PFN NUMBER 011-9754
SEPTEMBER 2004

STUDENT GUIDE

FOR

UH-60 HEALTH INDICATOR TEST BASELINE

AND MAXIMUM POWER CHECK

THIS PACKAGE HAS BEEN DEVELOPED FOR USE BY:	**Black Hawk (UH-60)) Helicopter Maintenance Test Pilot Training Program**
PROPONENT FOR THIS TSP IS:	**U.S. Army Maintenance Test Pilot School AVIATION TRAINING BRIGADE ATTN: ATZQ-ATB-CA Ft. Rucker, Alabama 36362-5000**
FOREIGN DISCLOSURE RESTRICTIONS:	**Unclassified: This product/publication has been reviewed by the product developers in coordination with the USAALS foreign disclosure authority. This product is releasable to students from foreign countries on a case-by-case basis.**

SEPTEMBER 2004

HEALTH INDICATOR TEST BASELINE AND MAXIMUM POWER CHECK

TABLE OF CONTENTS

This TSP supersedes None, Dated NA.

SECTION I. - INTRODUCTION

TERMINAL LEARNING OBJECTIVE:

At the completion of this lesson you will:

ACTION: Perform a Maximum Power Check and computations, establish HIT Baseline and computations, and record all data on the applicable forms.

CONDITIONS: As an UH-60 Maintenance Test pilot.

STANDARD: In Accordance With (IAW) TM 1-2840-248-23

SAFETY REQUIREMENTS: Remove all watches, rings and other jewelry before operating, or maintaining electronic equipment.

RISK ASSESSMENT LEVEL: Low

ENVIRONMENTAL CONSIDERATIONS: There are no environmental concerns for this lesson.

EVALUATION: Evaluation will be accomplished with performance exam at the end of this module of instruction.

SECTION II. - PRESENTATION

A. ENABLING LEARNING OBJECTIVE No. 1

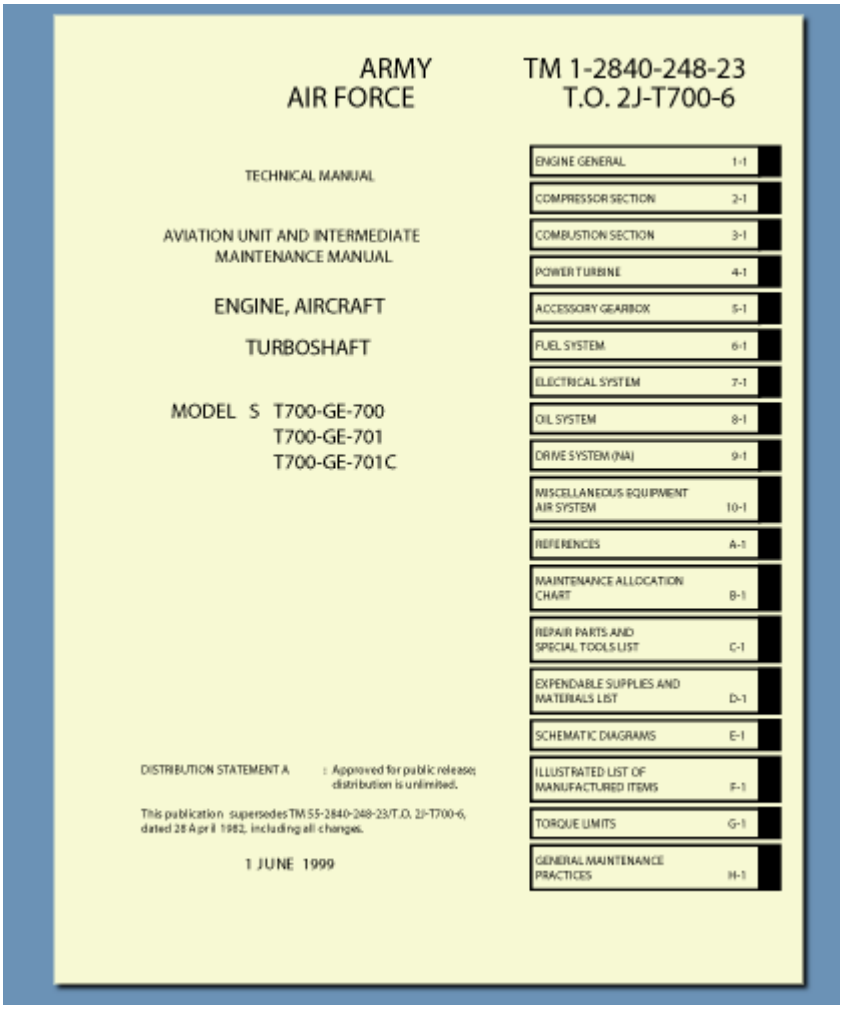
ACTION: Properly use TM 1-2840-248-23 for Health Indicator Test (HIT) Baseline, Maximum Power Check, and Troubleshooting.

CONDITIONS: Using TM 1-2840-248-23.

STANDARD: IAW TM 1-2840-248-23.

a. Engine Manual

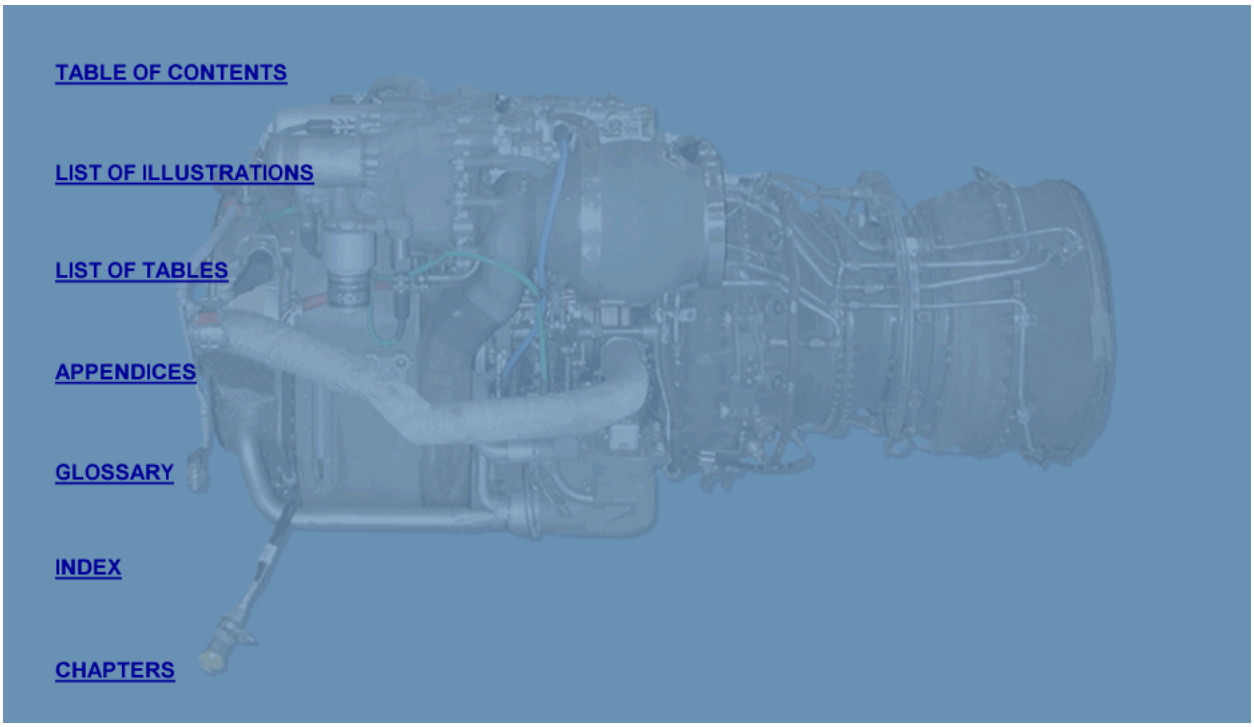
Frame #0025 (Engine Manual Front Cover)



(1) As a maintenance test pilot, you must become familiar with the engine manual (TM 1-2840-248-23).

(2) You must know how to locate and use the areas related to HIT, Max Power Check, and troubleshooting.

Frame #0030 (Engine Manual Menu)



(3) The information supplied in the engine manual can be broken down into seven major topics: the table of contents, figures, tables, appendices, glossary, index and chapters.

(4) Each topic addresses pertinent information related to the engine.

(a) Table of Contents

Frame #0035 (Table of Contents)

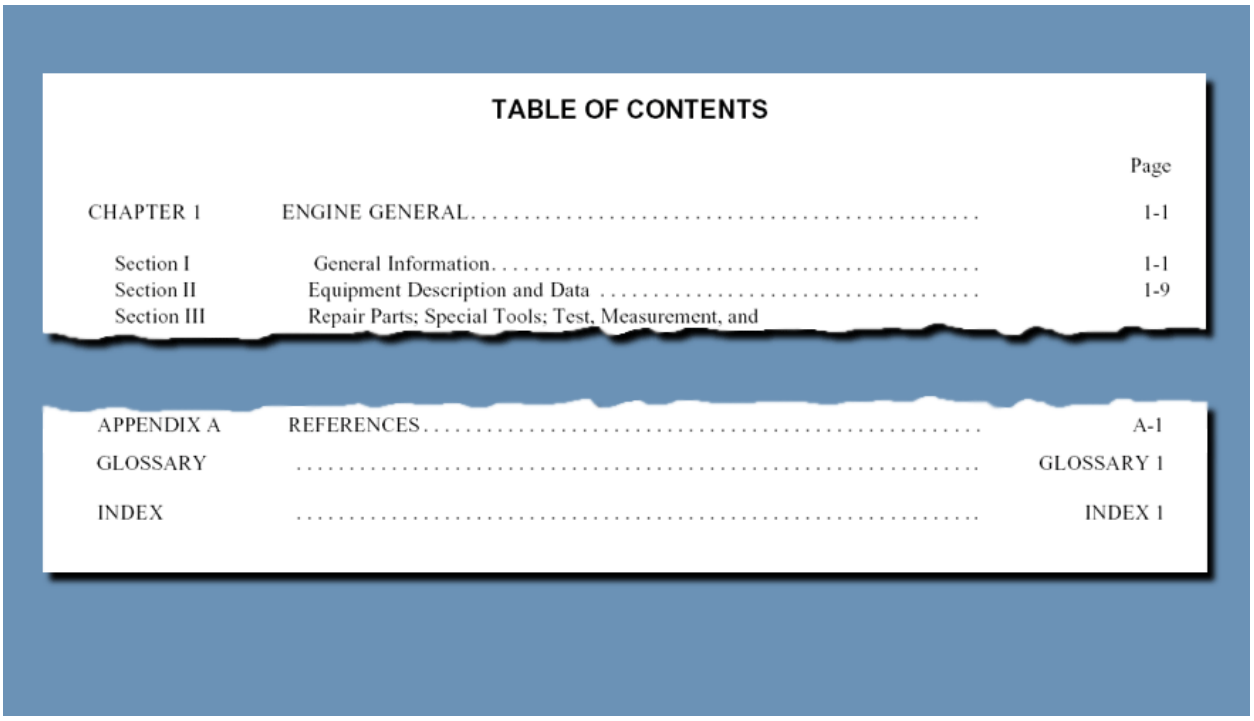


TABLE OF CONTENTS

1) The table of contents provides a list of subjects, items, and or topics contained in this manual.

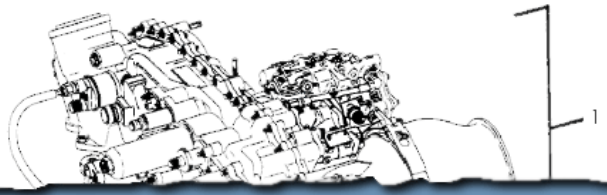
2) The listings include page references with the associated contents.

(b) Figures

Frame #0040 (Figures)

The T700-GE-700, T700-GE-701 and T700-GE-701C engines are front-driven, turboshaft engines, that have four modules. See figure 1-2 for **T700** and **T701C** modules and

frame (5). The rest of the inlet particle separator consists of a scroll case, an inlet duct, a particle separator blower, and an aircraft discharge duct. The inlet particle separator



1156831-00-A2A

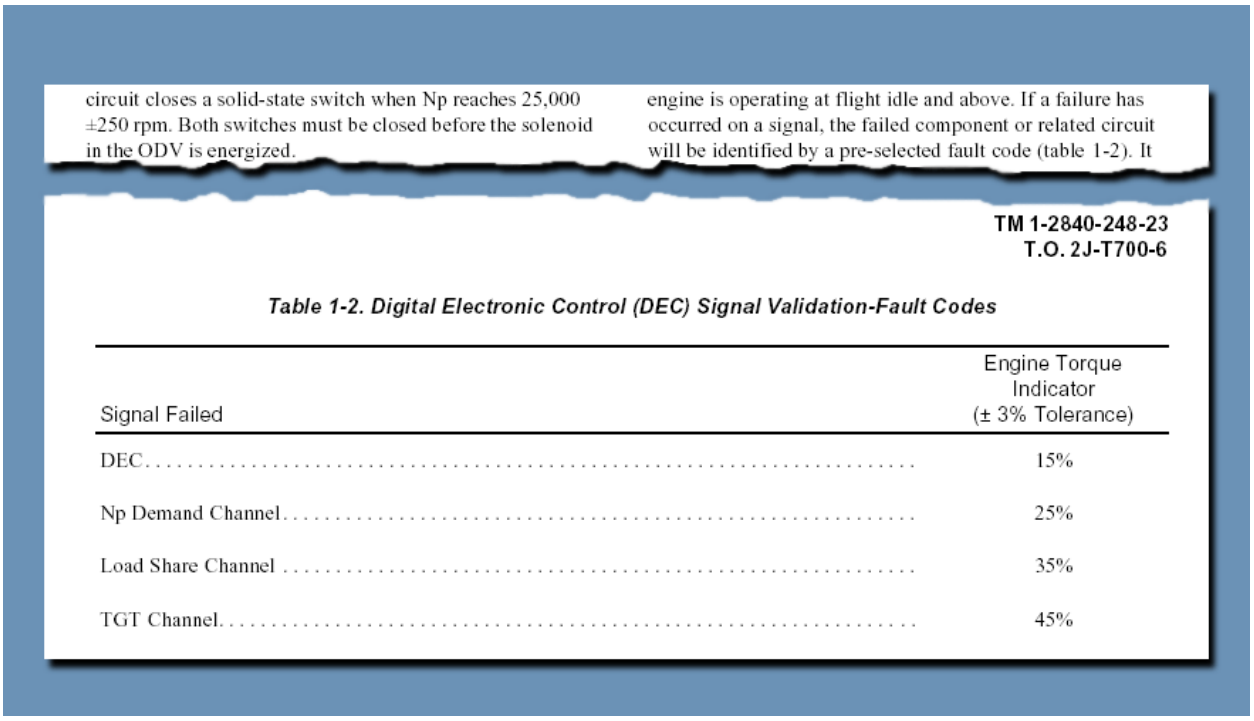
Figure 1-2. (T700, T701C) Engine Modules (Typical)

1-3

1) The figures are illustrations used to "visually" identify or further explain a subject or item found in the text.

(c) Tables

Frame #0045 (Tables)



circuit closes a solid-state switch when Np reaches 25,000 ±250 rpm. Both switches must be closed before the solenoid in the ODV is energized.

engine is operating at flight idle and above. If a failure has occurred on a signal, the failed component or related circuit will be identified by a pre-selected fault code (table 1-2). It

TM 1-2840-248-23
T.O. 2J-T700-6

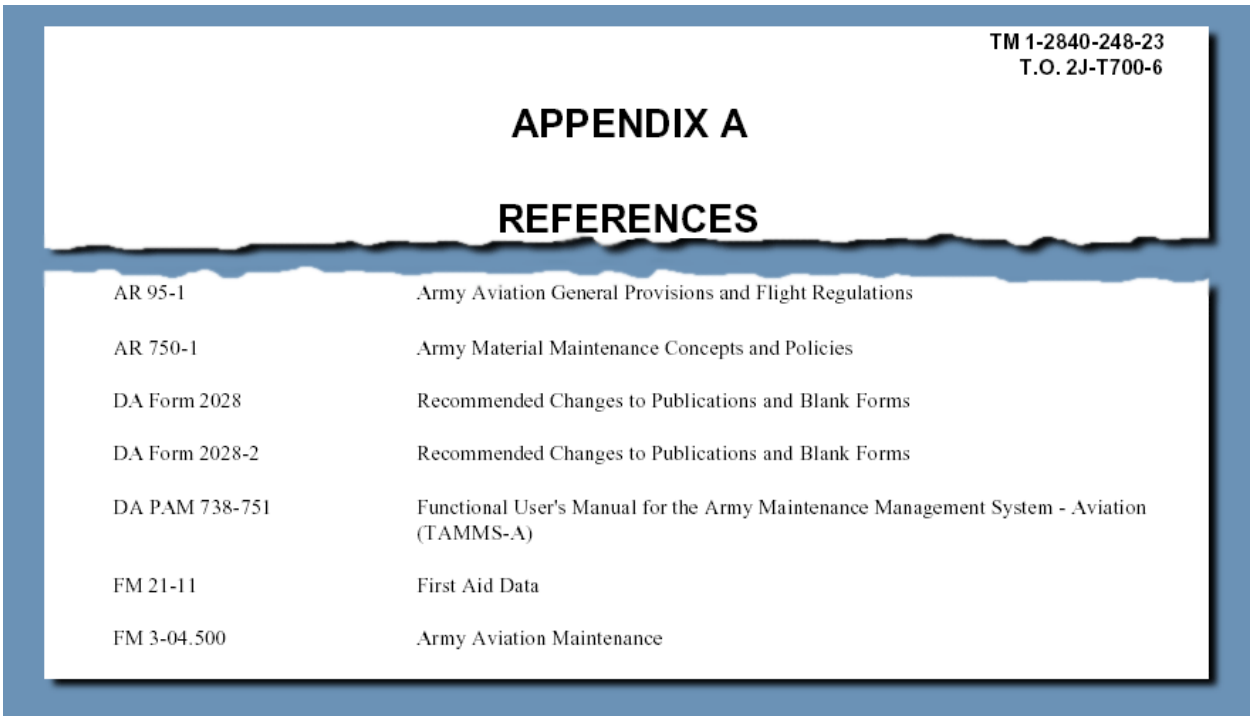
Table 1-2. Digital Electronic Control (DEC) Signal Validation-Fault Codes

Signal Failed	Engine Torque Indicator (± 3% Tolerance)
DEC	15%
Np Demand Channel	25%
Load Share Channel	35%
TGT Channel	45%

1) The tables are organized listings of data used throughout the manual to better identify or explain a subject or item found in the text.

(d) Appendices

Frame #0050 (Appendices)



TM 1-2840-248-23
T.O. 2J-T700-6

APPENDIX A

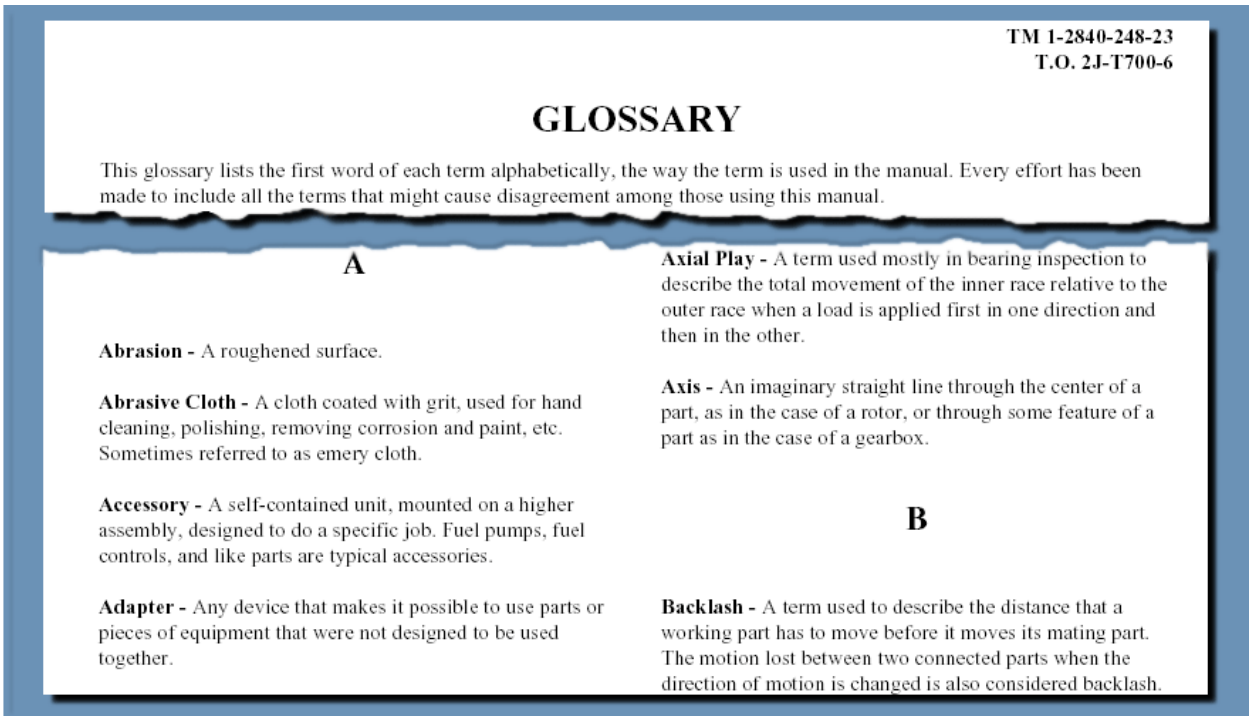
REFERENCES

AR 95-1	Army Aviation General Provisions and Flight Regulations
AR 750-1	Army Material Maintenance Concepts and Policies
DA Form 2028	Recommended Changes to Publications and Blank Forms
DA Form 2028-2	Recommended Changes to Publications and Blank Forms
DA PAM 738-751	Functional User's Manual for the Army Maintenance Management System - Aviation (TAMMS-A)
FM 21-11	First Aid Data
FM 3-04.500	Army Aviation Maintenance

1) Appendices are located near the back of the TM and provide a listing of References, Maintenance Allocation Charts, Expendable Supplies and Materials List, Schematic Diagrams, Illustrated List of Manufactured Items, Torque Limits, and General Maintenance Practices.

(e) Glossary

Frame #0055 (Glossary)



TM 1-2840-248-23
T.O. 2J-T700-6

GLOSSARY

This glossary lists the first word of each term alphabetically, the way the term is used in the manual. Every effort has been made to include all the terms that might cause disagreement among those using this manual.

A

Abrasion - A roughened surface.

Abrasive Cloth - A cloth coated with grit, used for hand cleaning, polishing, removing corrosion and paint, etc. Sometimes referred to as emery cloth.

Accessory - A self-contained unit, mounted on a higher assembly, designed to do a specific job. Fuel pumps, fuel controls, and like parts are typical accessories.

Adapter - Any device that makes it possible to use parts or pieces of equipment that were not designed to be used together.

Axial Play - A term used mostly in bearing inspection to describe the total movement of the inner race relative to the outer race when a load is applied first in one direction and then in the other.

Axis - An imaginary straight line through the center of a part, as in the case of a rotor, or through some feature of a part as in the case of a gearbox.

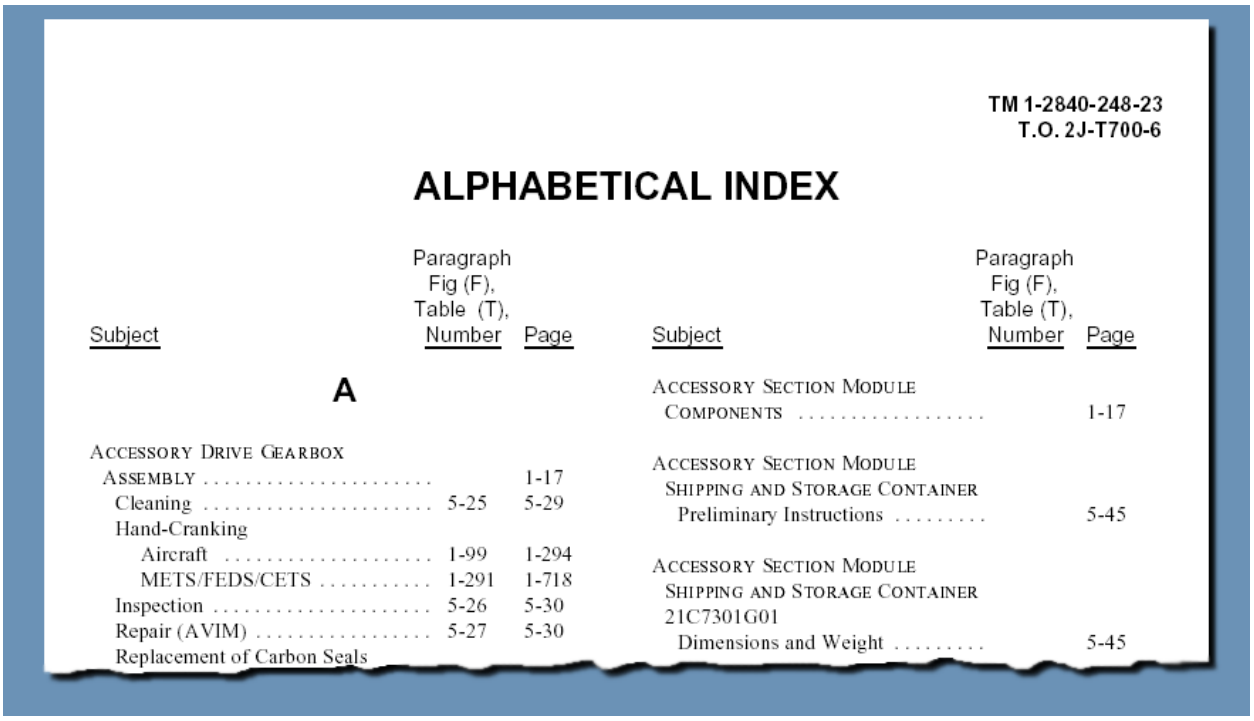
B

Backlash - A term used to describe the distance that a working part has to move before it moves its mating part. The motion lost between two connected parts when the direction of motion is changed is also considered backlash.

1) The glossary follows the appendices in the TM and contains definitions of words or terms used in this manual, listed in alphabetical order.

