83.2	84.9	85.7	87.4	88.2
21	79.1	80.8	82.5	84.2	85.0	86.7	87.5
22	78.5	80.1	81.8	83.5	84.3	86.0	86.8
23	77.8	79.5	81.1	82.8	83.6	85.3	86.1
24	77.2	78.8	80.5	82.1	82.9	84.6	85.4
25	76.5	78.2	79.8	81.4	82.2	83.9	84.7
26	75.9	77.5	79.1	80.7	81.5	83.2	84.0
27	75.3	76.9	78.5	80.1	80.9	82.5	83.3
28	74.6	76.2	77.8	79.4	80.2	81.7	82.5
29	74.0	75.5	77.1	78.7	79.5	81.0	81.8
30	73.3	74.9	76.4	78.0	78.8	80.3	81.1
31	72.7	74.2	75.8	77.3	78.1	79.6	80.4
32	72.0	73.6	75.1	76.6	77.4	78.9	79.7
33	71.4	72.9	74.4	75.9	76.7	78.2	79.0
34	70.7	72.2	73.7	75.3	76.0	77.5	78.3
35	70.1	71.6	73.1	74.6	75.3	76.8	77.6
36	69.5	70.9	72.4	73.9	74.6	76.1	76.8
37	68.8	70.3	71.7	73.2	73.9	75.4	76.1
38	68.2	69.6	71.1	72.5	73.2	74.7	75.4
39	67.5	69.0	70.4	71.8	72.5	74.0	74.7
40	66.9	68.3	69.7	71.1	71.9	73.3	74.0

Figure 5-5. Required Torque Chart (Sheet 6 of 7)

REQUIRED TORQUE CHART
T53-L-703 ENGINE

PA: 11,000 FEET

DATA PLATE TORQUE

	58	59	60	61	62	63	64
OAT	REQUIRED TORQUE (% INDICATED)						
5	86.8	88.6	90.4	92.3	93.2	95.1	96.0
6	86.1	88.0	89.0	91.6	92.5	94.4	95.3
7	85.5	87.3	89.1	90.9	91.9	93.7	94.6
8	84.9	86.7	88.5	90.3	91.2	93.0	93.9
9	84.2	86.0	87.8	89.6	90.5	92.3	93.2
10	83.6	85.4	87.2	88.9	89.8	91.6	92.5
11	83.0	84.7	86.5	88.3	89.1	90.9	91.8
12	82.3	84.1	85.8	87.6	88.5	90.2	91.1
13	81.7	83.4	85.2	86.9	87.8	89.5	90.4
14	81.1	82.8	84.5	86.2	87.1	88.8	89.7
15	80.4	82.2	83.9	85.6	86.4	88.1	89.0
16	79.8	81.5	83.2	84.9	85.8	87.5	88.3
17	79.2	80.9	82.5	84.2	85.1	86.8	87.6
18	78.5	80.2	81.9	83.6	84.4	86.1	86.9
19	77.9	79.6	81.2	82.9	83.7	85.4	86.2
20	77.3	78.9	80.6	82.2	83.0	84.7	85.5
21	76.7	78.3	79.9	81.5	82.4	84.0	84.8
22	76.0	77.6	79.3	80.9	81.7	83.3	84.1
23	75.4	77.0	78.6	80.2	81.0	82.6	83.4
24	74.8	76.4	77.9	79.5	80.3	81.9	82.7
25	74.1	75.7	77.3	78.9	79.7	81.2	82.0
26	73.5	75.1	76.6	78.2	79.0	80.5	81.3
27	72.9	74.4	76.0	77.5	78.3	79.8	80.6
28	72.2	73.8	75.3	76.8	77.6	79.2	79.9
29	71.6	73.1	74.7	76.2	76.9	78.5	79.2
30	71.0	72.5	74.0	75.5	76.3	77.8	78.5
31	70.3	71.8	73.3	74.8	75.6	77.1	77.8
32	69.7	71.2	72.7	74.2	74.9	76.4	77.1
33	69.1	70.6	72.0	73.5	74.2	75.7	76.4
34	68.5	69.9	71.4	72.8	73.5	75.0	75.7
35	67.8	69.3	70.7	72.1	72.9	74.3	75.0
36	67.2	68.6	70.0	71.5	72.2	73.6	74.3
37	66.6	68.0	69.4	70.8	71.5	72.9	73.6
38	65.9	67.3	68.7	70.1	70.8	72.2	72.9
39	65.3	66.7	68.1	69.5	70.2	71.5	72.2
40	64.7	66.0	67.4	68.8	69.5	70.9	71.5

CAUTION: SHADED AREAS CONTAIN VALUES THAT EXCEED MAXIMUM CALIBRATED TORQUE.