(f) Index

Frame #0060 (Index)



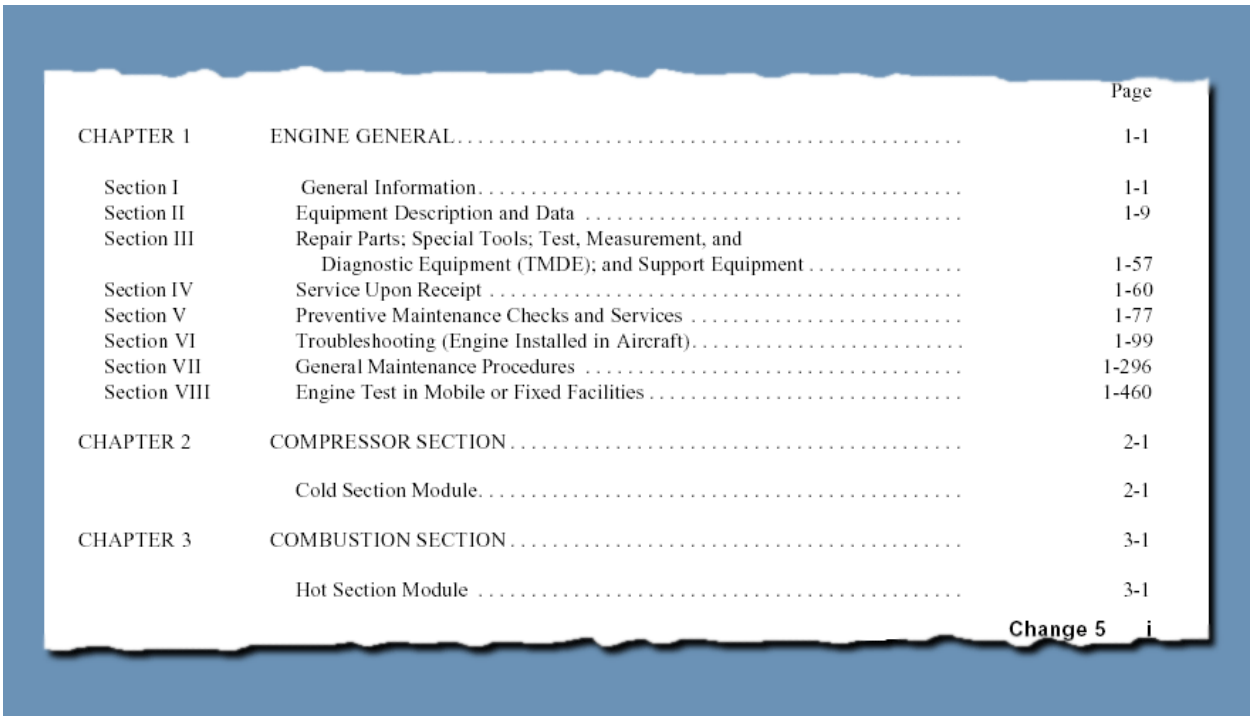
TM 1-2840-248-23
T.O. 2J-T700-6

ALPHABETICAL INDEX

1) Following the glossary, the index is a list of subjects, in alphabetical order, with the paragraph, figure, table, or page reference listed.

(g) Chapters

Frame #0065 (Chapters)



1) The chapters, located throughout the TM, cover the major topics discussed in the manual.

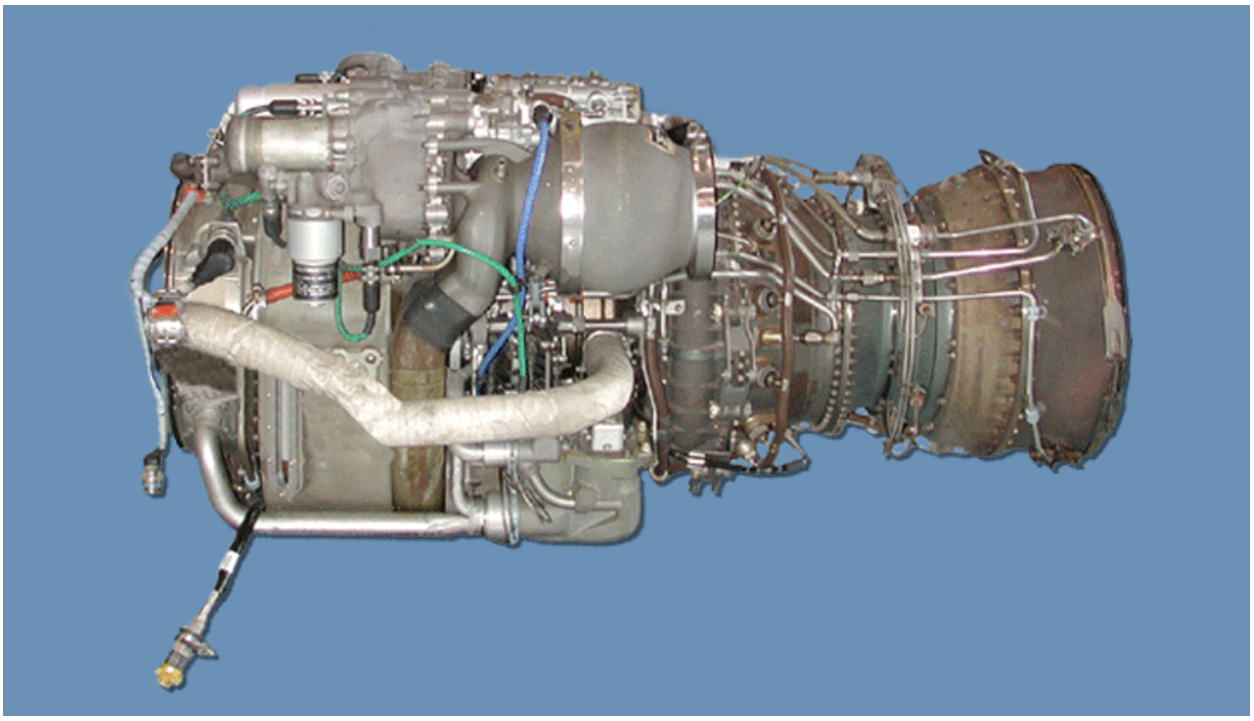
2) Some of the chapters are broken down further into sections.

Frame #0070 (Chapter 1 Sections Menu)

3) This chapter contains general information, equipment descriptions and instructions regarding support equipment, servicing of the engine upon receipt, preventive maintenance checks, troubleshooting, general maintenance, and engine testing.

a) Section I

Frame #0075 (Section I)

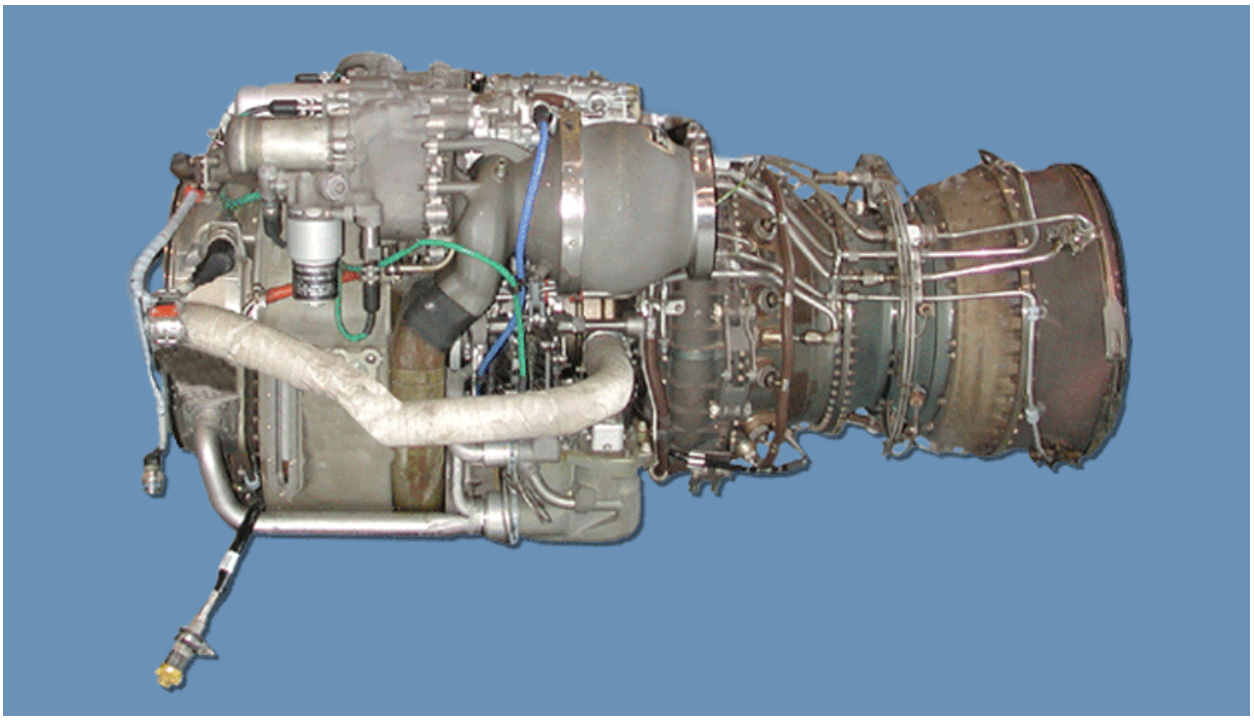


1 Section I provides general information concerning the engine, references for forms and records, maintenance concepts, Line Replaceable Units (LRU), asbestos warning, and a listing of Flight Safety Critical Aircraft Parts (FSCAP).

2 FSCAP is defined as any part, assembly, or installation whose failure, malfunction, or absence could cause an uncommanded engine shutdown, and or catastrophic engine failure resulting in loss or serious damage to the aircraft and or serious injury or death to the occupants.

b) Section II

Frame #0080 (Section II)



1 Section II provides information about the engine system operation.

2 Also included in this section are tables for the Digital Electronic Control (DEC) Codes, anti-icing bleed and start valves, and equipment data.

c) Section III

Frame #0085 (Section III)

1 Section III contains two tables.

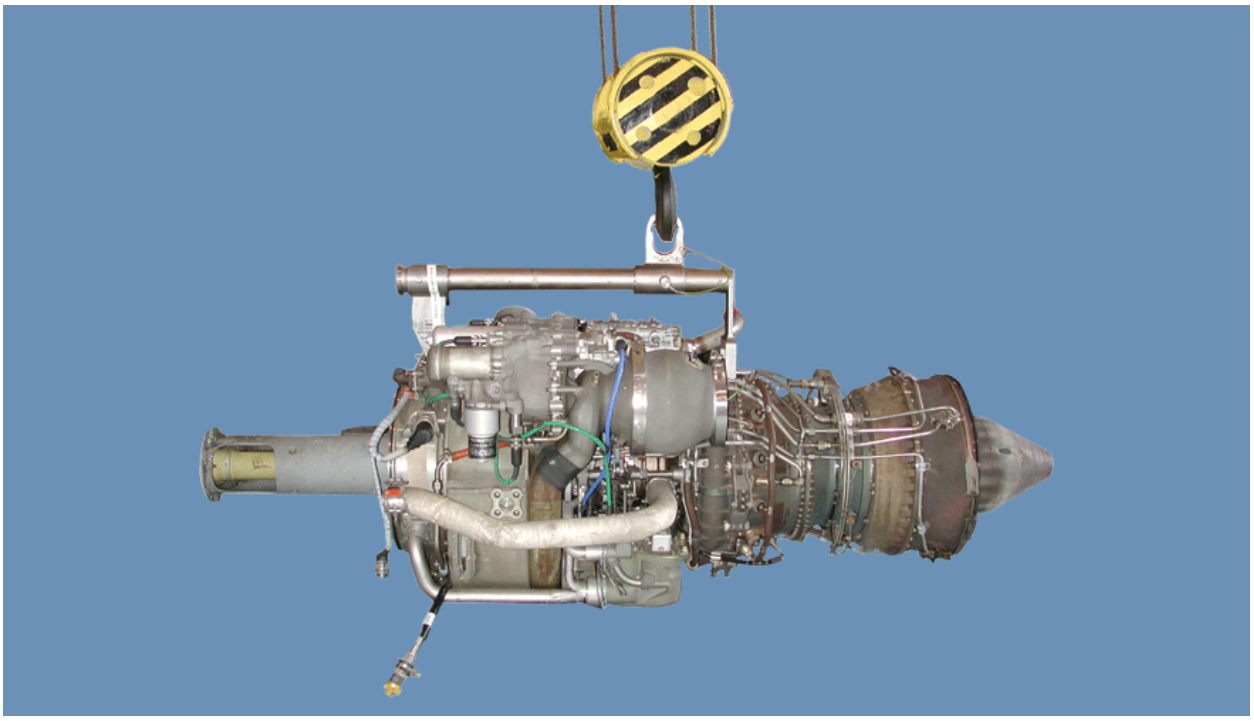
2 The first is a list of Special Tools and Support Equipment.

3 The second is a list of Test, Measurement, and Diagnostic Equipment (TMDE).

4 This section also contains a paragraph listing the appropriate Repair Parts and Special tools List (RPSTL) i.e. the Parts manuals.

d) Section IV

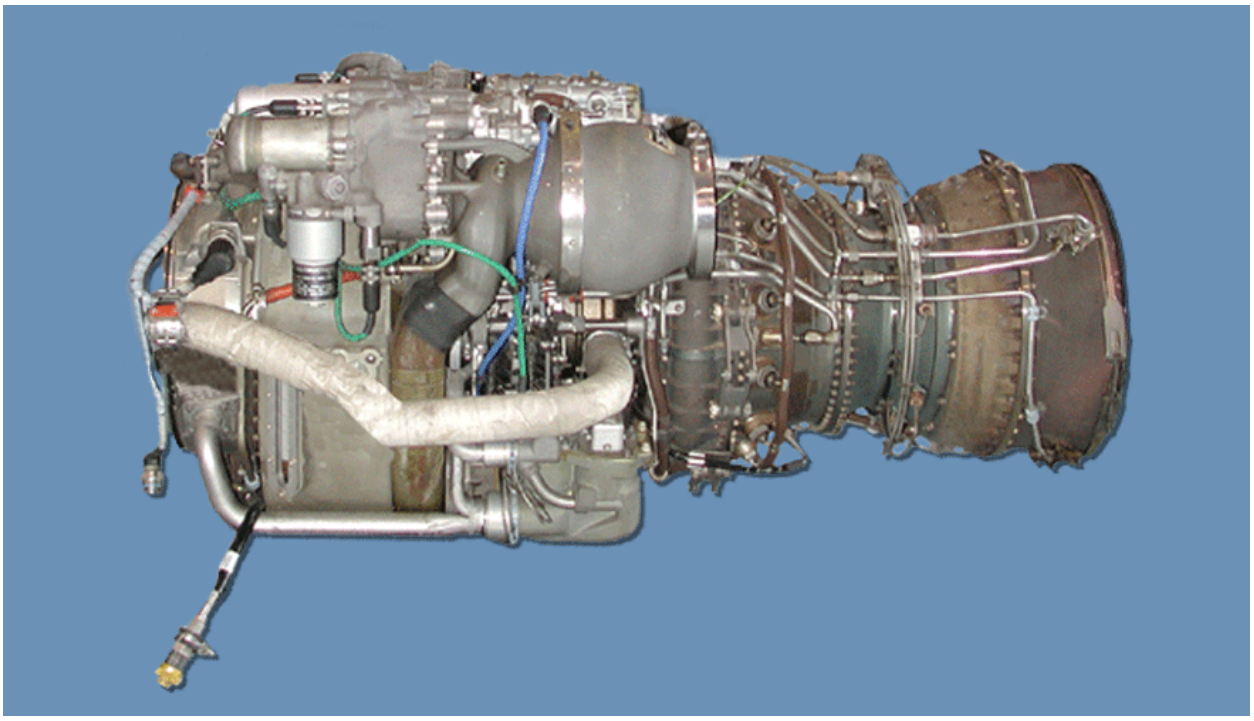
Frame #0090 (Section IV)



1 Section IV provides instruction to properly remove an engine from the shipping container or maintenance stand, and how to install an engine in a shipping container or on a maintenance stand using the engine sling.

e) Section V

Frame #0092 (Section V)



1 Section V discusses preventive maintenance checks and services for the engine.

2 Specific areas addressed are 10 hour/14 day, 250 and 500 hourly inspections, retirement intervals for life-limited parts, and corrections of the history recorder.

f) Section VI

Frame #0095 (Section VI)

NOTE: Two basic things have been assumed in these procedures:

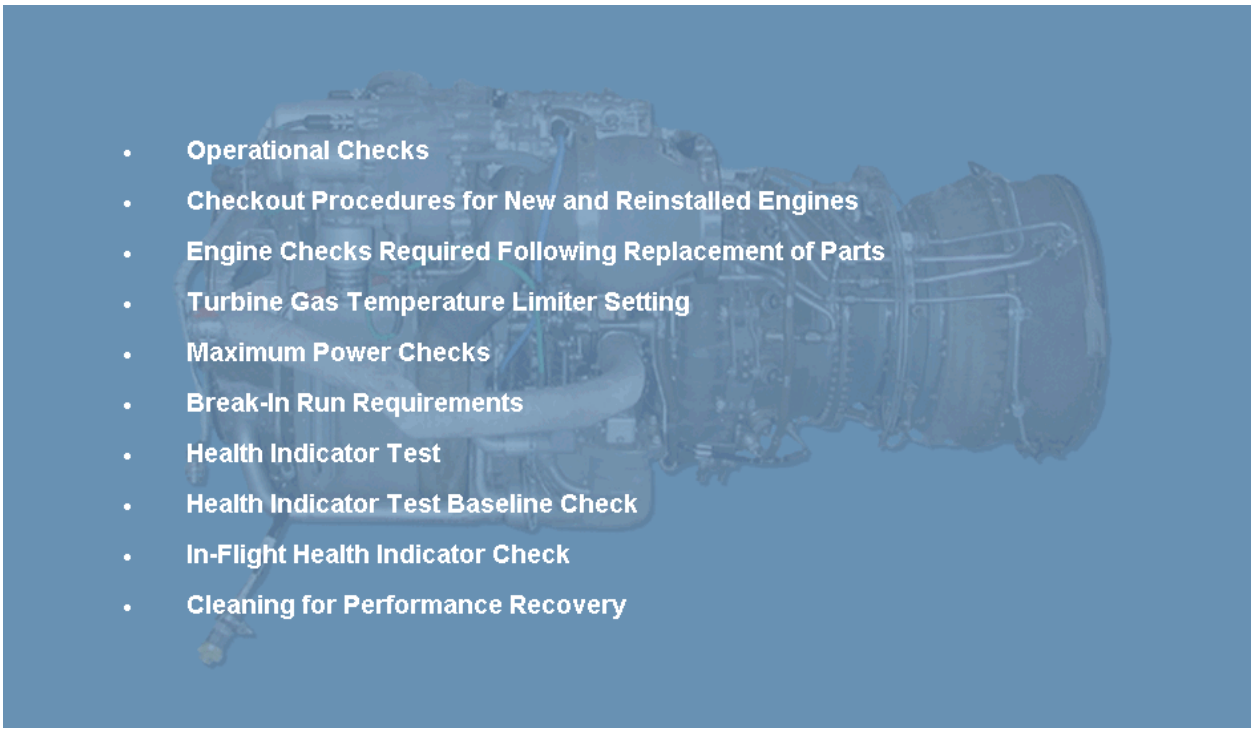
- The correct operating procedures have been followed.
- The fault is caused by a single failure.

1 Section VI provides an outline of procedures to follow when troubleshooting and a Symptoms Index with a list of troubleshooting symptoms and applicable troubleshooting procedures.

2 Two examples would be Low Engine Performance and TGT Margin Out-of-Limits.

g) Section VII

Frame #0105 (Section VII)



1 In Section VII, general maintenance procedures for the engine are addressed.

a Operational Checks

b Checkout Procedures for New and Reinstalled Engines

c Engine Checks Required Following Replacement of Parts

d Turbine Gas Temperature Limiter Setting

e Maximum Power Checks

f Break-In Run Requirements

g Health Indicator Test

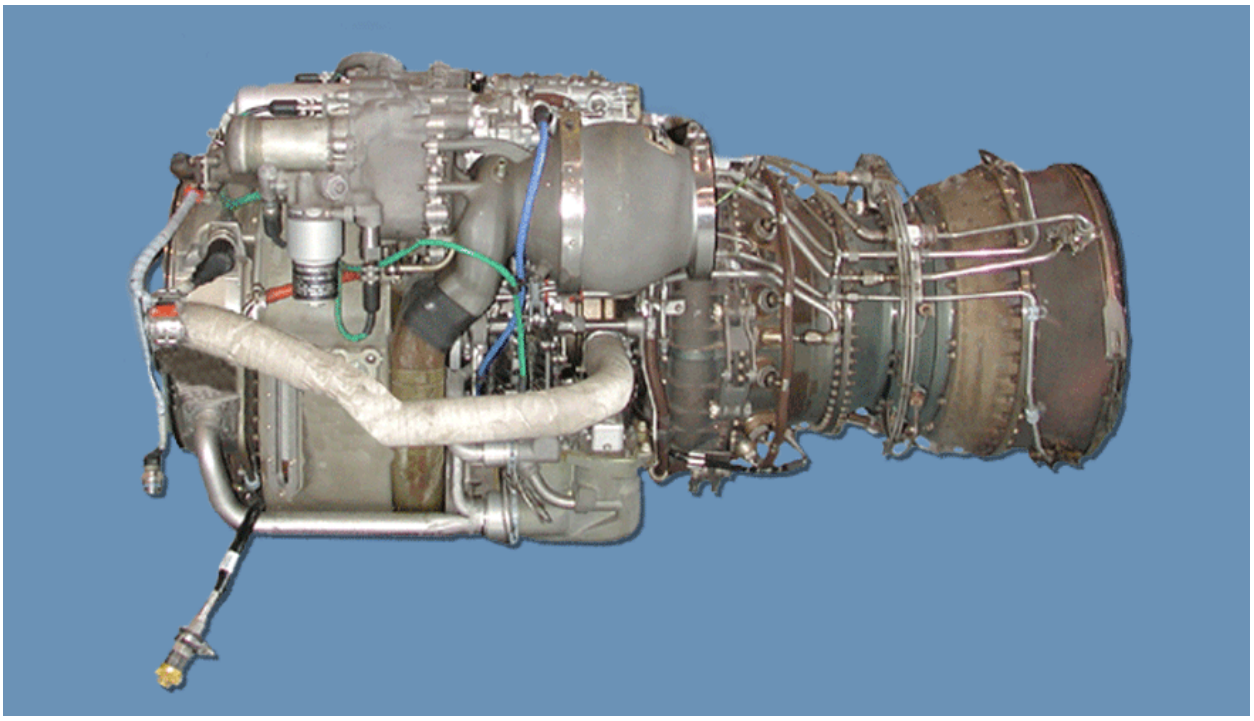
h Health Indicator Test Baseline Check

i In-Flight Health Indicator Check

j Cleaning for Performance Recovery

h) Section VIII

Frame #0115 (Section VIII)



1 Section VIII covers testing of the engine in a mobile or fixed facility.

2 The testing of an engine in these facilities is the preferred method, although the testing of an engine in the aircraft is an authorized alternate method.

CHECK ON LEARNING

1. Where would you find the General Maintenance Practices and Schematic Diagrams in this TM?

2. Which section in Chapter 1 provides HIT Check, HIT Baseline, and the Maximum Power Check procedures?

3. In which section of Chapter 1 are the Troubleshooting Procedures located?

SECTION III. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Engine Manual Overview of the HIT Baseline and Maximum Power Check topic.
The key points to remember are:

- The TM 1-2840-248-23 is separated into seven major areas: Table of Contents, Figures, Tables, Appendices, Glossary, Index, and Chapters.
- The table of contents provides a list of subjects, items, and or topics contained in the manual.
- Figures are illustrations used to visually identify or further explain a subject or item found in the text.
- Tables provide listed information to better identify or explain a subject or item.
- References, maintenance allocation charts, schematics, and an illustrated list of manufactured items are listed in the appendices.
- The Glossary provides definitions of words and terms, listed in alphabetical order, used throughout the TM.
- A list of all subjects covered in this TM, in alphabetical order, is found in the Index. Provided with the subjects are the paragraph, figure, table, or page number.
- The Chapters cover all of the major topics.
- Listed under some Chapters are Sections. Sections provide an additional subtopic breakdown found in the Chapter.
- General information concerning the engine is found in Section I.
- In Section II, an equipment description and data about the engine are found.
- The Repair Parts; Special Tools Listing, RPSTL, is listed in Section III.
- Section IV addresses the process required for accepting an engine, Service Upon Receipt.
- Scheduled inspections, 10 hour/14 day, 250 hour, and 500 hour, are addressed in Section V.
- A Symptom Index, Low Engine Performance, and TGT Limits are covered in Section VI, Troubleshooting.
- Section VII, General Maintenance, provides information and procedures that include HIT Check, HIT Baseline, and Maximum Power Check.

B. ENABLING LEARNING OBJECTIVE No. 2

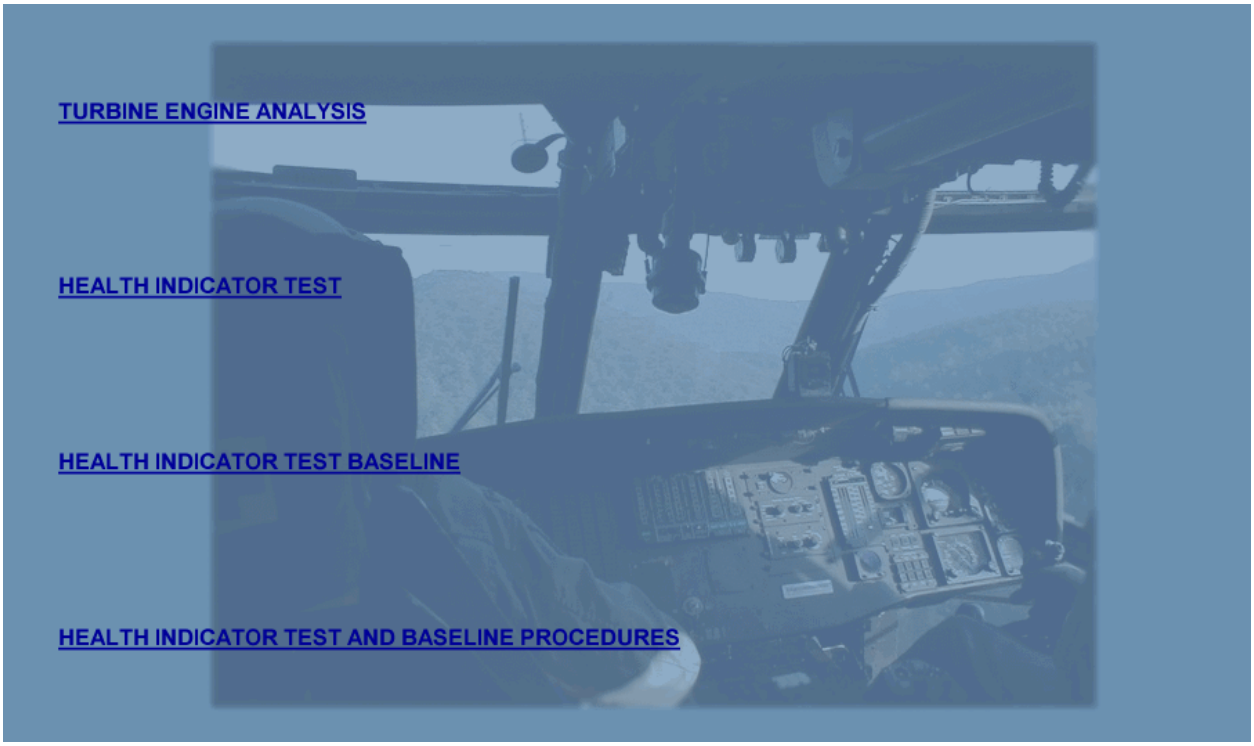
ACTION: Perform and compute Health Indicator Test (HIT) Baseline.

CONDITION: Using TM 1-2840-248-23

STANDARD: IAW TM 1-2840-248-23.

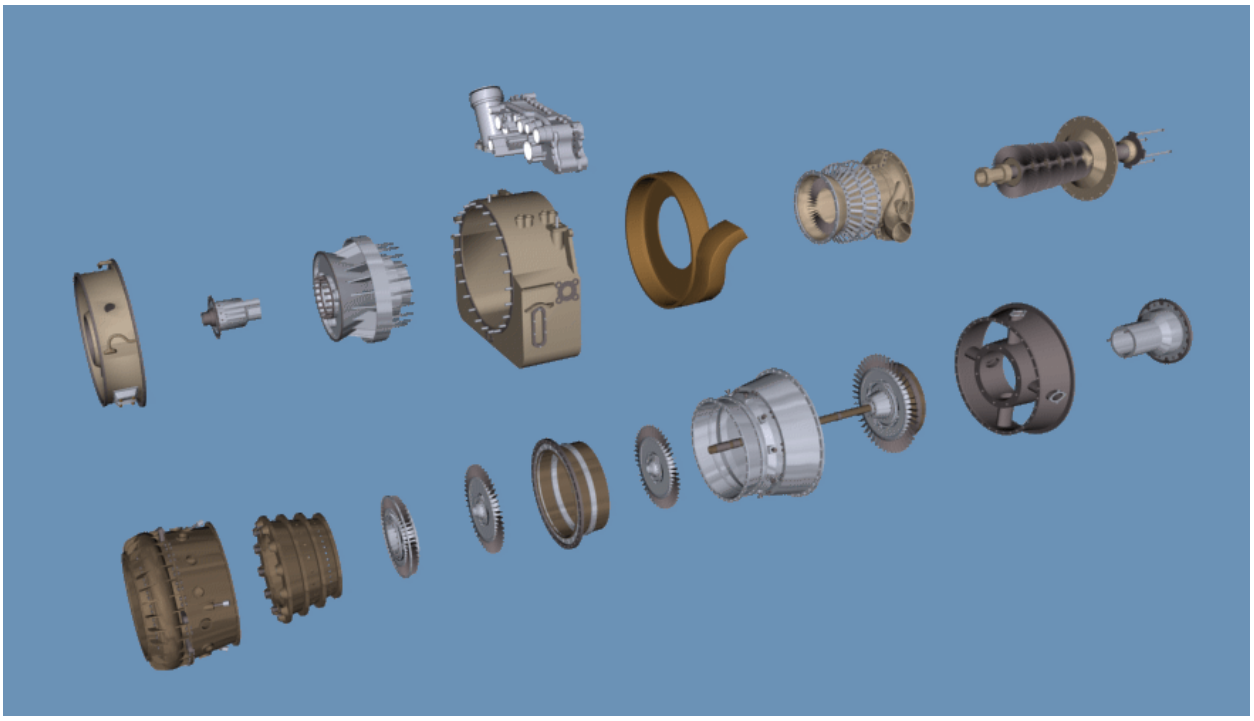
a. HIT Baseline Menu

Frame #1005 (HIT Baseline Menu)



b. Turbine Engine Analysis

Frame #1010 (Turbine Engine)



(1) Each turbine engine's ability to produce design stand horsepower output, 1622 Shaft Horse Power (SHP), will be dependent on and vary with the design and condition of dynamic and non-dynamic components as well as changes in ambient temperatures and pressure.

Frame #1015 (Maintenance Test Pilot)

(2) The maintenance test pilot will periodically test and evaluate each engine's performance and operation, monitoring for any deterioration in engine performance.

(3) The procedures used to monitor engine performance are the operational HIT and Max Power Check.

c. Health Indicator Test

Frame #1020 (Health Indicator Test)

WARNING: Anti-Ice Bleed and Start Valve

Do not cycle anti-ice bleed and start valve more than once to determine proper operation. Valve malfunction can cause engine flameout at low power settings or during rapid collective movements. Do not fly the aircraft if TGT rise is less than 30 ºC (54 ºF), or switch cycling is required.

CAUTION: If any part of engine anti-ice check fails, do not fly helicopter.

(1) The Health Indicator Test (HIT) check is done by the operational pilot before the first flight of the day.

(2) The HIT check provides valuable information for the operational pilot, maintainer, and the maintenance test pilot.

(3) The HIT check assists in identifying significant performance shifts, engine performance trends, verifies proper operation of the engine anti-ice bleed and start valve, and inlet anti-ice valve.

(4) The HIT check also alerts the maintenance test pilot that a maximum power check may be needed to confirm the engine meets torque factor requirements.

d. Health Indicator Test Baseline

Frame #1025 (Health Indicator Test Baseline)

WARNING: Anti-Ice Bleed and Start Valve

Do not cycle anti-ice bleed and start valve more than once to determine proper operation. Valve malfunction can cause engine flameout at low power settings or during rapid collective movements. Do not fly the aircraft if TGT rise is less than 30 ºC (54 ºF), or switch cycling is required.

CAUTION: • If icing conditions exist, do not keep anti-icing off for longer than is necessary to do HIT check.

• If any part of engine anti-ice check fails, do not fly helicopter.

NOTE: The HIT baseline must be established prior to maximum power check, prior to first takeoff, to replicate daily HIT check procedures.

If helicopter is equipped with two FAT gages, and the readings are different, the higher reading must be used. (UH-60A, UH-60L) ENG INLET ANTI-ICE advisory light may or may not come on between 4 ºC (39 ºF) and 13 ºC (55 ºF).

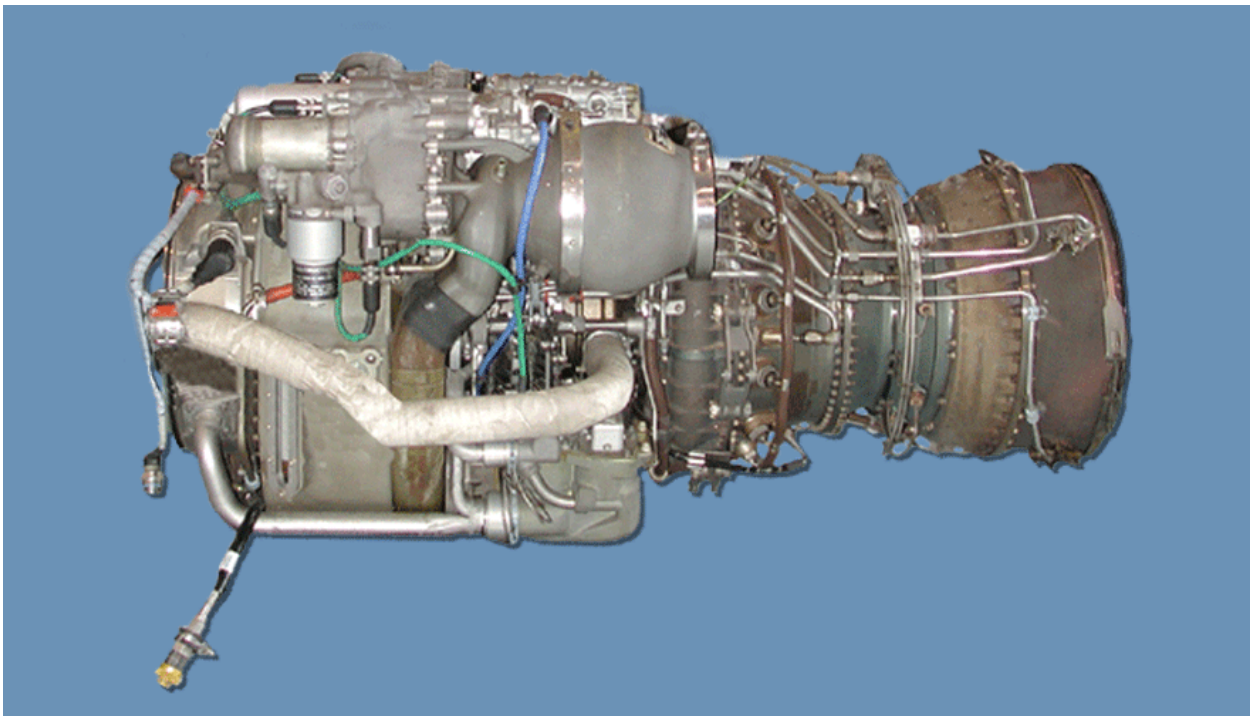
When using TGT reference table, FAT must be rounded up, and pressure altitude must be rounded off to the nearest value, if applicable.

(1) For the HIT to be useful, and accurate, a new baseline has to be established by the maintenance test pilot.

(2) The HIT baseline must be established on a newly installed or reinstalled engine, completed prior to doing a maximum power check, and after certain maintenance checks.

(3) The HIT baseline must be completed prior to doing a Max Power check.

Frame #1032 (Health Indicator Test Baseline)



(4) Occasionally, an engine will fail a HIT check as a result of a faulty anti-icing bleed and start valve or a dirty compressor.

(5) If this is the case; replace the anti-icing bleed and start valve, or clean the engine for performance recovery and repeat the HIT check.

(6) If the engine returns to the previously established baseline, a new HIT baseline and in-flight maximum power check are not required.

(7) Any other time an engine fails a HIT check, troubleshooting procedure number 65 (TGT Margin Out-of-Limits) must be performed.

Frame #1033 (Operational HIT Check)

(8) When an operational HIT check TGT margin is equal to or less than 5 ℃ from limits established during the baseline, an entry will be made on DA Form 2408-13 to notify the Maintenance Officer.

(9) The Maintenance Officer will then decide if troubleshooting or preventative maintenance procedures, such as compressor cleaning for performance recovery should be accomplished.

(10) Factors which may influence the decision are:

(a) Has a trend been established?

(b) Has the operational environment changed?

(c) How much time has elapsed since last compressor cleaning?

(d) Has there been a change in Maximum Power Check?

(e) Has the engine had recent maintenance which might influence its performance?

(f) Has the engine had recent maintenance which might influence its performance?

e. Health Indicator Test and Baseline Procedures

Frame #1026 (Health Indicator Test and Baseline Procedures)

STEP	PROCEDURE
1.	Position helicopter into prevailing wind.
2.	Set ENG ANTI-ICE, HEATER, and AIR SOURCE HEAT/START switches to OFF.
3.	Set both engine % RPM and RPM R to 100%.
4.	Retard ENG POWER CONT lever on engine not being checked to 0%-5% TRQ at 92%-98% RPM (Np).
5.	Increase collective pitch to 60% TRQ and hold for at least 30 seconds.
	NOTE If helicopter is equipped with two FAT gages and the readings are different, the higher reading must be used.
6.	Deleted.
7.	Record date, A/C hours, FAT, pressure altitude, and TGT on figure 1-65.
8.	If the ENG ANTI-ICE advisory light remains on at 60% TRQ, increase collective to a minimum of 90% Ng, or until the advisory light is off.
	WARNING Do not cycle anti-ice bleed and start valve more than once. Valve malfunction can cause engine flameout at low-power settings or during rapid collective movements. Do not fly the aircraft if the ENG ANTI-ICE light will NOT go off.
9.	Set AIR SOURCE HEAT/START switch to ENG. If TGT rises more than 5 degrees, troubleshoot bleed air system for leaks.
10.	Set AIR SOURCE HEAT/START switch OFF.
	NOTE Steps 11 and 12 contain instructions for performing the Anti-Ice System Check.
11.	For engine being checked, set ENG ANTI-ICE switch to ON and note the following: a. Increase in TGT of at least 30°C but less than 110°C. If TGT rise is not within these limits the engine or airframe inlet valve may be faulty. b. ENG ANTI-ICE advisory light comes ON. c. ENG INLET ANTI-ICE advisory light comes on after inlet fairing temperature reaches 93°C (200°F) and if OAT is less than 4°C (39°F).

STEP	PROCEDURE
12.	**NOTE** A malfunctioning engine anti-ice and engine inlet anti-ice system may result in power losses as much as 40% maximum torque available at 30-minute TGT demands. If any part of the engine inlet anti-ice check fails, do not fly the helicopter.
13. 14.	Set ENG ANTI-ICE switch to OFF and note the following:
15.	a. Decrease in TGT to approximate value in step 7. b. ENG ANTI-ICE advisory light goes OFF. c. ENG INLET ANTI-ICE advisory light goes OFF after inlet fairing temperature goes below 93°C (200°F).
16.	Readjust collective to 60% TRQ if necessary.
17.	Set ENG POWER CONT lever of engine not being checked to FLY.
18.	Set ENG POWER CONT lever on opposite engine to 0% -5% TRQ at about 92% to 98% RPM (Np). (TRQ on the other engine should be 60% ±5%.)
19.	Readjust collective pitch to 60% TRQ if necessary, and hold for at least 30 seconds.
20.	Repeat steps 7, 8, 11, and 12 for other engine. Set collective pitch to full down. Set ENG POWER CONT lever of engine not being checked to FLY. Check TGT reference table, **(T700)** (table 1-22) or **(T701C)** (table 1-23). Section V, for TGT corresponding to recorded FAT and pressure altitude, record on HIT LOG 2. Compare table TGT 2 with indicated TGT 1 and record TGT margin on HIT LOG. TGT margin is indicated TGT 1, minus table TGT 2.
21.	**NOTE** When using HIT table, round FAT up, and pressure altitude to nearest value.
22.	If TGT margin is 5°C or less from the limit, make appropriate entry on DA Form 2408-13-1. If TGT margin is outside acceptance limits, repeat check. Make sure all procedures are followed. If TGT margin is still outside acceptance limits, do not fly the helicopter. Make appropriate entry on DA Form 2408-13-1. If any part of the engine anti-ice valve check fails, do not fly the helicopter.
23.	
24.	

(1) The aircraft HIT procedure can be found in the TM 1-2840-248-23 and TM 1-1520-237-MTF.

(2) During the HIT procedure, there are several areas that should be addressed.

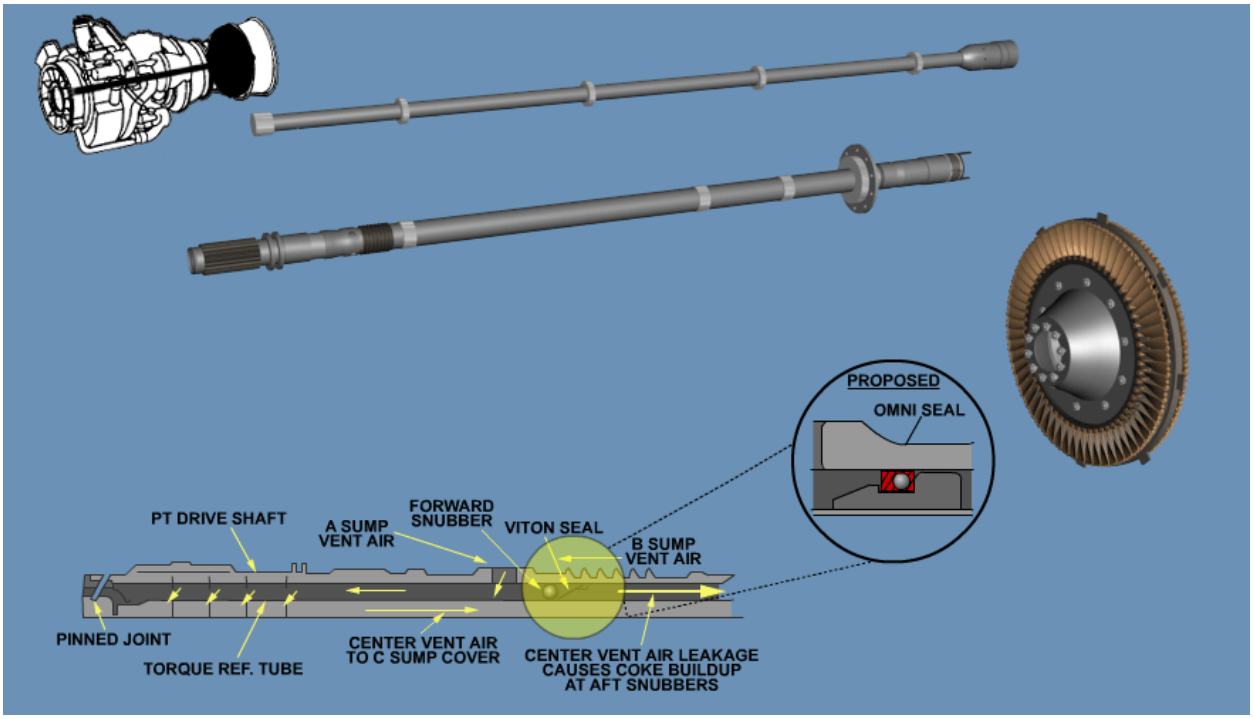
(3) Why 0 - 5% torque?

(4) Why the Warning about cycling the anti-ice bleed and start valve more than once?

(5) Why 5 degrees with the AIR SOURCE HEAT/START switch to ENG?

(6) Why 30º to 110º with the ENG ANTI-ICE switch?

Frame #1027 (TRQ Indications)



(7) If the TRQ indications in the cockpit are greater than 5% during the HIT check when the PCL is retarded to 92 - 98% Np, the torque reference shaft may have coking of oil inside the power turbine shaft.

(8) This is known as toque stiction, and typically occurs when the power turbine module has more than 1000 hours.

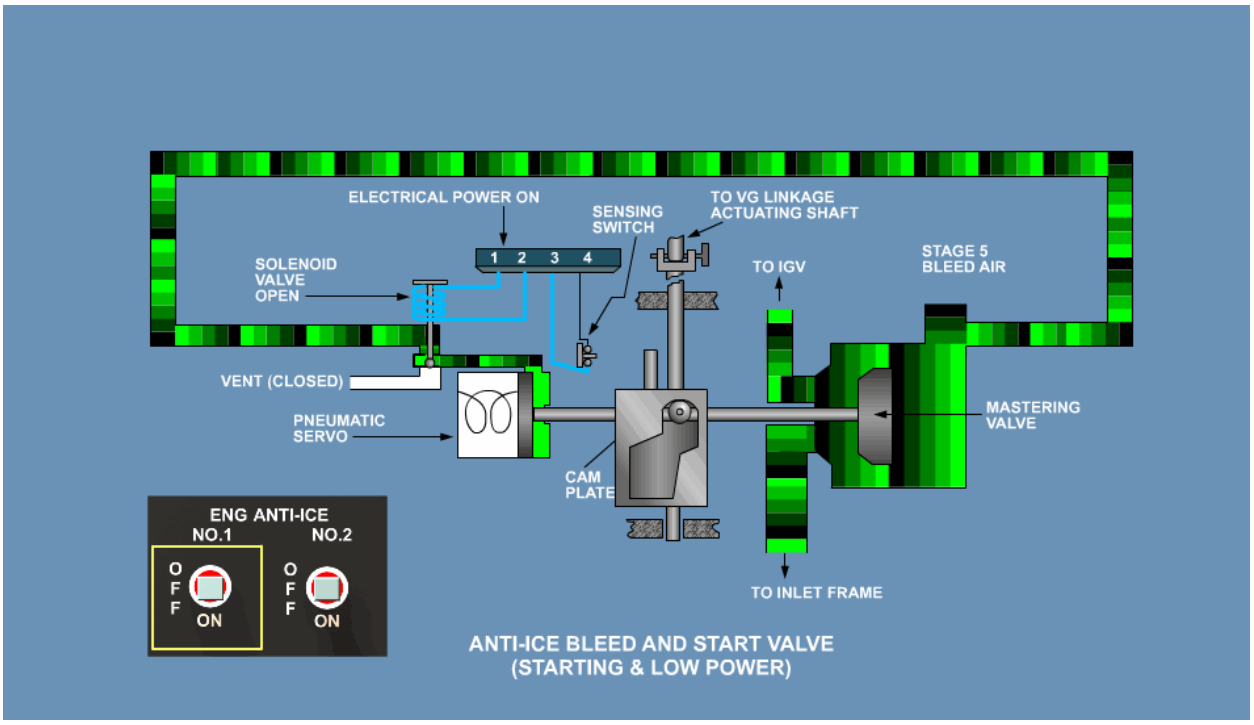
(9) Initially, the procedure required 0 - 3% TRQ indications.

(10) Due to the frequency torque stiction was occurring, it was necessary to revise the limit to the current 5%.

(11) The Army is introducing a power turbine shaft with torque stiction improvements by changing the Viton Seal with an Omni Seal.

f. Health Indicator Test and Baseline Procedures

Frame #1028 (Health Indicator Test and Baseline Procedures Flash)



(1) The anti-icing system prevents ice from forming in the flow path of the engine inlet.

(2) The valve also bleeds air from the compressor during engine starting.

(3) This reduces back pressure on the axial compressor at lower speeds and prevents compressor stalls.

(4) Its fail-safe is in the open position.

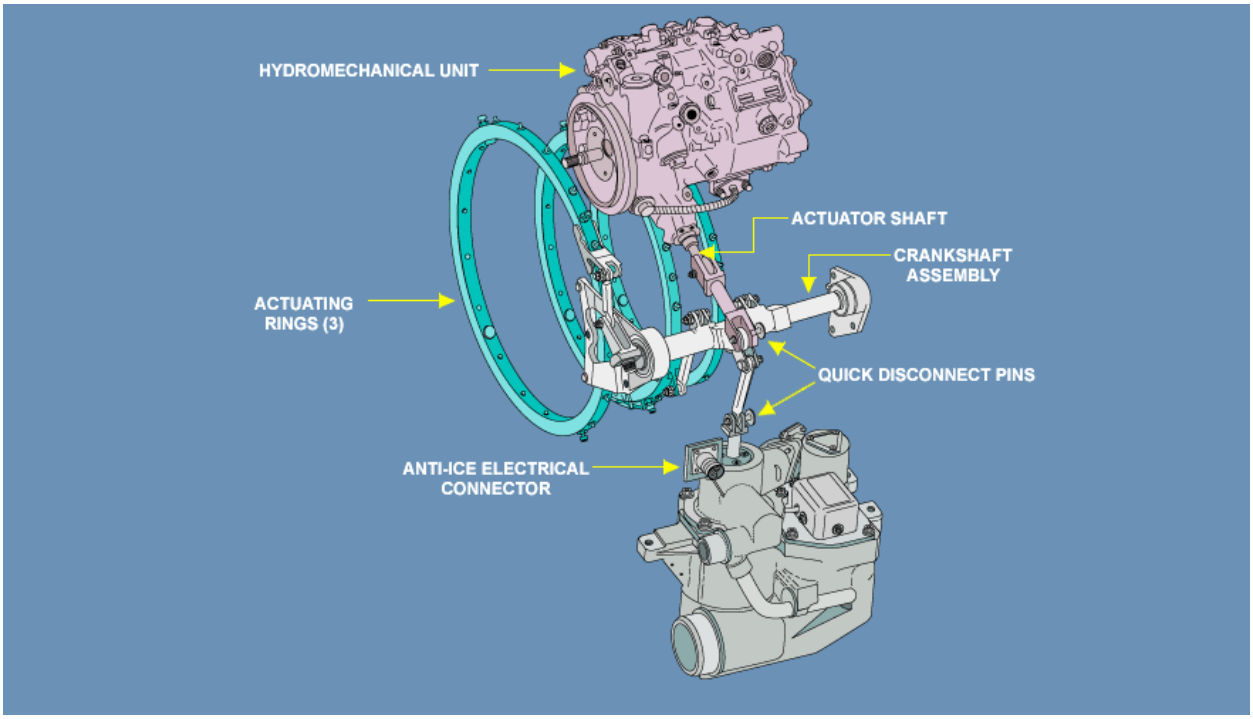
(5) Aircraft power is removed when the switch is placed in the ON position, allowing anti-icing to take place.

(6) During engine start and low power settings, bleed air from the compressor is controlled by a cam plate in the valve.

(7) The actuating shaft is controlled by the HMU, positions the cam plate in the down position, holding the metering valve open.

(8) This will close as engine power is increased, provided the switch is OFF.

Frame #1029 (Hydromechanical Unit)



(9) The reason that it is important that the anti-ice start and bleed valve has proper operation is twofold.

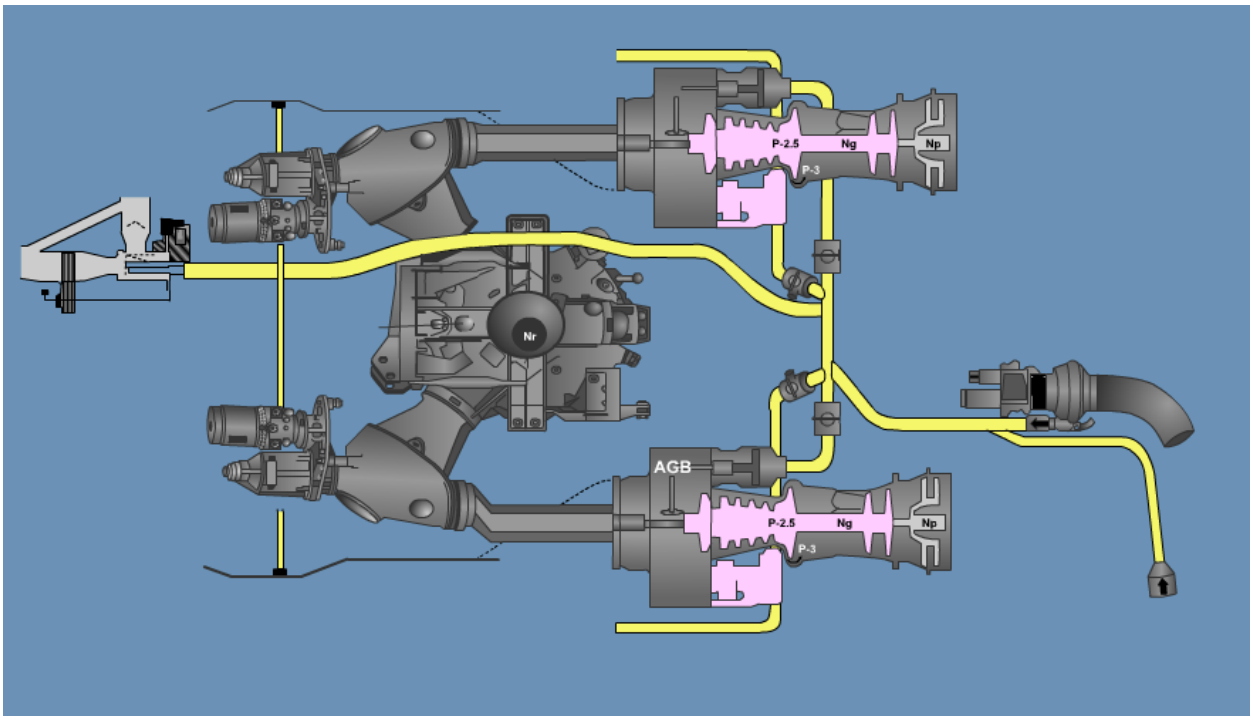
a. The first, which is not as important, is the increased hot air being induced into the inlet and robbing the P3 bleed air from the engine, which raises the operating temperature.

b. The second is the potential of flameout due to the wrong air/fuel mixture being incorrect because the actuator linkage may stick in the wrong position.