Figure 5-5. Required Torque Chart (Sheet 7 of 7)

T53-L-703 ENGINE WITH FUEL CONTROL PIN 100770

BLEED BAND CLOSING SPEED		VIGV BEGIN TO OPEN		VIGV FULLY OPEN	
OAT	RANGE (%N1)	OAT	RANGE (%N1)	OAT	RANGE (%N1)
-30	68.2 ~ 70.4	-30	74.0 ~ 78.0	-30	85.0 ~ 87.9
-28	68.5 ~ 70.7	-28	74.2 ~ 76.2	-28	85.3 ~ 88.2
-26	68.8 ~ 71.0	-26	74.4 ~ 76.4	-26	85.7 ~ 88.6
-24	69.4 ~ 71.3	-24	74.7 ~ 76.7	-24	88.0 ~ 88.9
-22	69.4 ~ 71.6	-22	74.9 ~ 76.9	-22	88.4 ~ 89.3
-20	69.7 ~ 71.9	-20	75.1 ~ 77.1	-20	88.7 ~ 89.5
-18	70.0 ~ 72.2	-18	75.3 ~ 77.3	-18	87.1 ~ 90.0
-16	70.2 ~ 72.4	-16	75.6 ~ 77.8	-16	87.4 ~ 90.3
-14	70.5 ~ 72.7	-14	75.8 ~ 77.8	-14	87.8 ~ 90.7
-12	70.8 ~ 73.0	-12	76.0 ~78.0	-12	88.1 ~ 91.0
-10	71.1 ~ 73.3	-10	76.2 ~ 78.2	-10	88.4 ~ 91.3
-8	71.4 ~ 73.6	-8	76.5 ~ 78.5	-8	88.8 ~ 91.7
-6	71.7 ~ 73.0	-6	76.7 ~ 78.7	-6	89.1 ~ 92.0
-4	72.0 ~ 74.2	-4	76.9 ~ 78.9	-4	89.5 ~ 92.4
-2	72.3 ~ 74.5	-2	77.1 ~ 79.1	-2	89.8 ~ 92.7
0	72.6 ~ 74.8	0	77.4 ~ 79.4	0	90.2 ~ 93.1
2	72.9 ~ 75.1	2	77.6 ~ 79.6	2	90.5 ~ 93.4
4	73.2 ~ 75.4	4	77.8 ~ 79.8	4	90.9 ~ 93.8
6	73.5 ~ 75.7	6	76.0 ~ 60.0	6	91.2 ~ 94.1
8	73.8 ~ 76.0	8	78.3 ~ 80.3	8	91.5 ~ 94.5
10	74.1 ~ 76.3	10	78.5 ~ 80.5	10	91.9 ~ 94.6
12	74.3 ~ 76.5	12	78.7 ~ 80.7	12	92.2 ~ 95.1
14	74.6 ~ 76.8	14	78.9 ~ 80.9	14	92.6 ~ 95.5
16	74.9 ~ 77.1	16	79.2 ~ 81.2	16	92.9 ~ 95.8
18	75.2 ~ 77.4	18	79.4 ~ 81.4	18	93.3 ~ 96.2
20	75.5 ~ 77.7	20	79.6 ~ 81.6	20	93.6 ~ 96.5
22	75.8 ~ 78.0	22	79.8 ~ 81.8	22	94.0 ~ 96.9
24	76.1 ~ 78.3	24	80.1 ~ 82.1	24	94.3 ~ 97.2
26	76.4 ~ 78.6	26	80.3 ~ 82.3	26	94.7 ~ 97.6
28	76.7 ~ 78.9	28	80.5 ~ 82.5	28	95.0 ~ 97.9
30	77.0 ~ 79.2	30	80.7 ~ 82.7	30	95.3 ~ 96.2
32	77.3 ~ 79.5	32	81.0 ~ 83.0	32	95.7 ~ 98.6
34	77.6 ~ 79.6	34	81.2 ~ 83.2	34	96.0 ~ 98.2
36	77.9 ~ 80.1	36	81.4 ~ 83.4	36	96.4 ~ 99.3
38	79.1 ~ 80.3	38	61.6 ~ 83.6	38	96.7 ~ 99.6
40	78.4 ~ 80.6	40	81.9 ~ 83.9	40	97.1 ~ 100.0
42	78.7 ~ 60.9	42	82.1 ~ 84.1	42	97.4 ~ 100.3
44	79.0 ~ 81.2	44	82.3 ~ 84.3	44	97.6 ~ 100.7
46	79.3 ~ 81.5	46	82.5 ~ 84.5	46	99.1 ~ 101.0
48	79.6 ~ 81.8	48	82.8 ~ 84.8	48	99.5 ~ 101.4
50	79.9 ~ 82.1	50	83.0 ~ 85.0	50	96.8 ~ 101.7

Figure 5-6. T53–L–763 Engine with Fuel Control P/N 1007700

TM 1-1520-236-MTF

By Order of the Secretary of the Army:

Official:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

JOEL B. HUDSON
Administrative Assistant to the
Secretary of the Army
0029902

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimenter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centrigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigrams = .035 grains
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 38.82 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

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