(10) The HMU actuator is connected to the Inlet Guide Vanes (IGV) and Anti-Ice Start Bleed Valve (AISBV) via the actuator shaft.

(11) If the AISBV is stuck, not allowing the HMU to schedule the proper air/fuel mixture and adjust the IGV accordingly, the fire in the hot section of the engine can be snuffed out due to too much or not enough air or fuel.

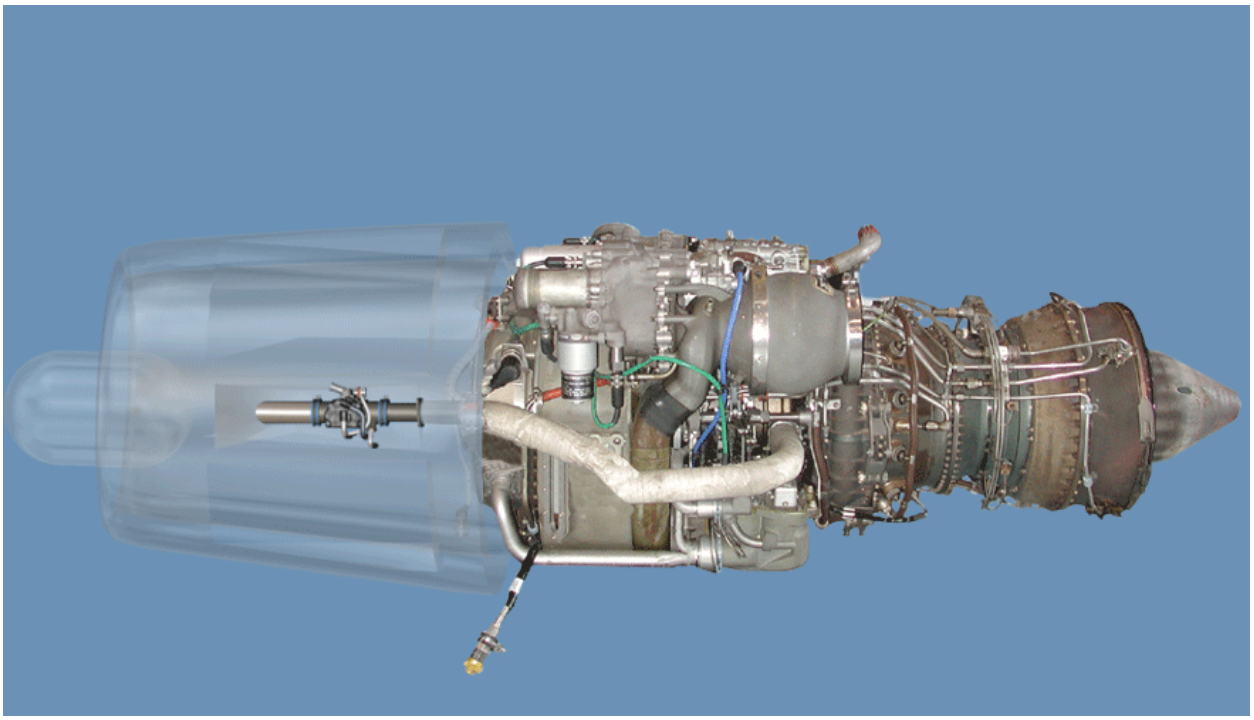
Frame #1030 (Air Source Heat/Start)



(12) When the AIR SOURCE HEAT/START switch is placed to ENG, if the engine TGT rises more than 5 ºC, troubleshoot the bleed air system for leaks.

(13) Common sources of pneumatic leaks are cracks in the pneumatic tubing, check valve on the APU, heater, ESSS tubing, and the crossbleed valves.

Frame #1031 (Engine Inlet Anti-Ice Valve)



(14) A TGT rise greater than 110 ºC normally indicates a failure in the engine inlet anti-ice system.

(15) A malfunctioning engine inlet anti-ice system may result in power losses as much as 40%.

(16) If any part of the engine inlet Anti-Ice check fail, do not fly the helicopter.

Frame #1034 (Establish HIT Baseline)

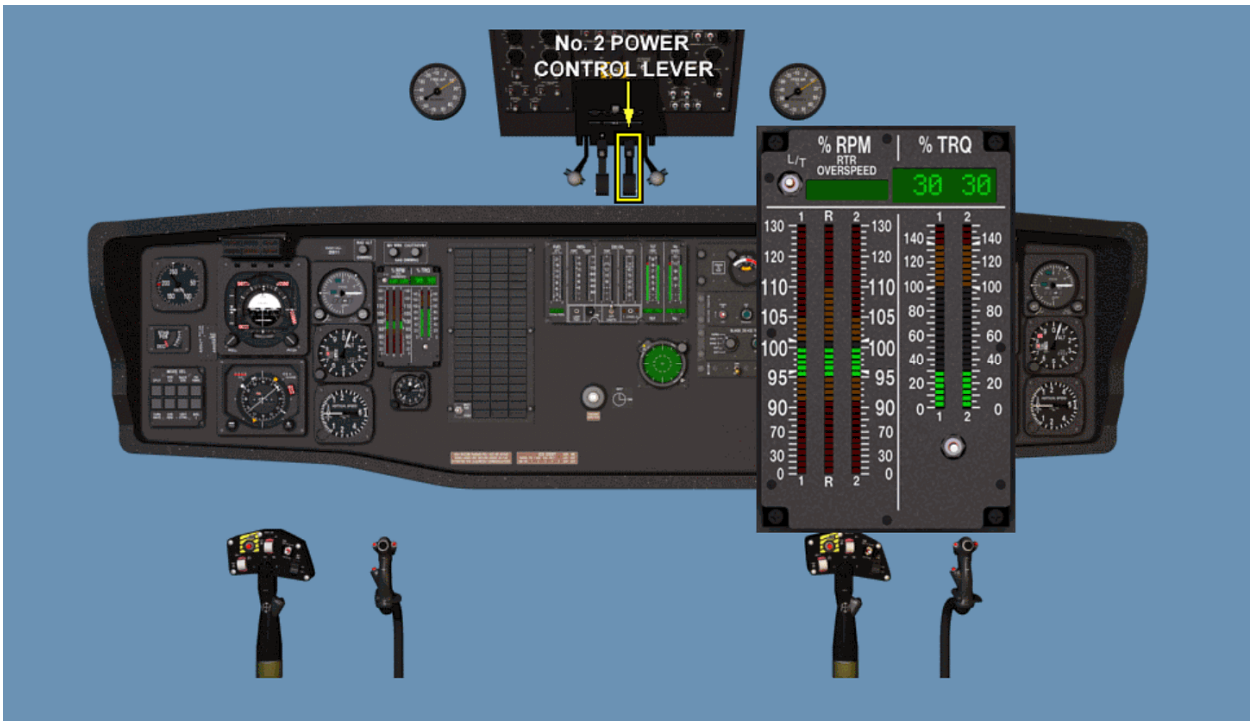
(17) Prior to completing a Max Power check, a new HIT baseline is established by the Maintenance Test Pilot, and used if the engine performance is satisfactory on the Max Power check.

(18) During the initial HIT check, the Maintenance Test Pilot compensates for the particular engine characteristic and establishes the TGT limits to be used in the operational HIT check.

(19) The operational pilot will compare the engine performance to this baseline to check the engines performance.

(20) Position the aircraft into the prevailing wind to minimize hot gas ingestion into the engines.

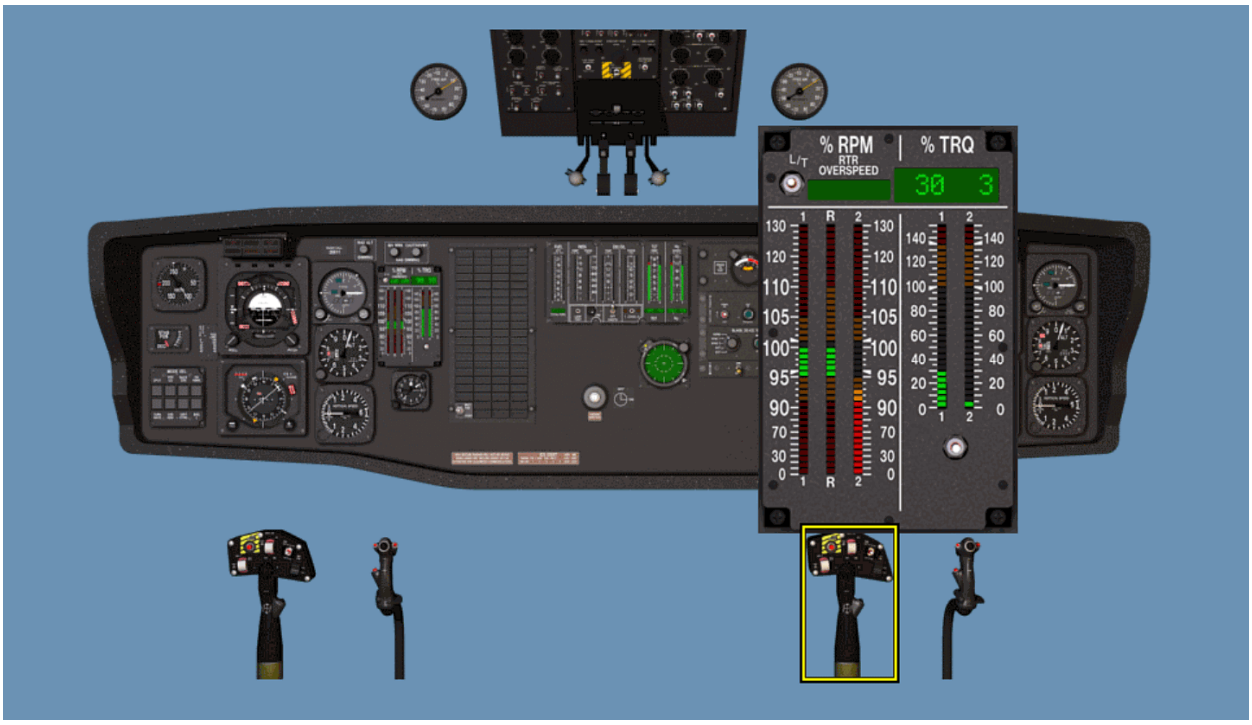
Frame #1035 (No. 2 Power Control Lever)



(21) The ENG ANTI-ICE switches are off, the Barometric Altimeter is set at 29.92 PA, and both engines are operating at 100% Np.

(22) Retard the No. 2 engine PCL (engine not being checked) until a 0% - 5% TRQ at 92% - 98% Np has been reached.

Frame #1035 (RPM/TRQ)



(23) When the settings for the No. 2 engine have been reached, check for torque stiction.

(24) Torque should be between 0% and 5%.

(25) Increase the collective pitch until the TRQ of the No. 1 engine reaches 60%.

(26) Allow the TRQ of the No. 1 engine to stabilize for at least 30 seconds.

Frame #1036 (Pre-HIT Test Logs Show Clipart)

NOTE: If the helicopter is equipped with two FAT gages, and the readings are different, the higher reading must be used.

(27) Record the aircraft hours, FAT, PA and indicated TGT of the engine being checked on the HIT baseline worksheet.

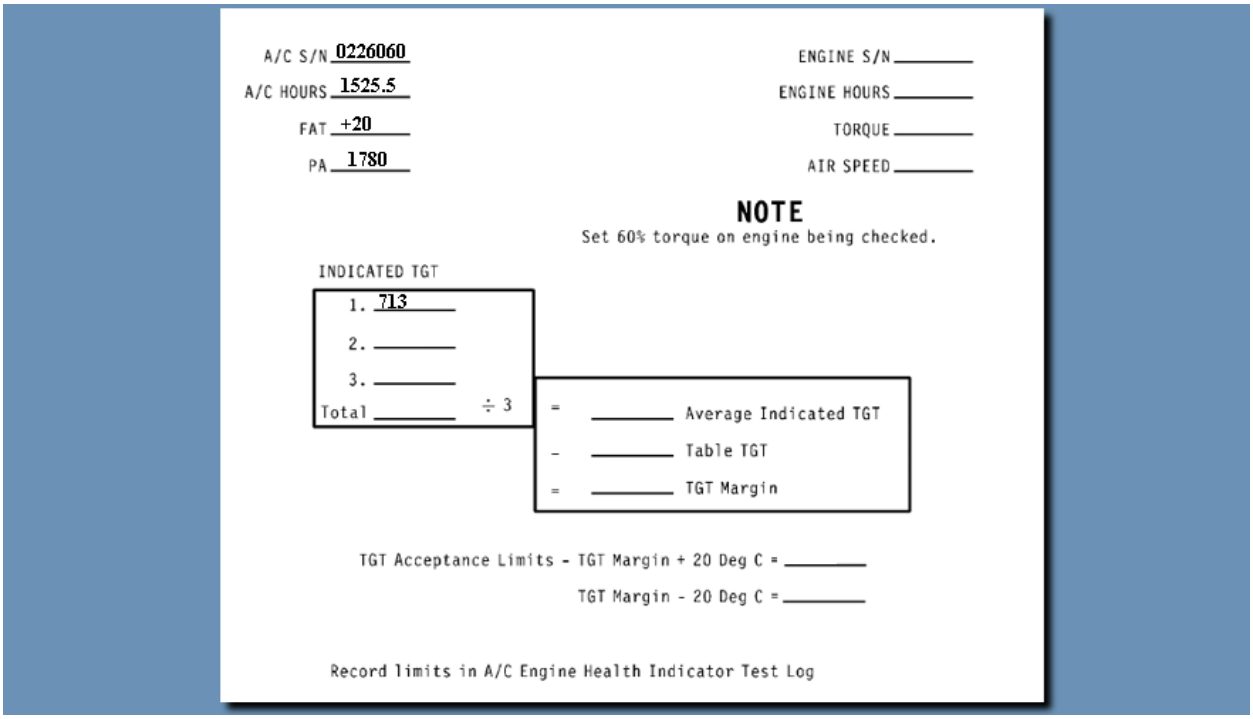
(a) Aircraft hours 1525.5

(b) FAT +20 ºC

(c) PA 1780’

(d) TGT 713

Frame #1040 (HIT Worksheet)



1) The aircraft HIT baseline worksheet can be found in the TM 1-2840-248-23 and TM 1-1520-237-MTF.

2) Once the initial required information has been entered, an Anti-Ice check must be done.

Frame #1045 (Anti-ice Check Show Clipart)

(28) The following steps contain instructions for performing the Anti-Ice check portion of the HIT baseline procedure.

(29) For the engine being checked, set the ENG ANTI-ICE switch to the ON position.

(30) When the No. 1 ENG ANTI-ICE switch is moved to the ON position, note the following:

(a) The No. 1 ENG TGT should rise at least 30 ºC, but less than 110 ºC.

(b) The No. 1 ENG ANTI-ICE advisory light comes on.

(c) The No. 1 ENG INLET ANTI-ICE advisory light comes on after the inlet fairing temperature reaches 93 ºC (200 ºF) and if FAT is less than 4 ºC (39 ºF).

(31) For the engine being checked, set the ENG ANTI-ICE switch to the OFF position.

(32) When the No. 1 ENG ANTI-ICE switch is moved to the OFF position, note the following:

(a) A decrease in TGT to approximate value of recorded indication

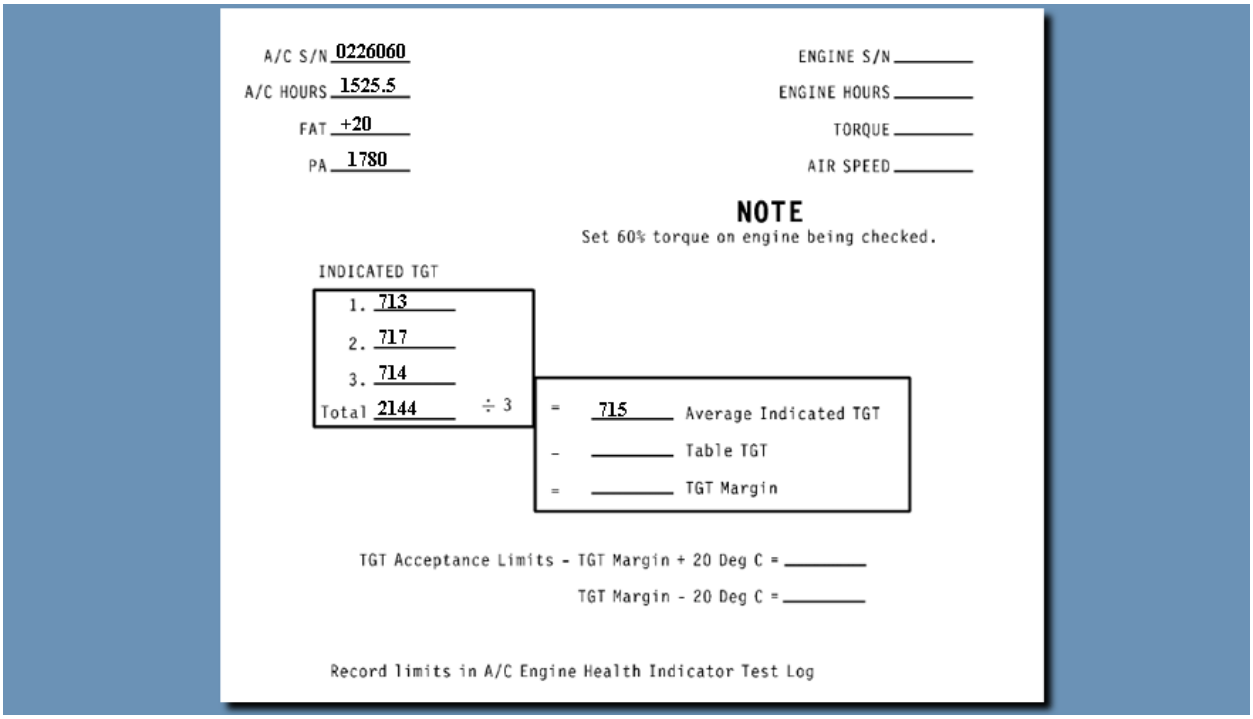
(b) The No. 1 ENG ANTI-ICE advisory light goes off

(c) The No. 1 ENG INLET ANTI-ICE advisory light goes off after inlet fairing temperature goes below 93 ºC (200 ºF)

(33) If any part of the engine inlet ANTI-ICE check fails, do not fly the helicopter.

(34) Once the ANTI-ICE check has been completed, two more HIT baseline readings of the engine TGT must be taken and the data recorded on the HIT baseline worksheet.

Frame #1055 (HIT Text Log)



(a) Once the Anti-Ice check was completed, a second and third HIT baseline reading of the No. 1 engine was done.

(b) The second and third readings provide the following information from the No. 1 engine: The second TGT reading is 717 ºC, while the third reading is 714 ºC.

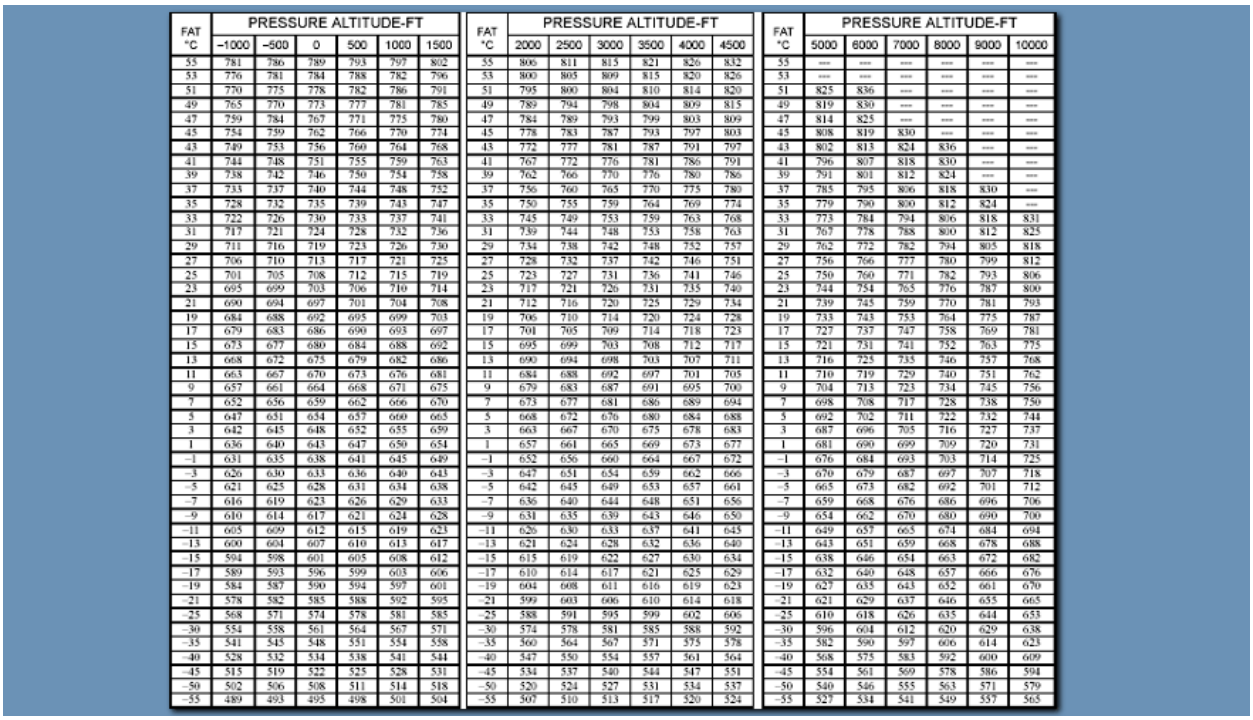
(c) Both readings are recorded on the HIT baseline worksheet on lines two and three in the Indicated TGT block.

(d) The total of all three readings is entered on the Total line.

(e) The total is divided by three for an average TGT which is entered on the Average Indicated TGT line.

(f) Next, the Table TGT must be found.

Frame #1060 (Pressure Altitude Chart)



FAT °C	PRESSURE ALTITUDE-FT					
	-1000	-500	0	500	1000	1500
55	781	786	789	793	797	802
53	776	781	784	788	782	796
51	770	775	778	782	786	791
49	765	770	773	777	781	785
47	759	784	767	771	775	780
45	754	759	762	766	770	774
43	749	753	756	760	764	768
41	744	748	751	755	759	763
39	738	742	746	750	754	758
37	733	737	740	744	748	752
35	728	732	735	739	743	747
33	722	726	730	733	737	741
31	717	721	724	728	732	736
29	711	716	719	723	726	730
27	706	710	713	717	721	725
25	701	705	708	712	715	719
23	695	699	703	706	710	714
21	690	694	697	701	704	708
19	684	688	692	695	699	703
17	679	683	686	690	693	697
15	673	677	680	684	688	692
13	668	672	675	679	682	686
11	663	667	670	673	676	681
9	657	661	664	668	671	675
7	652	656	659	662	666	670
5	647	651	654	657	660	665
3	642	645	648	652	655	659
1	636	640	643	647	650	654
-1	631	635	638	641	645	649
-3	626	630	633	636	640	643
-5	621	625	628	631	634	638
-7	616	619	623	626	629	633
-9	610	614	617	621	624	628
-11	605	609	612	615	619	623
-13	600	604	607	610	613	617
-15	594	598	601	605	608	612
-17	589	593	596	599	603	606
-19	584	587	590	594	597	601
-21	578	582	585	588	592	595
-25	568	571	574	578	581	585
-30	554	558	561	564	567	571
-35	541	545	548	551	554	558
-40	528	532	534	538	541	544
-45	515	519	522	525	528	531
-50	502	506	508	511	514	518
-55	489	493	495	498	501	504

FAT °C	PRESSURE ALTITUDE-FT					
	2000	2500	3000	3500	4000	4500
55	806	811	815	821	826	832
53	800	805	809	815	820	826
51	795	800	804	810	814	820
49	789	794	798	804	809	815
47	784	789	793	799	803	809
45	778	783	787	793	797	803
43	772	777	781	787	791	797
41	767	772	776	781	786	791
39	762	766	770	776	780	786
37	756	760	765	770	775	780
35	750	755	759	764	769	774
33	745	749	753	759	763	768
31	739	744	748	753	758	763
29	734	738	742	748	752	757
27	728	732	737	742	746	751
25	723	727	731	736	741	746
23	717	721	726	731	735	740
21	712	716	720	725	729	734
19	706	710	714	720	724	728
17	701	705	709	714	718	723
15	695	699	703	708	712	717
13	690	694	698	703	707	711
11	684	688	692	697	701	705
9	679	683	687	691	695	700
7	673	677	681	686	689	694
5	668	672	676	680	684	688
3	663	667	670	675	678	683
1	657	661	665	669	673	677
-1	652	656	660	664	667	672
-3	647	651	654	659	662	666
-5	642	645	649	653	657	661
-7	636	640	644	648	651	656
-9	631	635	639	643	646	650
-11	626	630	633	637	641	645
-13	621	624	628	632	636	640
-15	615	619	622	627	630	634
-17	610	614	617	621	625	629
-19	604	608	611	616	619	623
-21	599	603	606	610	614	618
-25	588	591	595	599	602	606
-30	574	578	581	585	588	592
-35	560	564	567	571	575	578
-40	547	550	554	557	561	564
-45	534	537	540	544	547	551
-50	520	524	527	531	534	537
-55	507	510	513	517	520	524

FAT °C	PRESSURE ALTITUDE-FT					
	5000	6000	7000	8000	9000	10000
55	---	---	---	---	---	---
53	---	---	---	---	---	---
51	825	836	---	---	---	---
49	819	830	---	---	---	---
47	814	825	---	---	---	---
45	808	819	830	---	---	---
43	802	813	824	836	---	---
41	796	807	818	830	---	---
39	791	801	812	824	---	---
37	785	795	806	818	830	---
35	779	790	800	812	824	---
33	773	784	794	806	818	831
31	767	778	788	800	812	825
29	762	772	782	794	805	818
27	756	766	777	780	799	812
25	750	760	771	782	793	806
23	744	754	765	776	787	800
21	739	745	759	770	781	793
19	733	743	753	764	775	787
17	727	737	747	758	769	781
15	721	731	741	752	763	775
13	716	725	735	746	757	768
11	710	719	729	740	751	762
9	704	713	723	734	745	756
7	698	708	717	728	738	750
5	692	702	711	722	732	744
3	687	696	705	716	727	737
1	681	690	699	709	720	731
-1	676	684	693	703	714	725
-3	670	679	687	697	707	718
-5	665	673	682	692	701	712
-7	659	668	676	686	696	706
-9	654	662	670	680	690	700
-11	649	657	665	674	684	694
-13	643	651	659	668	678	688
-15	638	646	654	663	672	682
-17	632	640	648	657	666	676
-19	627	635	643	652	661	670
-21	621	629	637	646	655	665
-25	610	618	626	635	644	653
-30	596	604	612	620	629	638
-35	582	590	597	606	614	623
-40	568	575	583	592	600	609
-45	554	561	569	578	586	594
-50	540	546	555	563	571	579
-55	527	534	541	549	557	565

NOTE: When using the HIT table, round FAT up, and pressure altitude to nearest value.

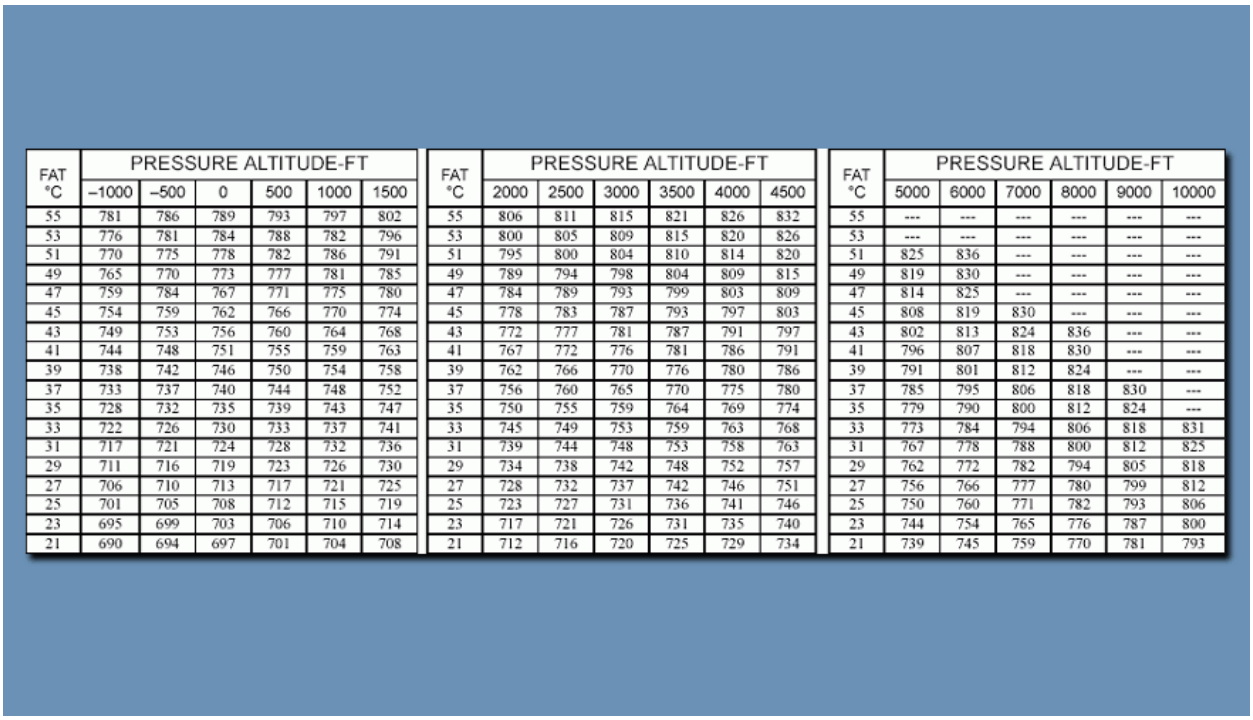
1) When selecting a TGT Reference Table, ensure you are using the correct table for the model engine being checked.

2) The model engine being checked is a T700.

3) Use the indicated FAT and PA acquired during the initial HIT readings, FAT +20 and PA +1780.

4) Begin with locating the FAT being used, 21 ºC.

Frame #1060 (Pressure Altitude Chart 2)



FAT °C	PRESSURE ALTITUDE-FT					
	–1000	–500	0	500	1000	1500
55	781	786	789	793	797	802
53	776	781	784	788	782	796
51	770	775	778	782	786	791
49	765	770	773	777	781	785
47	759	784	767	771	775	780
45	754	759	762	766	770	774
43	749	753	756	760	764	768
41	744	748	751	755	759	763
39	738	742	746	750	754	758
37	733	737	740	744	748	752
35	728	732	735	739	743	747
33	722	726	730	733	737	741
31	717	721	724	728	732	736
29	711	716	719	723	726	730
27	706	710	713	717	721	725
25	701	705	708	712	715	719
23	695	699	703	706	710	714
21	690	694	697	701	704	708

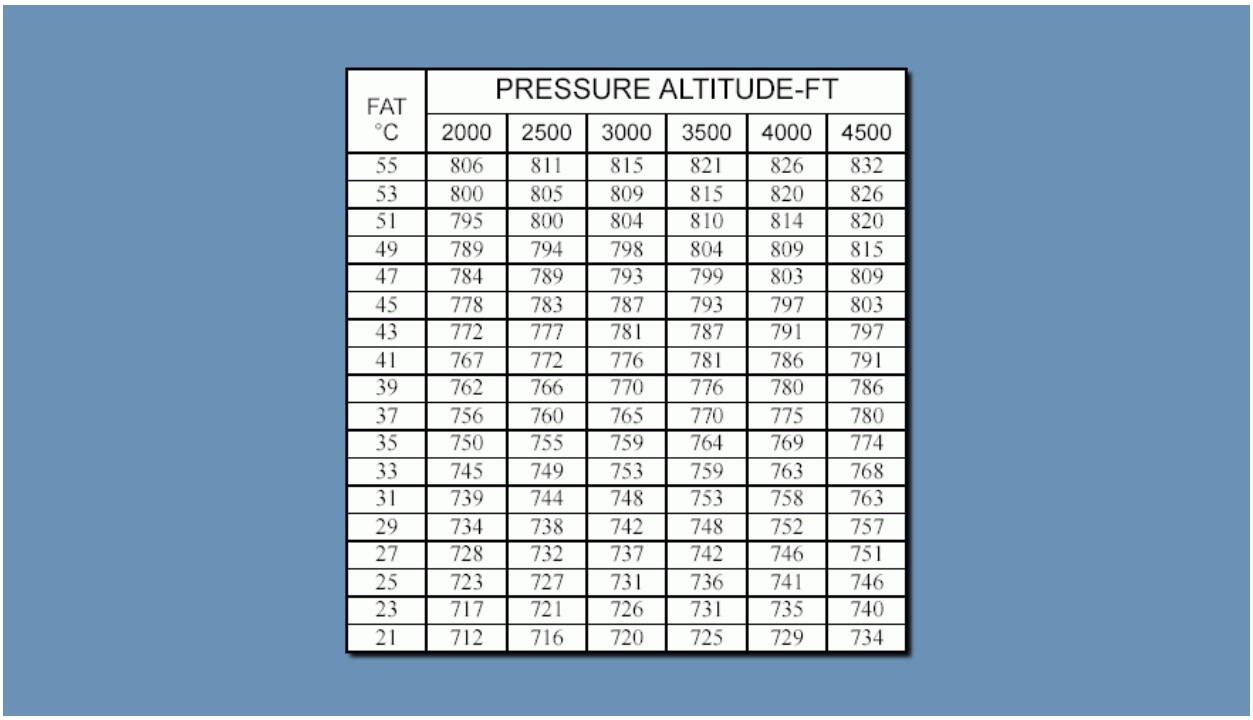
FAT °C	PRESSURE ALTITUDE-FT					
	2000	2500	3000	3500	4000	4500
55	806	811	815	821	826	832
53	800	805	809	815	820	826
51	795	800	804	810	814	820
49	789	794	798	804	809	815
47	784	789	793	799	803	809
45	778	783	787	793	797	803
43	772	777	781	787	791	797
41	767	772	776	781	786	791
39	762	766	770	776	780	786
37	756	760	765	770	775	780
35	750	755	759	764	769	774
33	745	749	753	759	763	768
31	739	744	748	753	758	763
29	734	738	742	748	752	757
27	728	732	737	742	746	751
25	723	727	731	736	741	746
23	717	721	726	731	735	740
21	712	716	720	725	729	734

FAT °C	PRESSURE ALTITUDE-FT					
	5000	6000	7000	8000	9000	10000
55	---	---	---	---	---	---
53	---	---	---	---	---	---
51	825	836	---	---	---	---
49	819	830	---	---	---	---
47	814	825	---	---	---	---
45	808	819	830	---	---	---
43	802	813	824	836	---	---
41	796	807	818	830	---	---
39	791	801	812	824	---	---
37	785	795	806	818	830	---
35	779	790	800	812	824	---
33	773	784	794	806	818	831
31	767	778	788	800	812	825
29	762	772	782	794	805	818
27	756	766	777	780	799	812
25	750	760	771	782	793	806
23	744	754	765	776	787	800
21	739	745	759	770	781	793

5) Next, locate the table that contains the PA to be used.

6) The indicated PA is +1780, the nearest value is +2000.

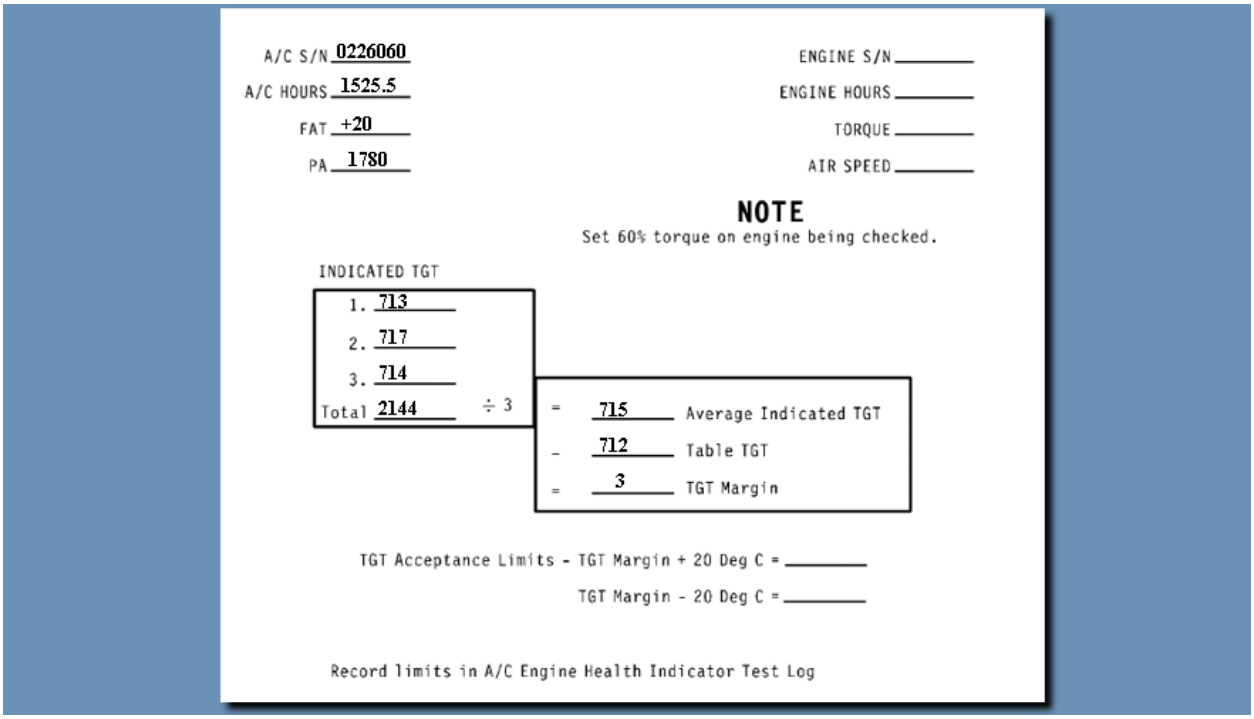
Frame #1060 (Pressure Altitude Chart 3)



FAT °C	PRESSURE ALTITUDE-FT					
	2000	2500	3000	3500	4000	4500
55	806	811	815	821	826	832
53	800	805	809	815	820	826
51	795	800	804	810	814	820
49	789	794	798	804	809	815
47	784	789	793	799	803	809
45	778	783	787	793	797	803
43	772	777	781	787	791	797
41	767	772	776	781	786	791
39	762	766	770	776	780	786
37	756	760	765	770	775	780
35	750	755	759	764	769	774
33	745	749	753	759	763	768
31	739	744	748	753	758	763
29	734	738	742	748	752	757
27	728	732	737	742	746	751
25	723	727	731	736	741	746
23	717	721	726	731	735	740
21	712	716	720	725	729	734

7) Using a FAT of +21 ºC and a PA of +2000, the table TGT is 712 ºC.

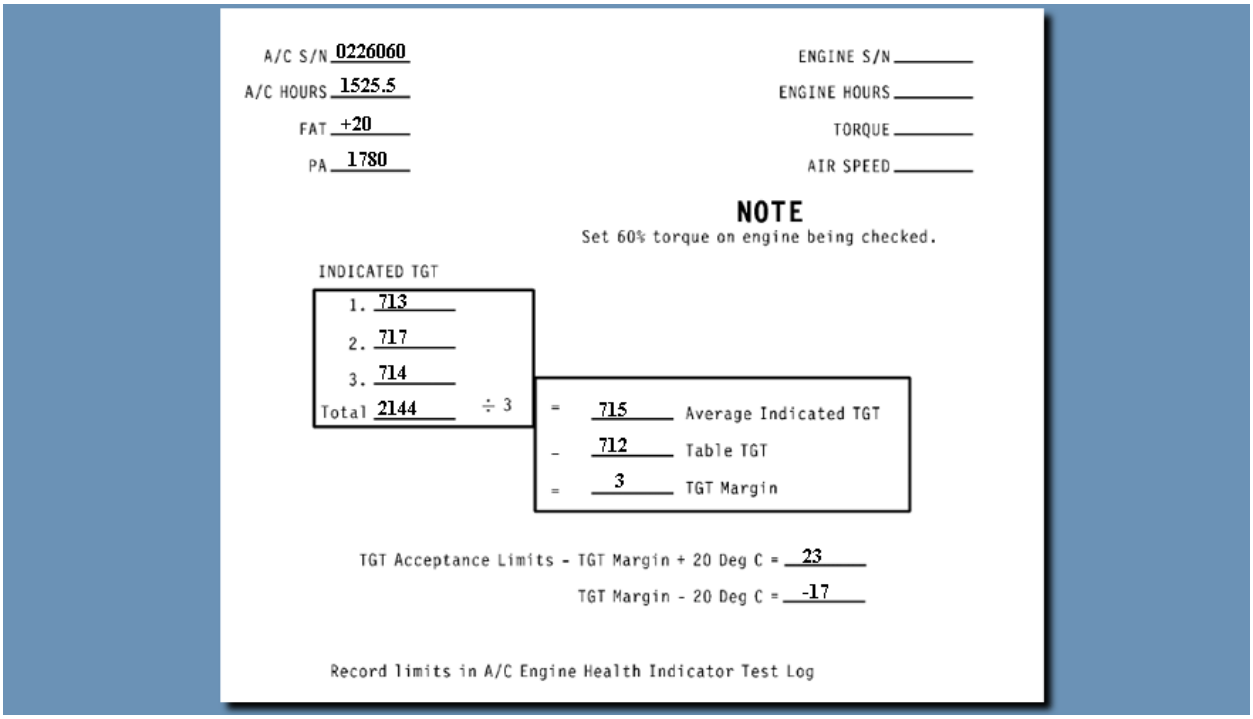
Frame #1060 (HIT Log)



8) The table TGT entered on the HIT baseline worksheet is 712 ºC. Subtract the Table TGT (712 ºC) from the Average Indicated TGT (715 ºC) for a TGT Margin of 3 ºC.

9) Calculating the TGT Acceptance Limits are the last steps in the HIT baseline worksheet.

Frame #1065 (Health Indicator Test Log)



A/C S/N 0226060
A/C HOURS 1525.5
FAT +20
PA 1780

ENGINE S/N _____
ENGINE HOURS _____
TORQUE _____
AIR SPEED _____

NOTE
Set 60% torque on engine being checked.

INDICATED TGT
1. 713
2. 717
3. 714
Total 2144 ÷ 3

= 715 Average Indicated TGT
– 712 Table TGT
= 3 TGT Margin

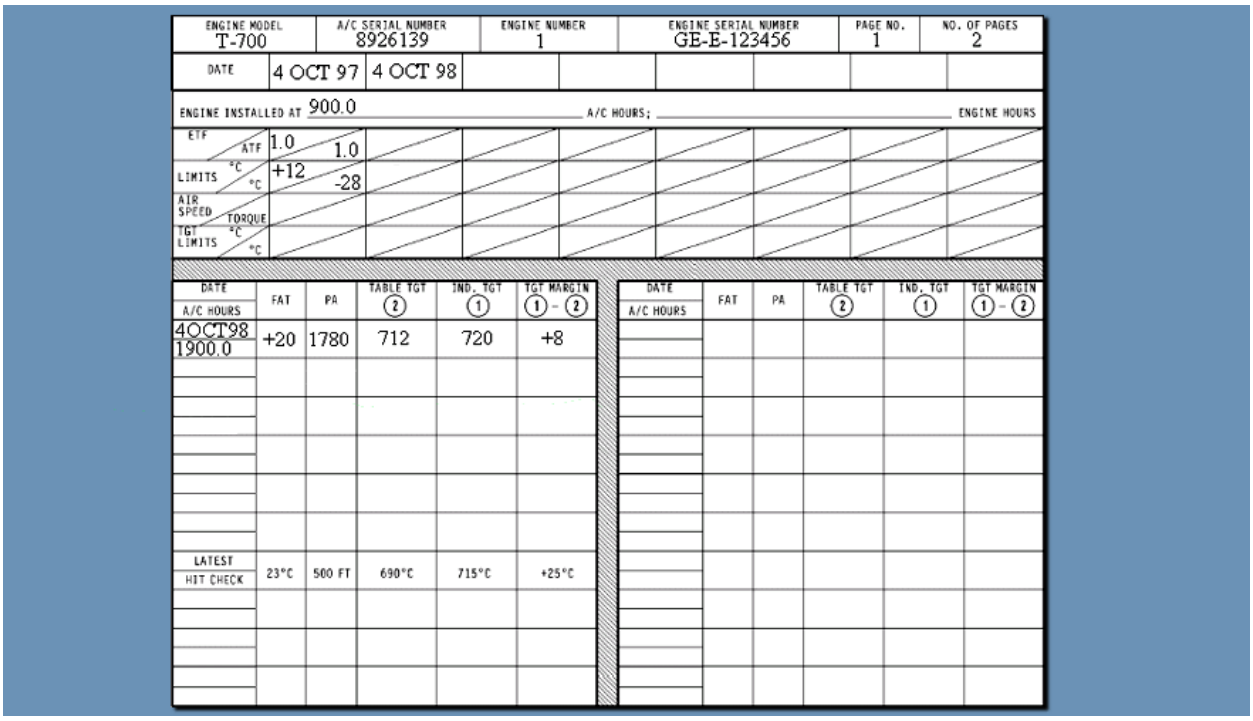
TGT Acceptance Limits - TGT Margin + 20 Deg C = 23
TGT Margin - 20 Deg C = -17

Record limits in A/C Engine Health Indicator Test Log

10) To calculate the TGT Acceptance Limits, add 20º C to the TGT Margin for a value of +23, and subtract 20 from the TGT Margin for a value of –17.

g. Engine HIT Log

Frame #1070 (Engine HIT Log)



ENGINE MODEL	A/C SERIAL NUMBER	ENGINE NUMBER	ENGINE SERIAL NUMBER	PAGE NO.	NO. OF PAGES
T-700	8926139	1	GE-E-123456	1	2

DATE	4 OCT 97	4 OCT 98							
ETF / ATF	1.0	1.0							
LIMITS °C / °C	+12	-28							
AIR SPEED / TORQUE									
TGT LIMITS °C / °C									

ENGINE INSTALLED AT 900.0 A/C HOURS; _____ ENGINE HOURS

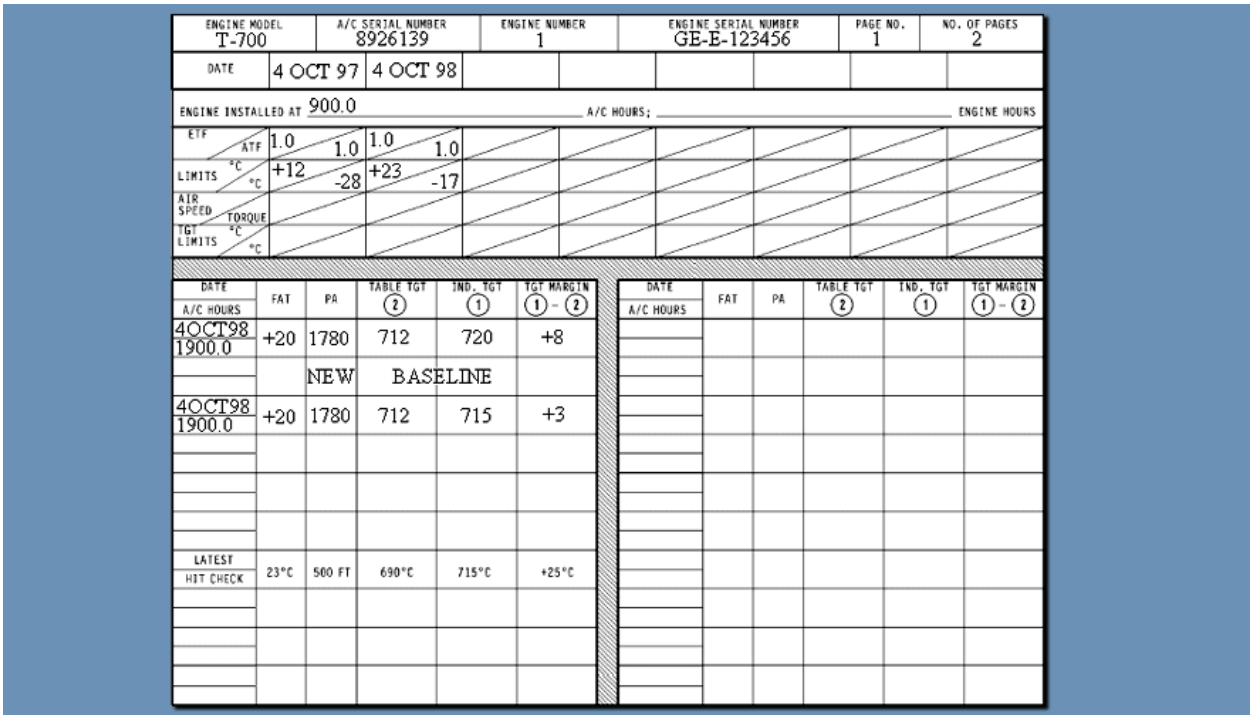
DATE / A/C HOURS	FAT	PA	TABLE TGT (2)	IND. TGT (1)	TGT MARGIN (1) - (2)
4OCT98 1900.0	+20	1780	712	720	+8
LATEST HIT CHECK	23°C	500 FT	690°C	715°C	+25°C

DATE / A/C HOURS	FAT	PA	TABLE TGT (2)	IND. TGT (1)	TGT MARGIN (1) - (2)

(1) Locate the HIT log for the engine being checked.

(2) Go to the last entry made.

Frame #1070 (Engine HIT Log2)



ENGINE MODEL	A/C SERIAL NUMBER	ENGINE NUMBER	ENGINE SERIAL NUMBER	PAGE NO.	NO. OF PAGES
T-700	8926139	1	GE-E-123456	1	2

DATE	4 OCT 97	4 OCT 98						
ETF / ATF	1.0	1.0	1.0	1.0				
LIMITS °C / °C	+12	-28	+23	-17				
AIR SPEED / TORQUE								
TGT LIMITS °C / °C								

ENGINE INSTALLED AT 900.0 A/C HOURS; _____ ENGINE HOURS

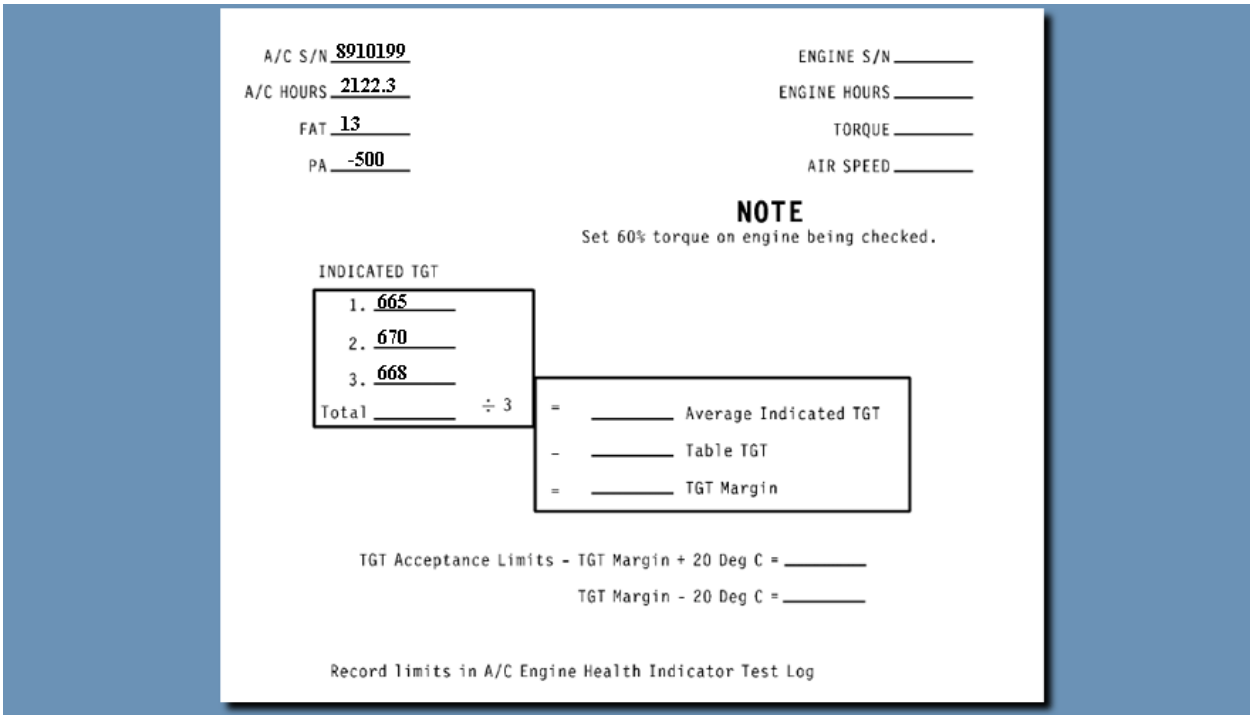
DATE / A/C HOURS	FAT	PA	TABLE TGT (2)	IND. TGT (1)	TGT MARGIN (1) - (2)
4OCT98 1900.0	+20	1780	712	720	+8
		NEW	BASELINE		
4OCT98 1900.0	+20	1780	712	715	+3
LATEST HIT CHECK	23°C	500 FT	690°C	715°C	+25°C

DATE / A/C HOURS	FAT	PA	TABLE TGT (2)	IND. TGT (1)	TGT MARGIN (1) - (2)

(3) On the Engine HIT Log, enter “NEW BASELINE” below the last reading logged.

(4) Then enter the new engine data in the appropriate blocks.

Frame #1075 (HIT LOG 1)



A/C S/N 8910199
A/C HOURS 2122.3
FAT 13
PA -500

ENGINE S/N _____
ENGINE HOURS _____
TORQUE _____
AIR SPEED _____

NOTE
Set 60% torque on engine being checked.

INDICATED TGT
1. 665
2. 670
3. 668
Total _____ ÷ 3

= _____ Average Indicated TGT
– _____ Table TGT
= _____ TGT Margin

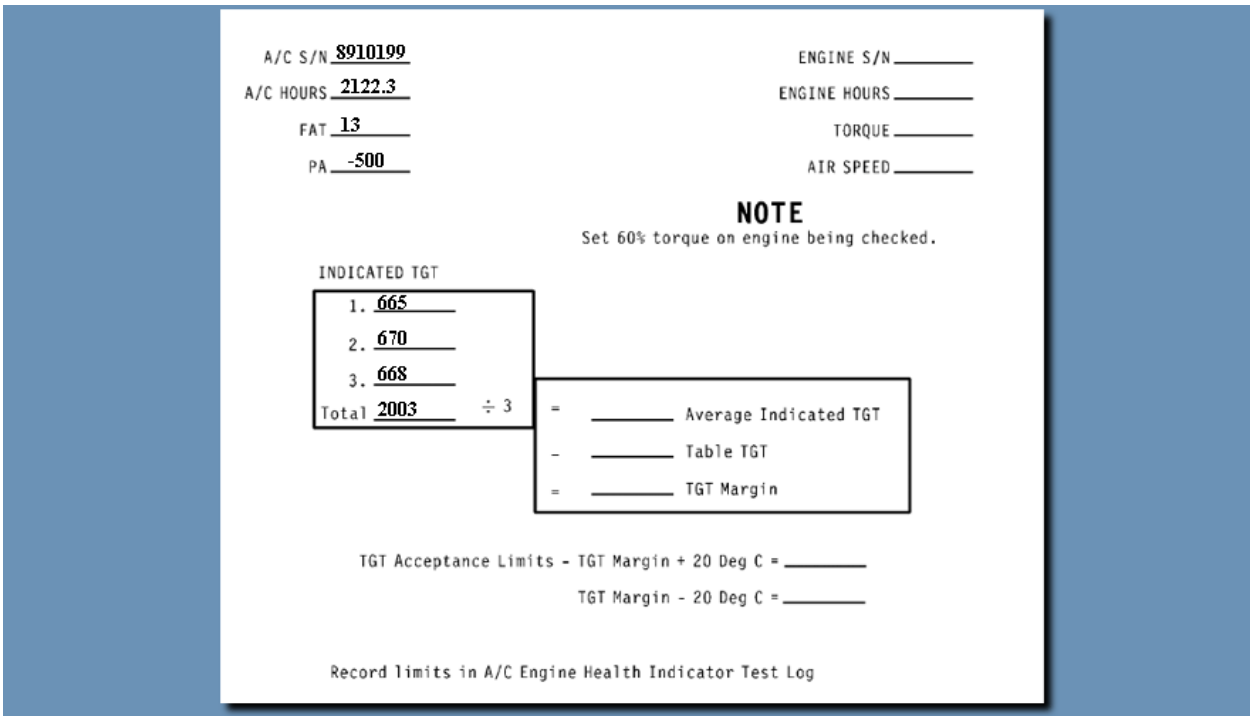
TGT Acceptance Limits - TGT Margin + 20 Deg C = _____
TGT Margin - 20 Deg C = _____

Record limits in A/C Engine Health Indicator Test Log

(5) Conduct a second set of calculations for a new HIT baseline with the information provided in the HIT baseline worksheet above.

(6) Calculate the Total Indicated TGT.

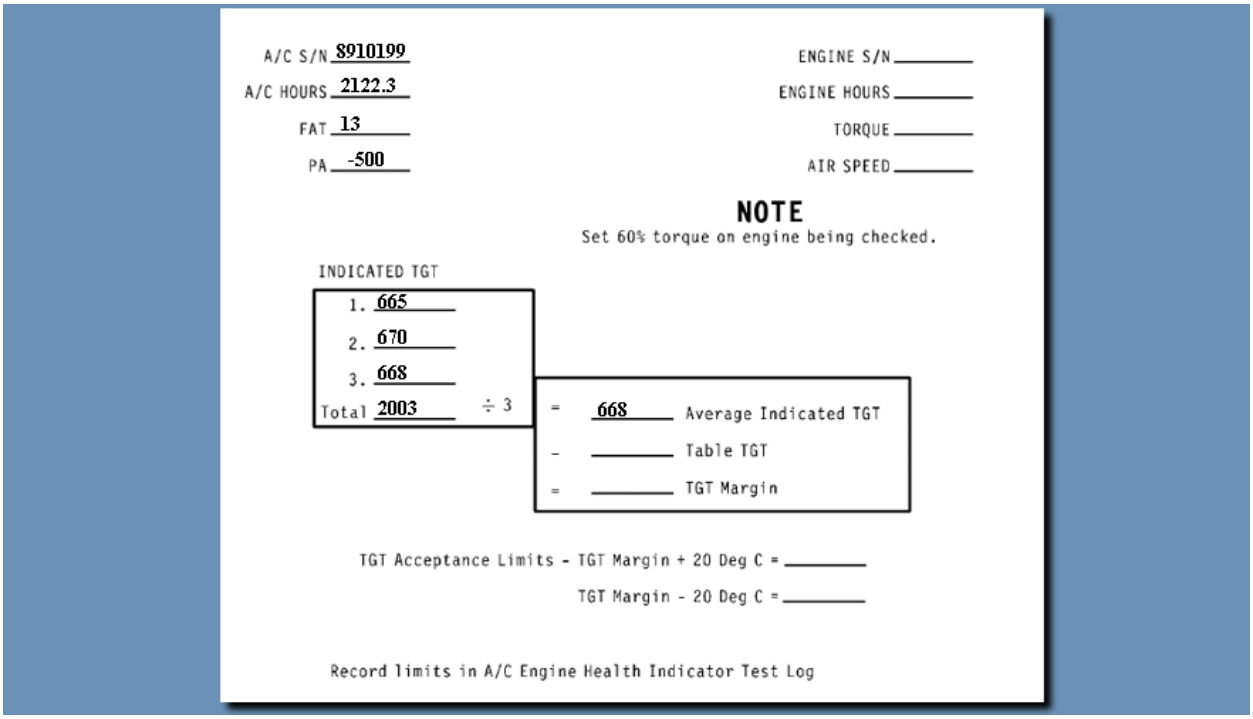
Frame #1075 (HIT Log 2)



(7) The total Indicated TGT is 2003.

(8) Calculate the Average Indicated TGT.

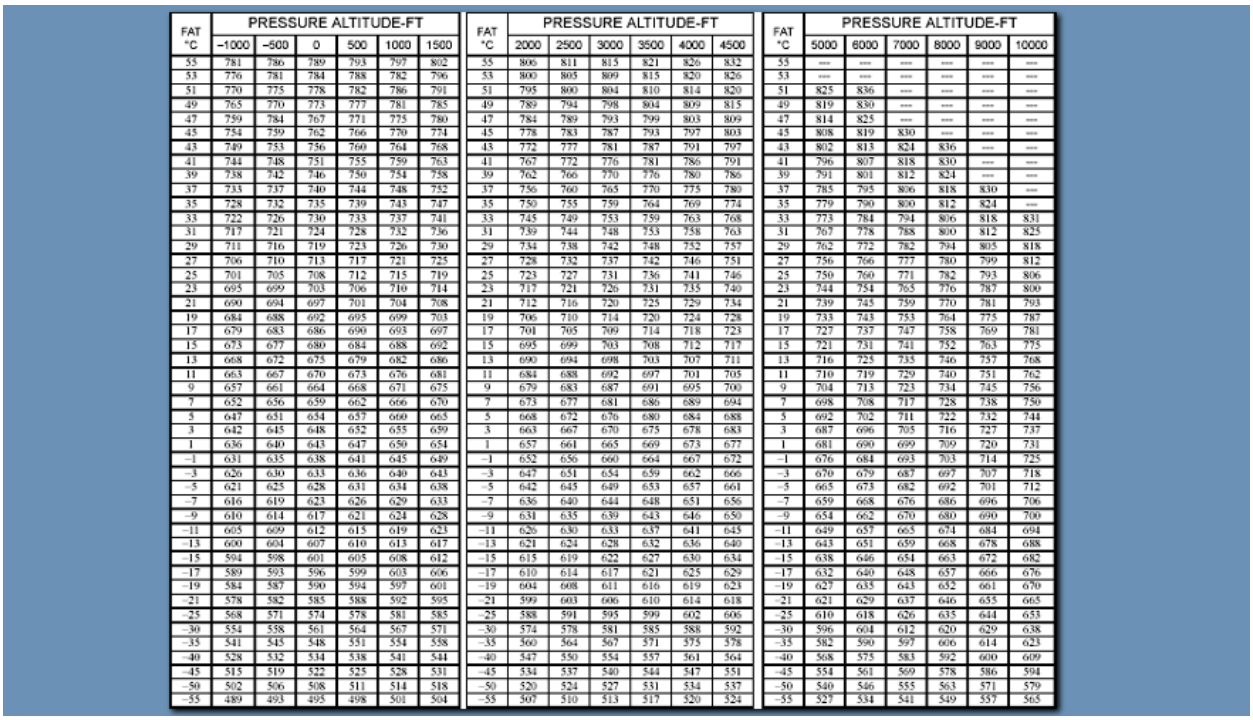
Frame #1075 (Hit Log 3)



(9) The Average Indicated TGT is 668.

(10) Find the Table TGT.

Frame #1080 (Pressure Altitude Chart)



FAT °C	PRESSURE ALTITUDE-FT					
	-1000	-500	0	500	1000	1500
55	781	786	789	793	797	802
53	776	781	784	788	782	796
51	770	775	778	782	786	791
49	765	770	773	777	781	785
47	759	784	767	771	775	780
45	754	759	762	766	770	774
43	749	753	756	760	764	768
41	744	748	751	755	759	763
39	738	742	746	750	754	758
37	733	737	740	744	748	752
35	728	732	735	739	743	747
33	722	726	730	733	737	741
31	717	721	724	728	732	736
29	711	716	719	723	726	730
27	706	710	713	717	721	725
25	701	705	708	712	715	719
23	695	699	703	706	710	714
21	690	694	697	701	704	708
19	684	688	692	695	699	703
17	679	683	686	690	693	697
15	673	677	680	684	688	692
13	668	672	675	679	682	686
11	663	667	670	673	676	681
9	657	661	664	668	671	675
7	652	656	659	662	666	670
5	647	651	654	657	660	665
3	642	645	648	652	655	659
1	636	640	643	647	650	654
-1	631	635	638	641	645	649
-3	626	630	633	636	640	643
-5	621	625	628	631	634	638
-7	616	619	623	626	629	633
-9	610	614	617	621	624	628
-11	605	609	612	615	619	623
-13	600	604	607	610	613	617
-15	594	598	601	605	608	612
-17	589	593	596	599	603	606
-19	584	587	590	594	597	601
-21	578	582	585	588	592	595
-25	568	571	574	578	581	585
-30	554	558	561	564	567	571
-35	541	545	548	551	554	558
-40	528	532	534	538	541	544
-45	515	519	522	525	528	531
-50	502	506	508	511	514	518
-55	489	493	495	498	501	504

FAT °C	PRESSURE ALTITUDE-FT					
	2000	2500	3000	3500	4000	4500
55	806	811	815	821	826	832
53	800	805	809	815	820	826
51	795	800	804	810	814	820
49	789	794	798	804	809	815
47	784	789	793	799	803	809
45	778	783	787	793	797	803
43	772	777	781	787	791	797
41	767	772	776	781	786	791
39	762	766	770	776	780	786
37	756	760	765	770	775	780
35	750	755	759	764	769	774
33	745	749	753	759	763	768
31	739	744	748	753	758	763
29	734	738	742	748	752	757
27	728	732	737	742	746	751
25	723	727	731	736	741	746
23	717	721	726	731	735	740
21	712	716	720	725	729	734
19	706	710	714	720	724	728
17	701	705	709	714	718	723
15	695	699	703	708	712	717
13	690	694	698	703	707	711
11	684	688	692	697	701	705
9	679	683	687	691	695	700
7	673	677	681	686	689	694
5	668	672	676	680	684	688
3	663	667	670	675	678	683
1	657	661	665	669	673	677
-1	652	656	660	664	667	672
-3	647	651	654	659	662	666
-5	642	645	649	653	657	661
-7	636	640	644	648	651	656
-9	631	635	639	643	646	650
-11	626	630	633	637	641	645
-13	621	624	628	632	636	640
-15	615	619	622	627	630	634
-17	610	614	617	621	625	629
-19	604	608	611	616	619	623
-21	599	603	606	610	614	618
-25	588	591	595	599	602	606
-30	574	578	581	585	588	592
-35	560	564	567	571	575	578
-40	547	550	554	557	561	564
-45	534	537	540	544	547	551
-50	520	524	527	531	534	537
-55	507	510	513	517	520	524

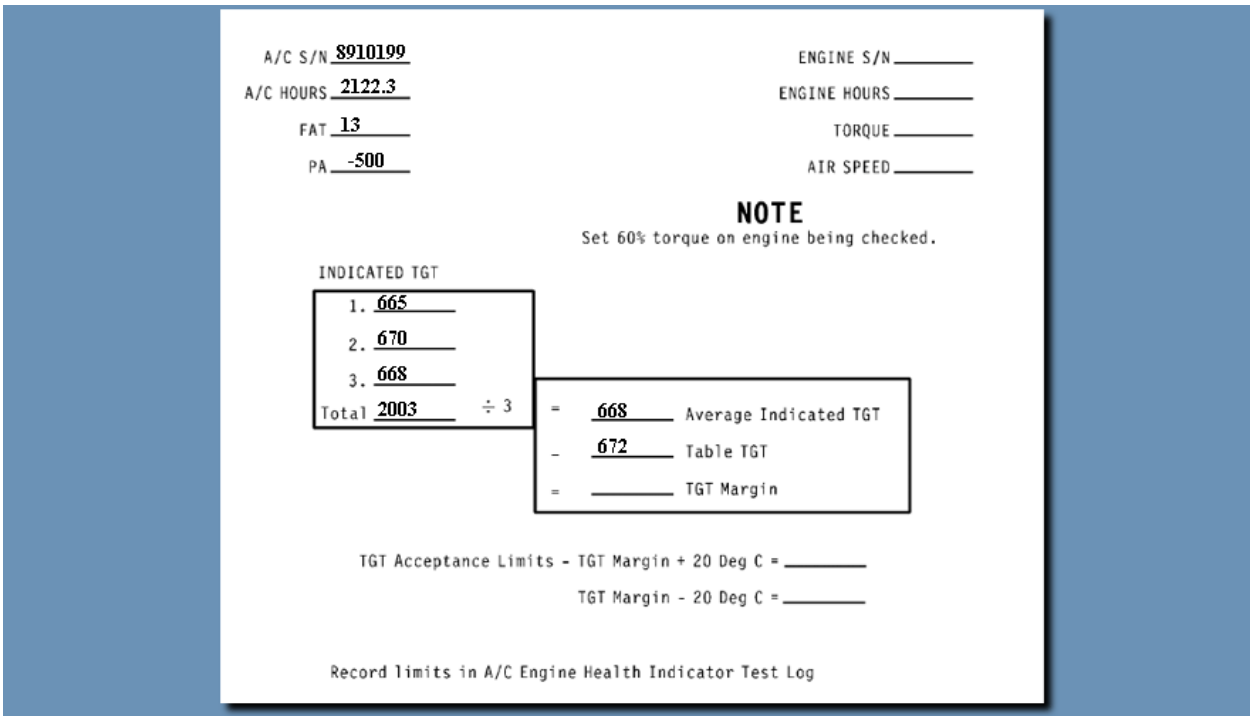
FAT °C	PRESSURE ALTITUDE-FT					
	5000	6000	7000	8000	9000	10000
55	---	---	---	---	---	---
53	---	---	---	---	---	---
51	825	836	---	---	---	---
49	819	830	---	---	---	---
47	814	825	---	---	---	---
45	808	819	830	---	---	---
43	802	813	824	836	---	---
41	796	807	818	830	---	---
39	791	801	812	824	---	---
37	785	795	806	818	830	---
35	779	790	800	812	824	---
33	773	784	794	806	818	831
31	767	778	788	800	812	825
29	762	772	782	794	805	818
27	756	766	777	780	799	812
25	750	760	771	782	793	806
23	744	754	765	776	787	800
21	739	745	759	770	781	793
19	733	743	753	764	775	787
17	727	737	747	758	769	781
15	721	731	741	752	763	775
13	716	725	735	746	757	768
11	710	719	729	740	751	762
9	704	713	723	734	745	756
7	698	708	717	728	738	750
5	692	702	711	722	732	744
3	687	696	705	716	727	737
1	681	690	699	709	720	731
-1	676	684	693	703	714	725
-3	670	679	687	697	707	718
-5	665	673	682	692	701	712
-7	659	668	676	686	696	706
-9	654	662	670	680	690	700
-11	649	657	665	674	684	694
-13	643	651	659	668	678	688
-15	638	646	654	663	672	682
-17	632	640	648	657	666	676
-19	627	635	643	652	661	670
-21	621	629	637	646	655	665
-25	610	618	626	635	644	653
-30	596	604	612	620	629	638
-35	582	590	597	606	614	623
-40	568	575	583	592	600	609
-45	554	561	569	578	586	594
-50	540	546	555	563	571	579
-55	527	534	541	549	557	565

(a) Using the charts and the information provided find the Table TGT.

1) FAT = 13

2) PA = -500

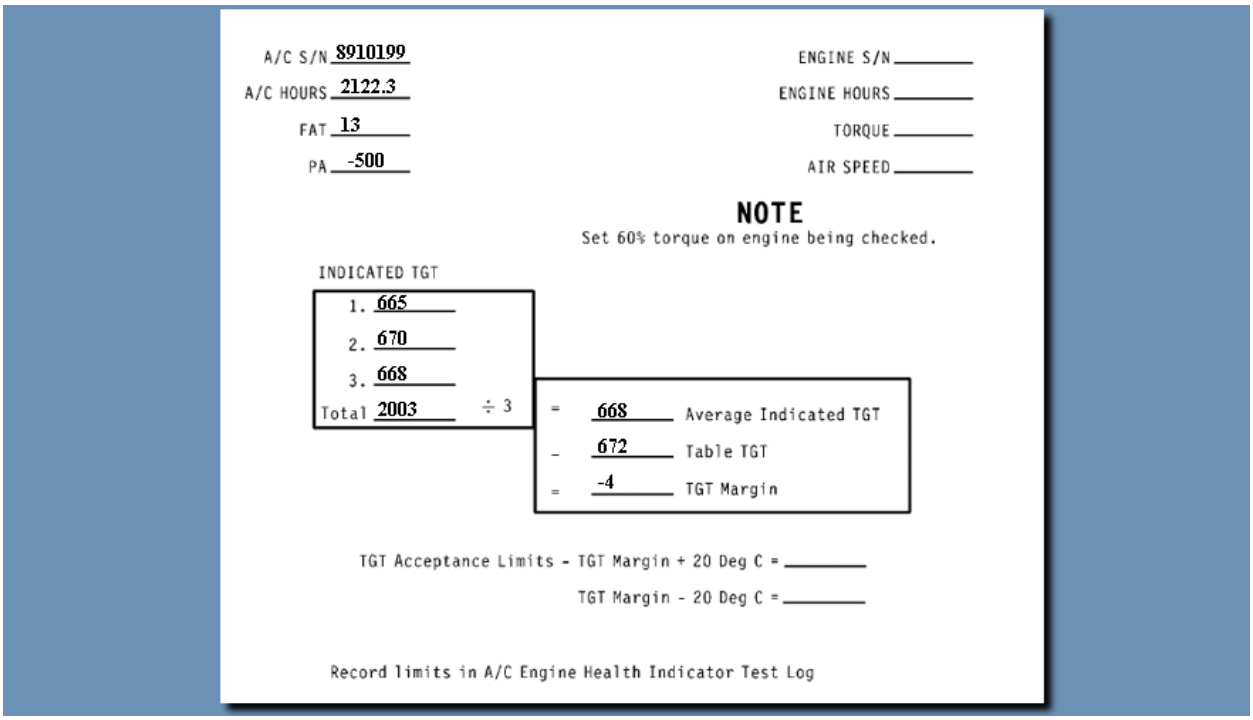
Frame #1080 (HIT Log 4)



(b) The Table TGT is 672.

(c) Calculate the TGT Margin.

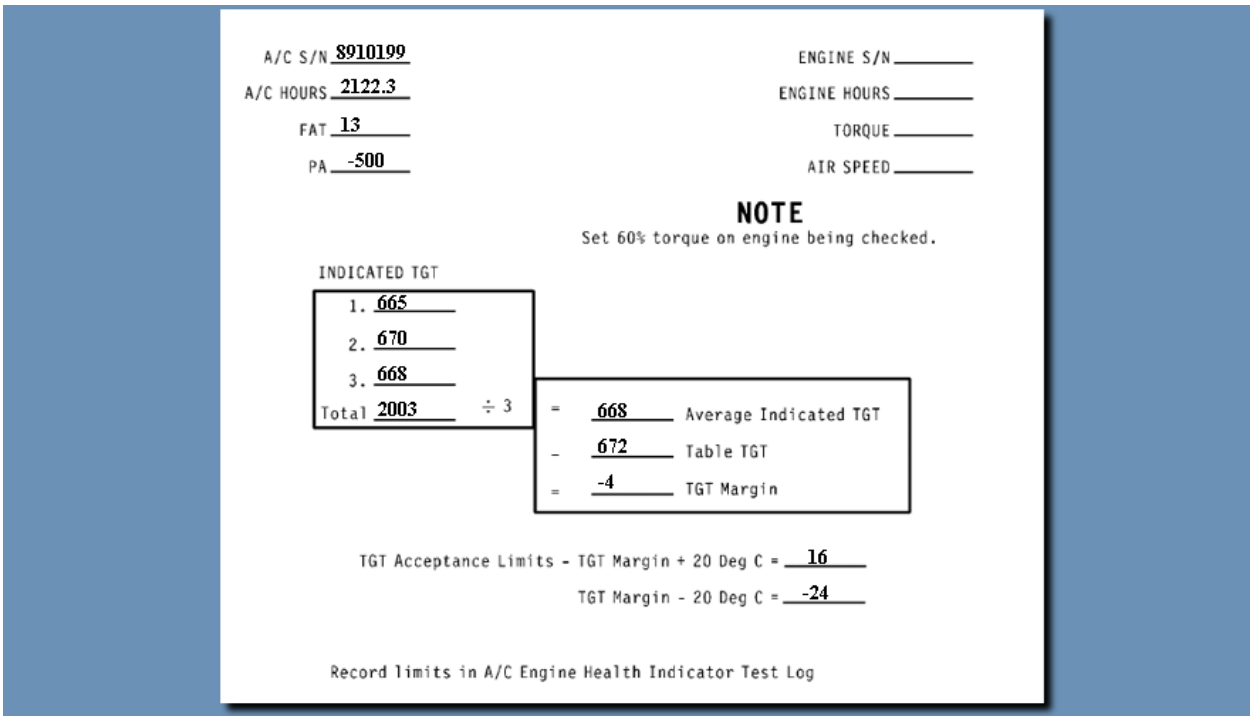
Frame #1080 (HIT Log 5)



(d) The TGT Margin is –4.

(e) Calculate the TGT Acceptance Limits.

Frame #1080 (HIT Log 6)



(f) The TGT Acceptance Limits are 16 and –24.

CHECK ON LEARNING

1. The HIT Check assists in identifying significant performance shifts, engine performance trends, and verifies _____.

2. During the Operational HIT Check, if the TRQ indication of the engine not being checked is greater than 5% at 92% - 98% Np, this is an indication of _____.

3. The AIR SOURCE HEAT/START switch has been set to ENG, but the TGT rise is 7 degrees. What is the probable cause?

4. The engine being checked has had the ENG ANTI-ICE switch placed in the ON position. What is the importance of at least a 30 degree rise, but less than a 110 degree rise in that engines TGT?

5. Cycling the Anti-Ice Bleed and Start Valve more than once will create the wrong fuel to air mixture and _____.

SECTION IV. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the Perform and Compute Health Indicator Test Baseline of the Health Indicator Test Baseline and Maximum Power Check topic.
The key points to remember are:

- Each turbine engine's ability to produce design stand horsepower output will be dependent on, and vary with the design and condition of dynamic and non-dynamic components as well as changes in ambient temperatures and pressure.
- The maintenance test pilot periodically tests and evaluates each engines performance and operation ensuring the detection of performance deterioration by the use of the operational HIT Check.
- Cycling of the Anti-Ice Bleed and Start Valve more than once can cause engine flameout at low power settings or during rapid collective movements.
- A new HIT baseline must be established on a newly installed/reinstalled engine, completed prior to doing a maximum power check, and after certain maintenance checks.
- If an engine fails a HIT check due to a dirty compressor or a faulty Anti-Ice Bleed and Start Valve, a new HIT baseline and maximum power check is not required.
- During the initial HIT check, the maintenance test pilot compensates for the particular engine characteristics and establishes the TGT limits to be used in the operational HIT check.
- When the AIR SOURCE HEAT/START switch is placed to ENG, if the TGT rise is greater than 5 ºC, troubleshoot the pneumatic system for leaks.
- If the TRQ indications in the cockpit are greater than 5% during the HIT check when the PCL is retarded to 92% - 98% Np, the TRQ reference shaft may have coking of oil inside the power turbine shaft, also known as TRQ stiction.
- When performing the Anti-Ice check on the engine being checked, should the TGT indicated be greater than 110 ºC, troubleshoot the Inlet Anti-Ice Valve.

C. ENABLING LEARNING OBJECTIVE No. 3

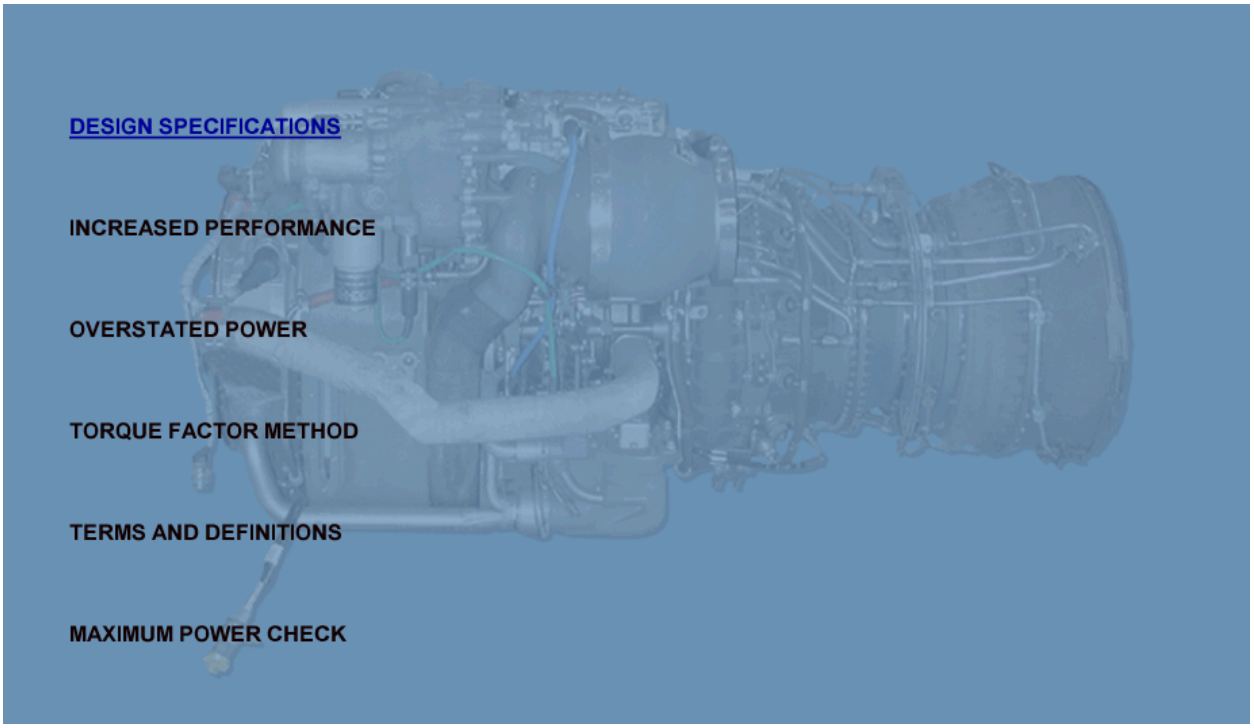
ACTION: Perform and compute a Maximum Power Check.

CONDITION: As a UH-60 Maintenance Test Pilot.

STANDARD: IAW TM 1-12840-248-23.

a. Maximum Power Check Menu

Frame #0505 (Maximum Power Check Menu)



(1) Design Specifications

Frame #0510 (Design Specifications)

(a) The T700 engine performance data is based on the Army Standard Hot Day.

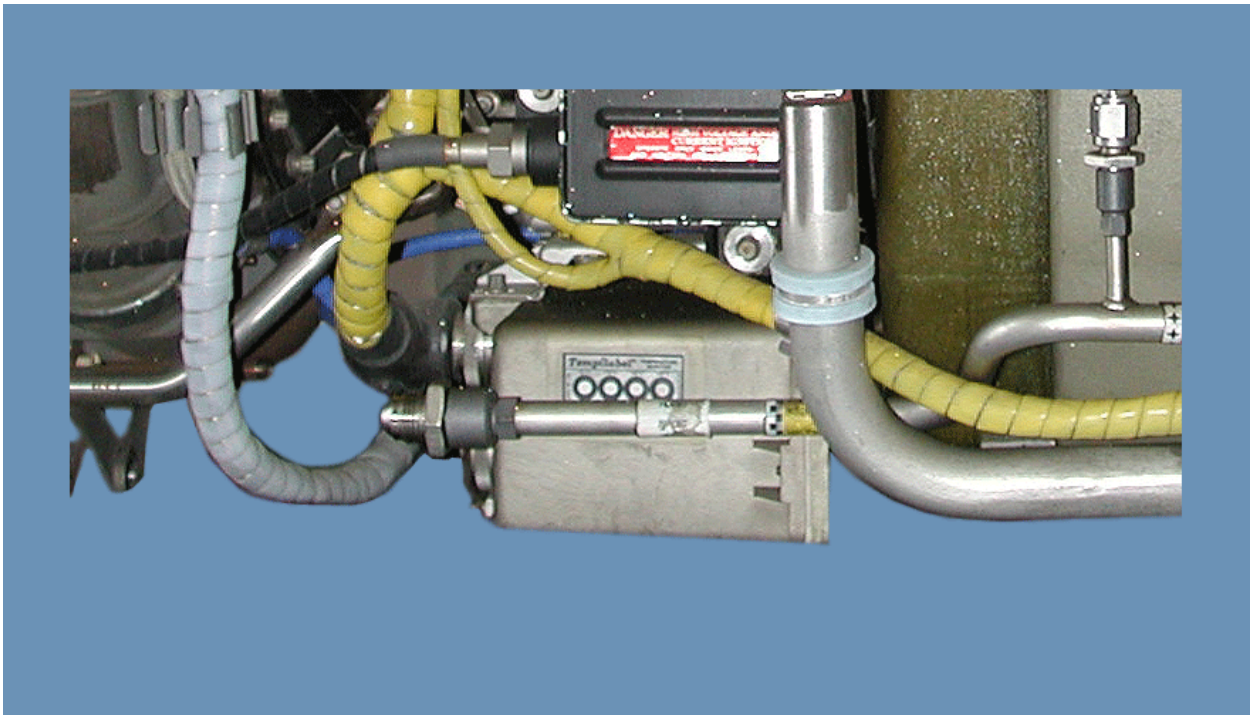
(b) The Army Standard Hot Day uses 4000' PA at 35 ºC.

(c) With this in mind, the manufacturing performance data and power limitations are based on a newly delivered low time engine.

(d) Some performance data can be affected by ambient temperature, aircraft configuration, degraded engine, and other influencing factors.

(2) Increased Performance

Frame #0515 (Increased Performance)



(a) The T-700 engine has achieved an increased performance by allowing the engines to operate at a higher maximum temperature.

(b) A bias resistor was placed in the ECU to change the TGT limiting value.

(c) No change was seen at the instrument since the resistor was placed in line prior to the instrument display.

(d) The increased power output ensured that specification power would be available throughout the expanding operating envelope of the UH-60.

ECU part number	Shaft Horse Power increase	ETF limit
4046T29G02 and 03	None	0.92
4046T29G06 and 07	+3%	0.92
4046T29G08 and later	+5%	0.97

(3) Overstated Power

Frame #0520 (Overstated Power)

(a) Continued testing of the T-700 engine uncovered some performance complications.

(b) The engines tend to overstate Max power output at cold free air temperatures.

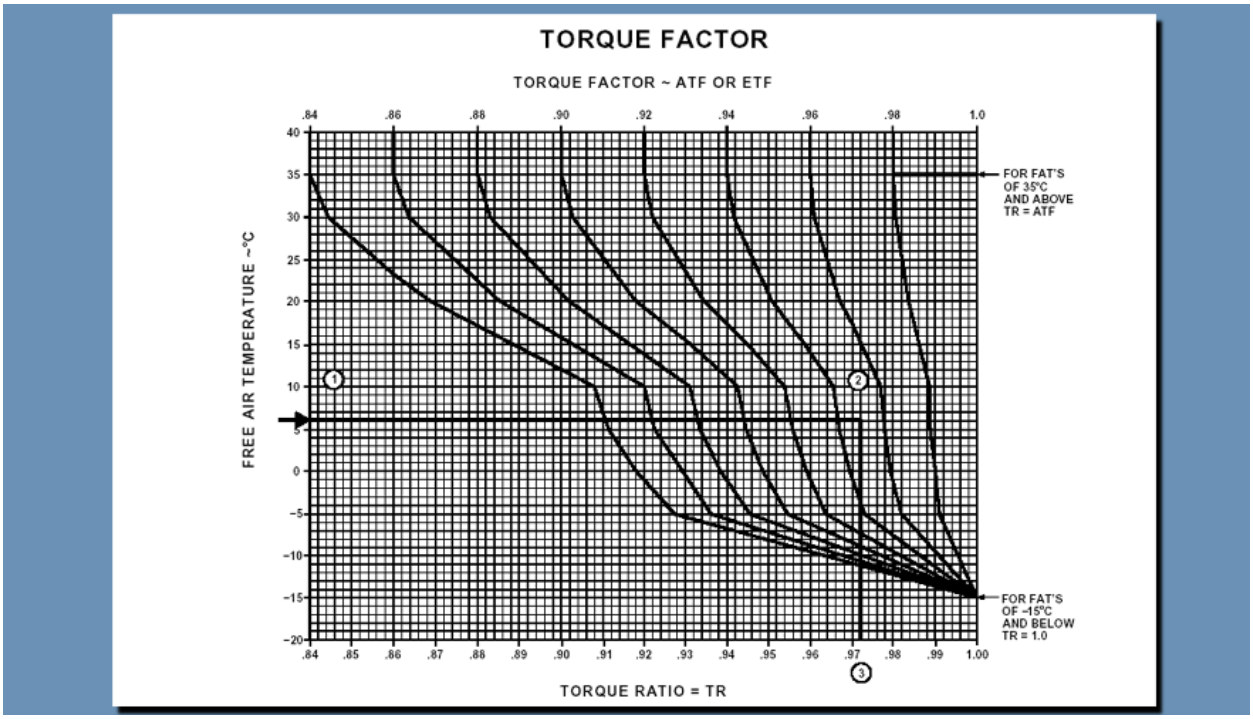
(c) This is due to the higher air density of extremely cold air.

(d) The compressor can easily provide the needed aid for engine operation when the air is very dense, even if erosion and/or Foreign Object Damage (FOD) exists.

(e) Hot Day performance could not be counted on from an engine that had only proven itself to the maintenance officer on cold days.

(4) Torque Factor Method

Frame #0525 (Torque Factor Method)



(a) The torque factor method provides a more accurate power check by taking potential errors into account.

(b) Charted data is used to accurately predict hot day performance based on a cold day check.

(c) To use the charts it is imperative that the Max power check be conducted at the engines performance limit when the control system is allowing maximum fuel flow.

(d) The control system will restrict fuel and limit power output for one of two reasons:

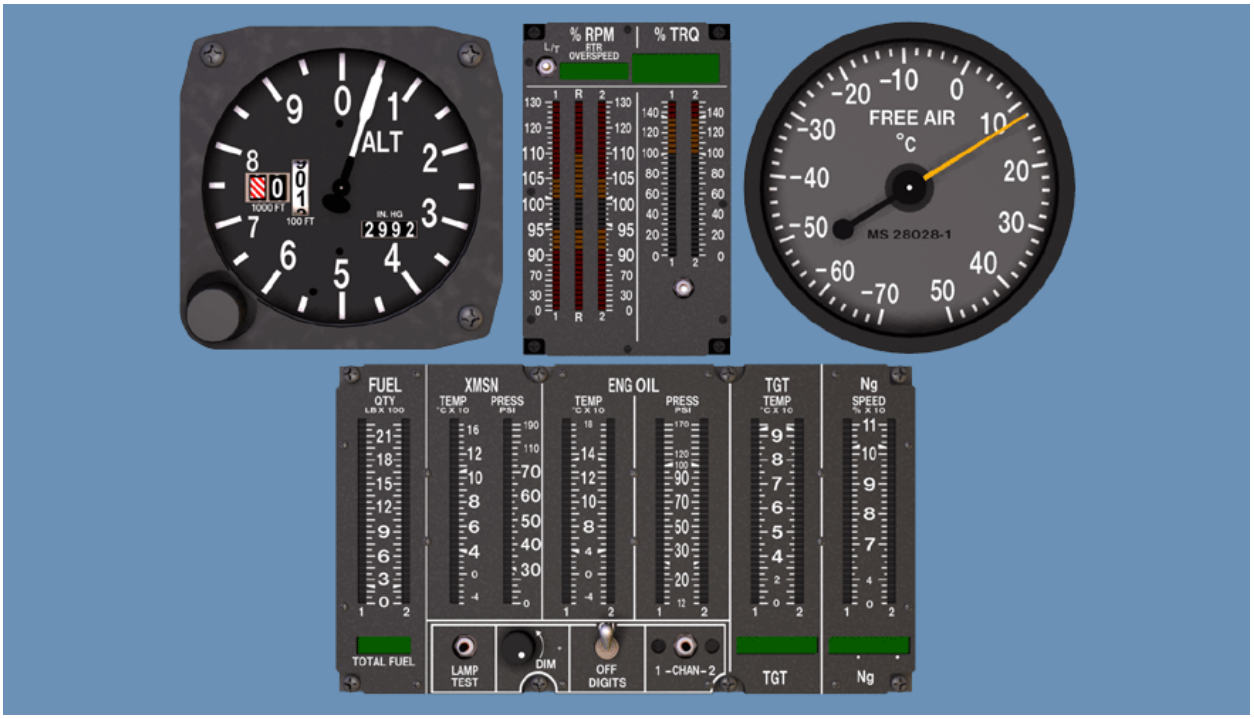
1) When the temperature is at the maximum permissible indicated TGT of 837 ºC to 849 ºC (TGT limiting by the ECU).

2) During cold free air temperatures (-12 ºC and less for the T-700, -14 ºC for the T-701C), the engine could build up to high of an internal pressure and/or excessive speed.

(e) Fuel flow is restricted to keep the Ng from causing an engine compressor stall (Ng limiting by the Hydromechanical Unit [HMU]).

(5) Terms and Definitions

Frame #0530 (Free Air Temperature)



(a) There are three ways that the data needed to complete the Max Power Check will be obtained:

1) Observed

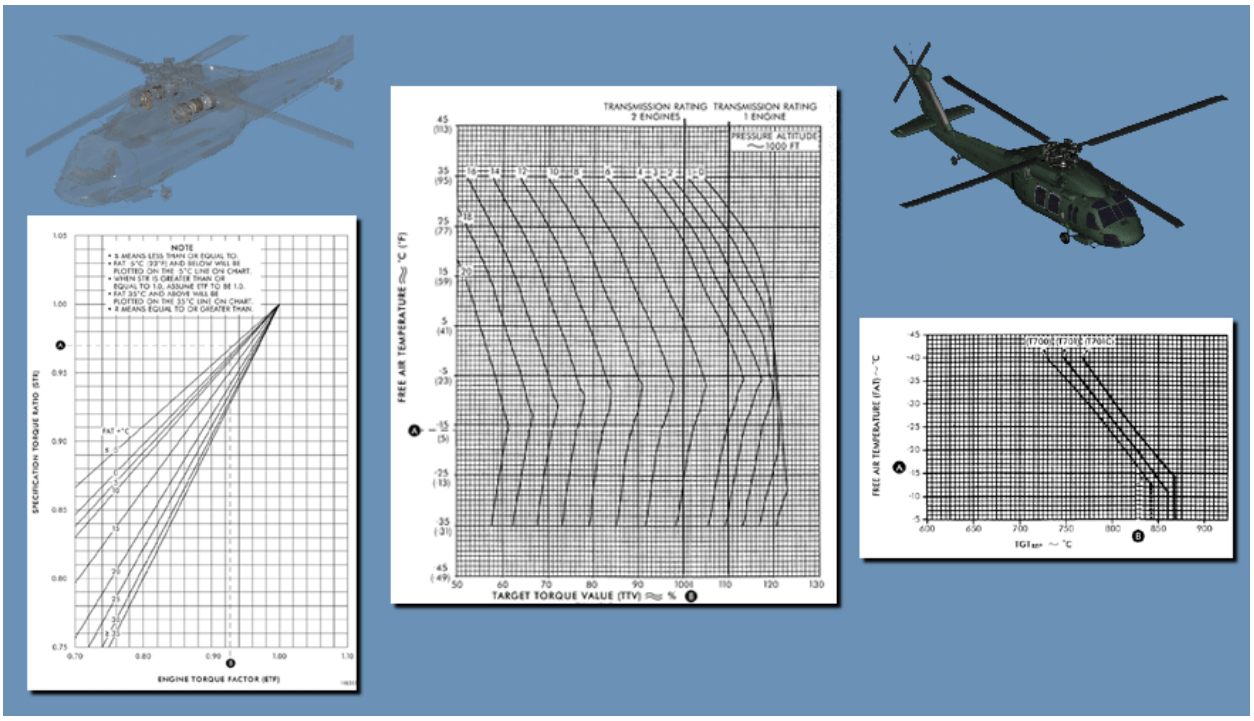
2) Charts

3) Calculated

(b) FAT, PA, TGT, TRQ, and Ng are all considered observed data.

(c) Charts

Frame #0535 (Charts)

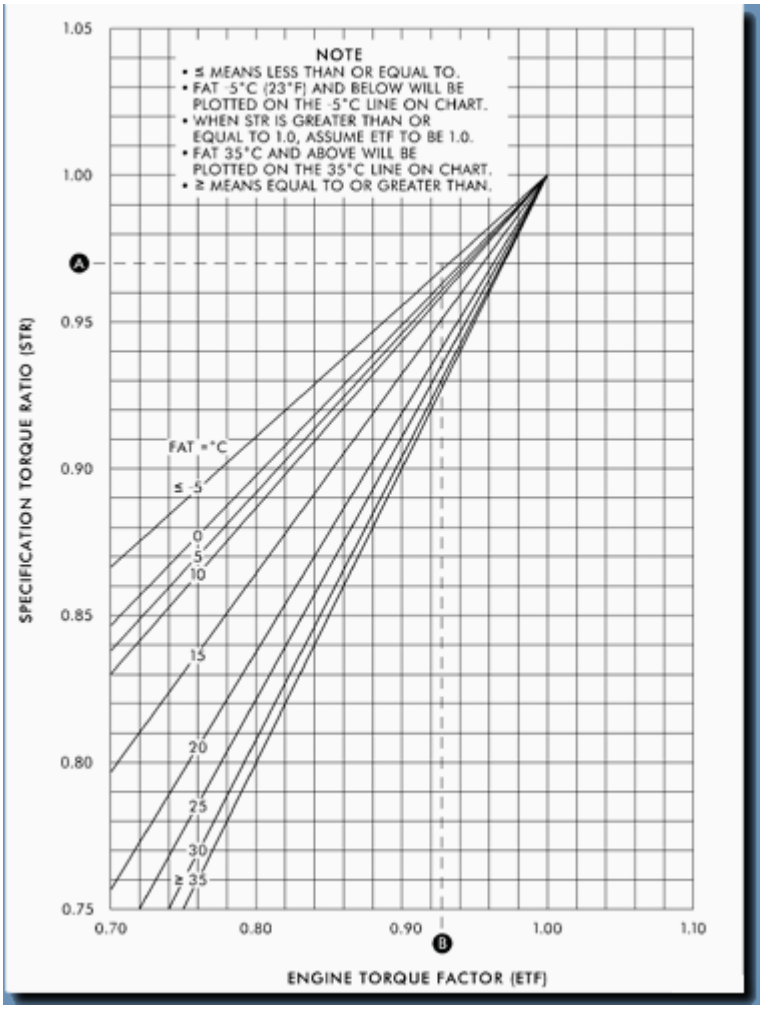


1) Chart data is retrieved from tables, figures, or graphs available in supplied reference material.

2) Information from the ETF, Target Torque Value (TTV), and Turbine Gas Temperature Reference (TGTREF) is chart data.

a) ETF Chart

Frame #0536 (ETF Chart)



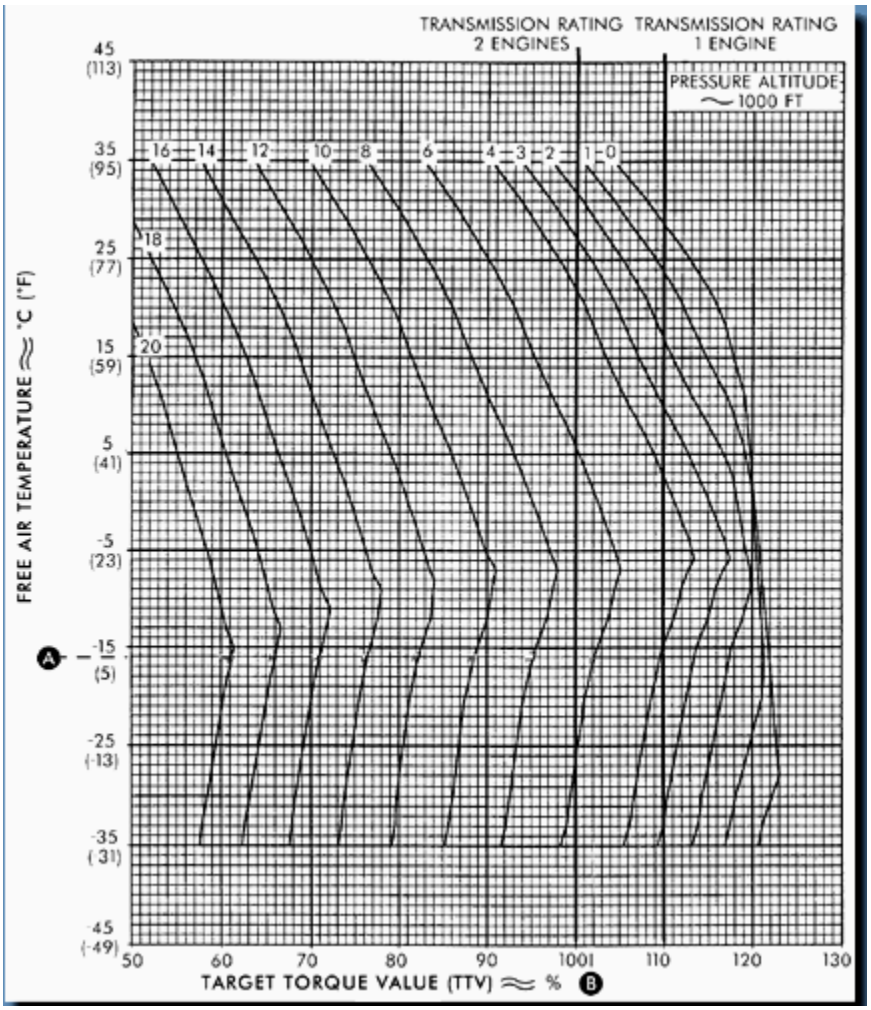
1 The ETF Chart is used to convert the Specification Torque Ratio (STR) into an Engine Torque Factor (ETF).

2 This value is the STR adjusted to a temperature of 35 ºC.

3 The ETF determines the acceptable level of performance degradation, and is used to make the GO/NOGO determination of acceptable performance.

b) TTV Chart

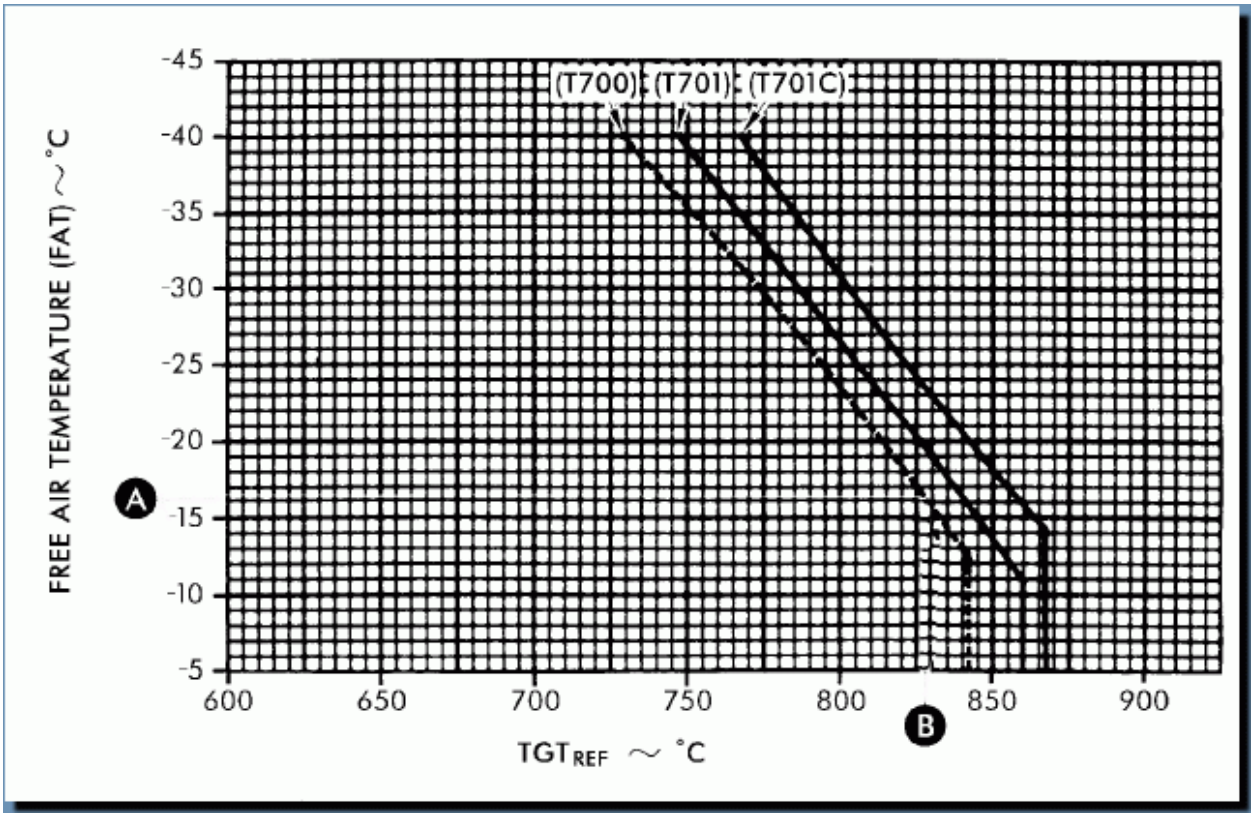
Frame #0537 (TTV Chart)



1 The TTV Chart provides the torque that a specification engine should produce when operated at the various charted environmental conditions.

c) TGTREF Chart

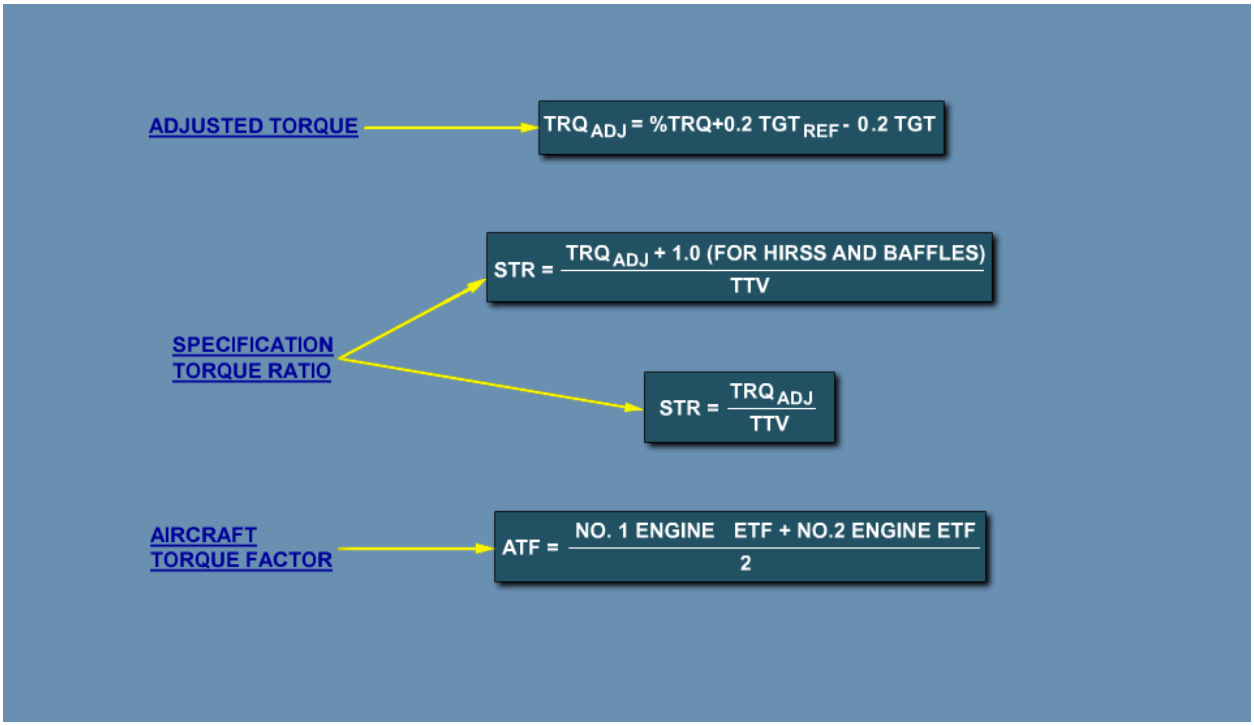
Frame #0538 (TGTREF Chart)



1 The TGTREF Chart provides the turbine gas temperature at which a specification engine would Ng limit when operated at the charted environmental conditions.

(d) Terms and Definitions Menu

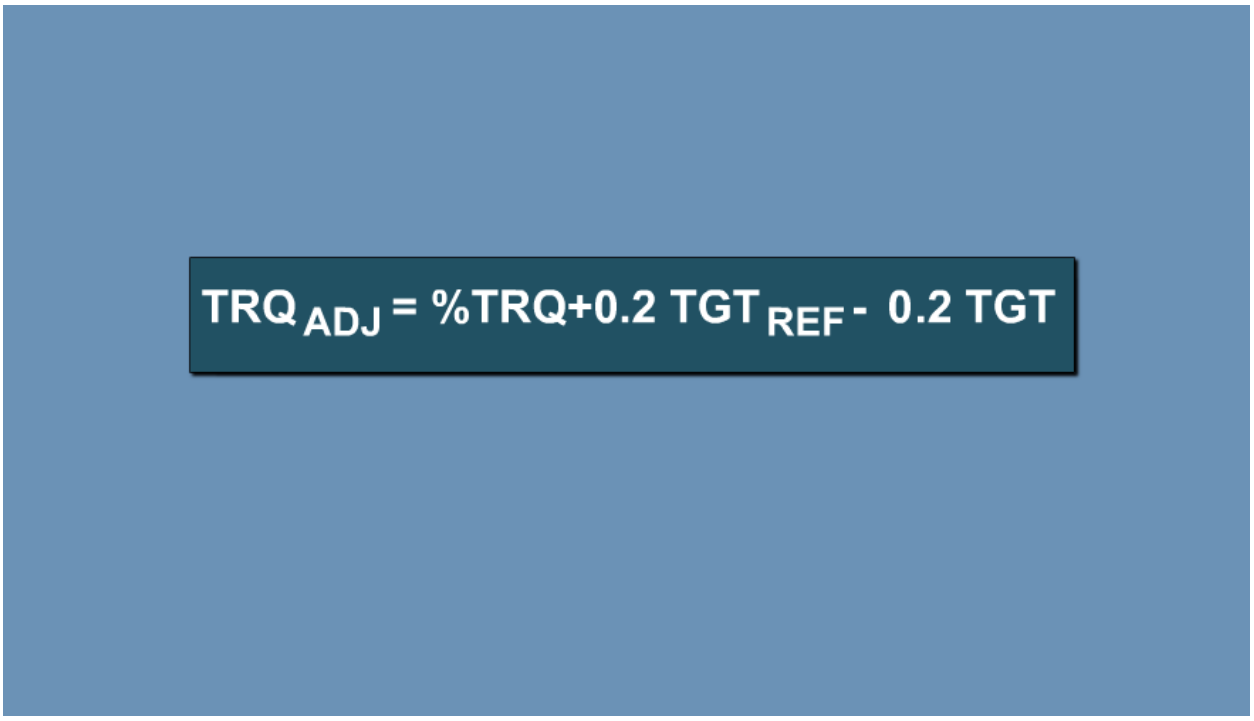
Frame #0540 (Terms and Definitions Menu)



1) Calculated data is computed using formulas supplied throughout this lesson and available reference material.

2) Adjusted Torque

Frame #0541 (Adjusted Torque)



a) Adjusted Torque (TRQADJ) is the observed TRQ corrected for cold free air temperatures.

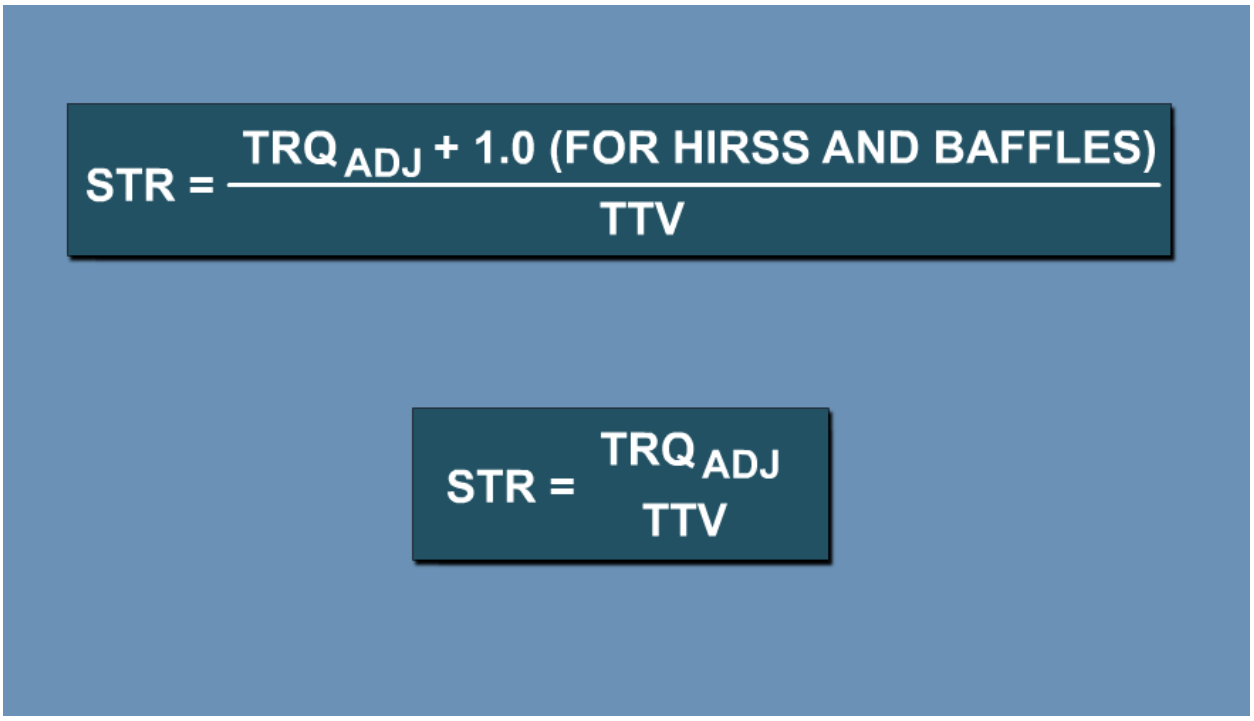
b) The amount of correction varies from "none" at temperatures warmer than -12 ºC (UH-60A), -14 ºC (UH-60L), to a variable amount at temperatures colder than -12 ºC (UH-60A), -14 ºC (UH-60L).

c) The amount depends on the TGT observed during the check procedures.

d) The TRQADJ is calculated by using the formula above.

3) Specification Torque Ratio

Frame #0542 (Specification Torque Ratio)



a) Specification Torque Ratio (STR) is the percentage of power that the engine developed during the maximum power check in relation to what a specification engine would have developed.

b) STR is calculated by using one of the formulas above.

c) Note the difference between the two formulas.

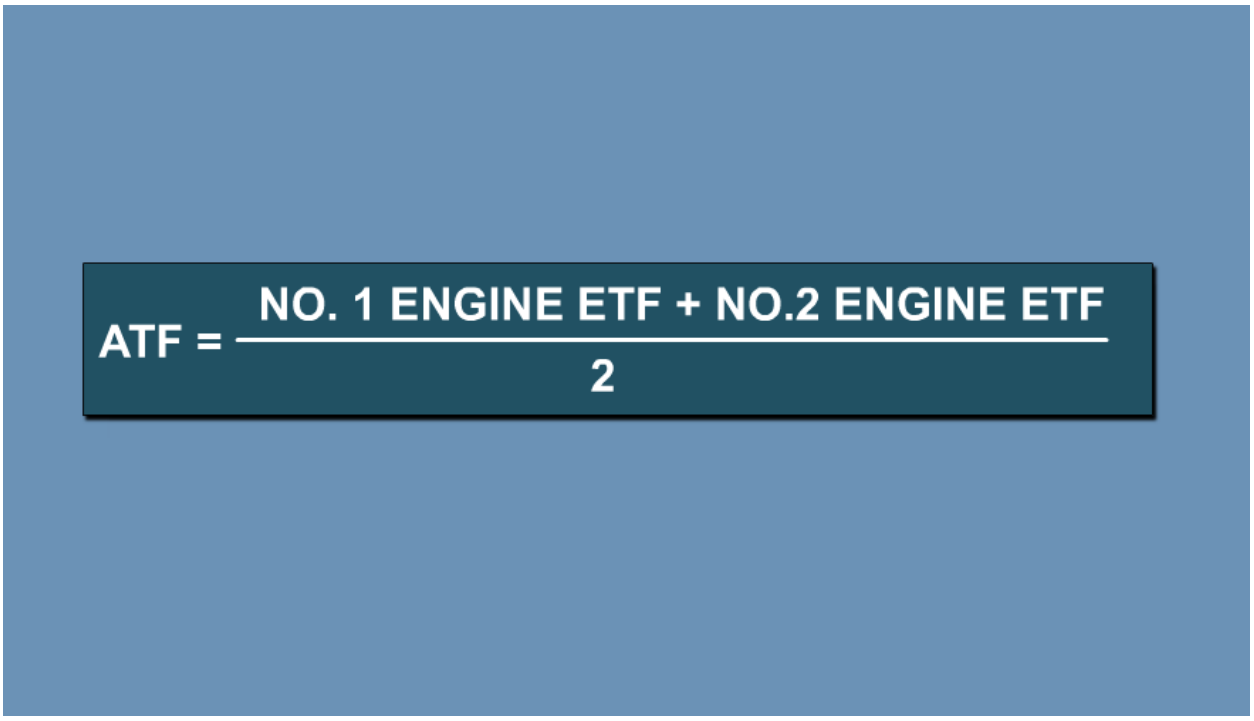
d) The first formula (top) is used for an aircraft with the Hover Infrared Suppression System (HIRSS) and baffles.

e) The second formula (bottom) is for an aircraft without the HIRSS and baffles.

f) If the correct formula is not used, the STR will not be correct.

4) Aircraft Torque Factor

Frame #0543 (Aircraft Torque Factor)



a) The Aircraft Torque Factor (ATF) is the average of the two installed engine's ETF.

b) Just as the ETF represents the engine's power producing capabilities adjusted for temperature, the ATF represents the aircraft's power producing capabilities adjusted for temperature.

c) The ATF is calculated by using the formula above.

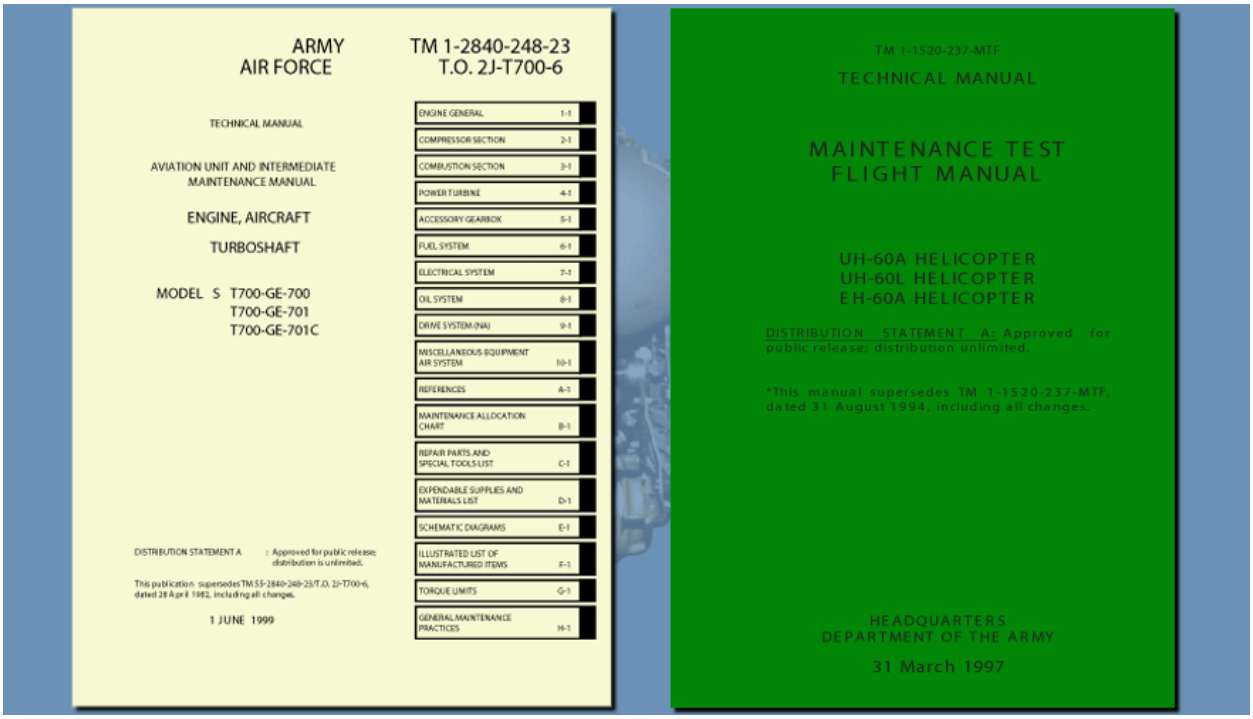
(6) Maximum Power Check

Frame #0545 (Maximum Power Check)

(a) The Max Power Check provides an accurate indication of available power by incorporating ambient temperature effects into the power available calculation.

(b) When an engine is reinstalled or installed for the first time, or after an engine fails the HIT check (not caused by a faulty anti-icing bleed and start valve, or a dirty compressor), an in-flight check will be made to ensure that the engine meets minimum power requirements and to establish/re-establish the ETF.

Frame #0550 (Technical Manuals)



(c) The procedure for performing a maximum power check can be found in either TM 1-2840-248-23 or TM 1-1520-237-MTF.

(d) These publications will take you through acquiring performance data, and performing the calculations needed to establish the available power for the engine.

(e) Performance data will be taken at an engine limiting condition while maintaining approximately 120 KIAS forward flight speed.

(f) The engine Anti-Ice and Heater will be off and the altimeter will be set to 29.92 in. Hg.

(g) Data will be taken on one engine at a time.

(h) If the Max power check is being performed because of a single engine installation/ re-installation or failed HIT Check, it is the maintenance officer's discretion to obtain new ETF data for the other engine.

Frame #0555 (Maximum Power Check for #1 Engine)

WARNING: Engine Torque Limit (UH-60)

Dual engine torque limit of 100% may be exceeded only if the torque applied by the other engine is less than 90%. Do not exceed the single engine torque limit of 110%.

CAUTION: To avoid torque oscillations when making performance checks, a torque split of at least 10% will be held between engines. If flight conditions prevent setting the performance point at 120 knots and keeping the 10% torque split, allow forward flight speed to increase or decrease; however, a torque split of at least 10% must be maintained.

If, and only if, maximum power check is being performed because of a failed HIT check, and weather conditions prevent a higher altitude, perform troubleshooting procedure 65 before using the alternatives of step (3).

NOTE: Some units are grounding aircraft when weather is inclement, and some units are assuming an ETF of 1.0, which could lead to serious planning errors.

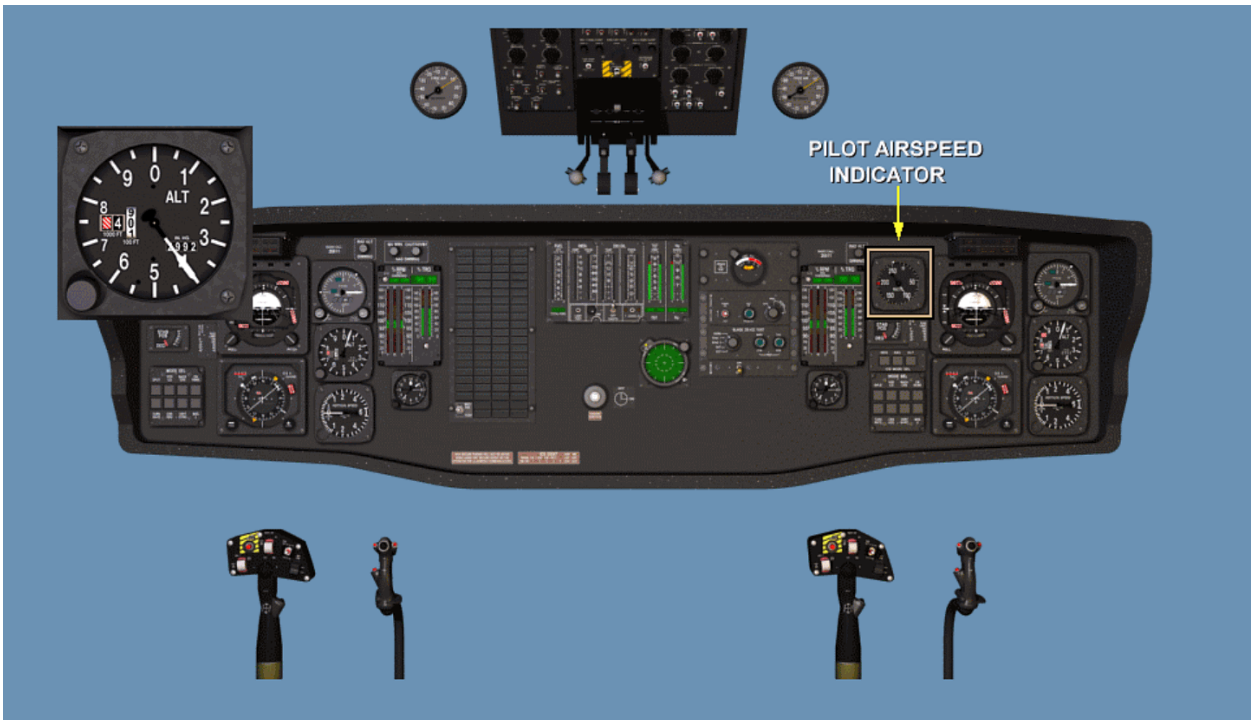
Transient overshoot up to 886 ºC (1627 ºF) for maximum duration of 12 seconds may be observed, followed by TGT stabilizing at the normal limiting range of 837 ºC to 849 ºC (1538 ºF to 1561 ºF).

TGT should not exceed the normal TGT limiter setting. If TGT exceeds the normal limiter setting, discontinue the maximum power check and refer to troubleshooting procedure 37 (table 1-13).

(i) The example Max Power Check being conducted is for the replacement of the No. 1 engine, model T700.

(j) The ECU that is installed on this engine is a G09 part number.

Frame #0560 (Copilot Altimeter)



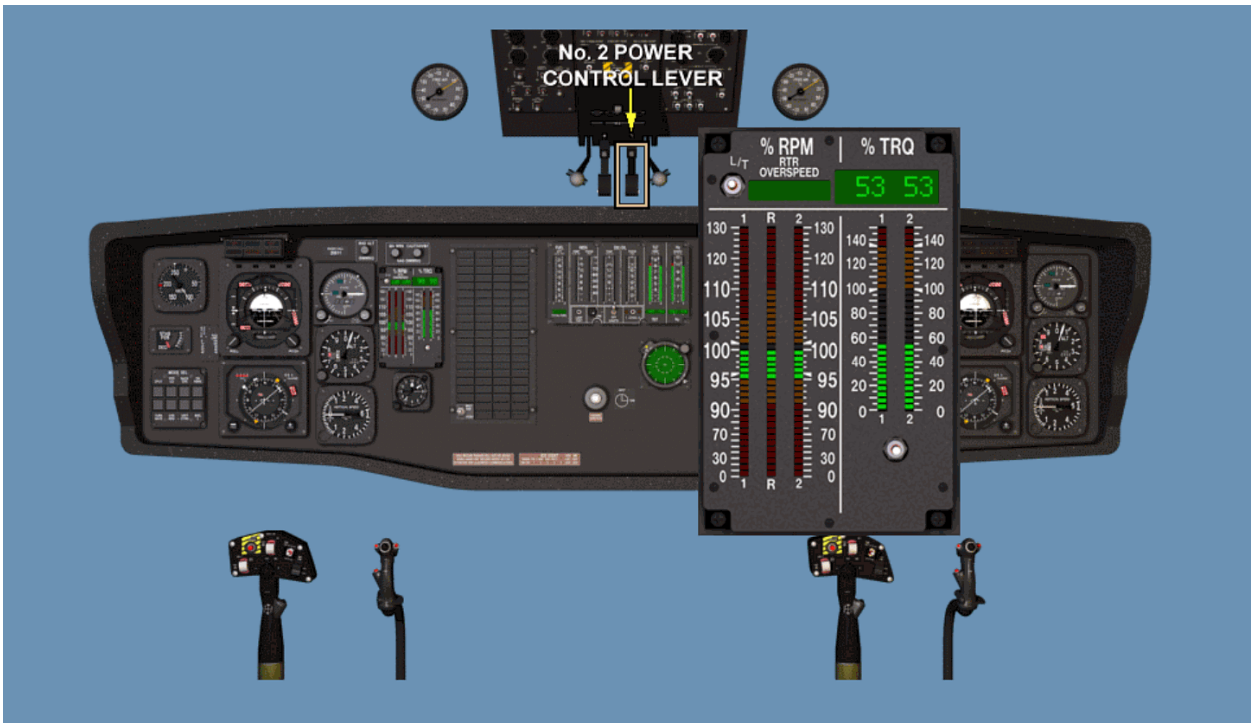
(k) For the purpose of this example, the Max Power Check will be conducted using the barometric altimeter setting of 29.92, at a PA of 4000'.

(l) Only one Barometric Altimeter should be set at 29.92 for this process, the other should remain at the current base setting.

Frame #0560 (Pilot Airspeed Indicator)

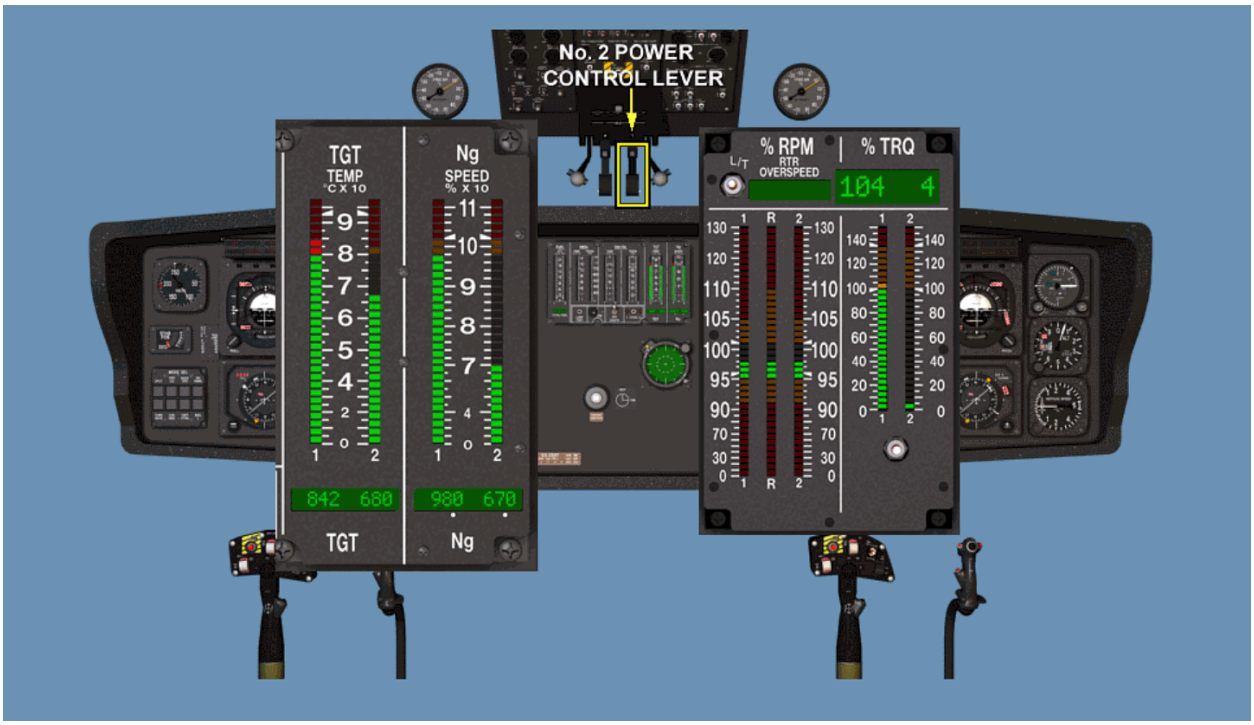
(m) The desired airspeed for a Max Power Check is 120 knots.

Frame #0560 (Pilot Display Unit)



(n) With both engine Power Control Levers (PCL) in the fly position, verify the RPMR is 100%.

Frame #0560 (TGT Temp/Ng Speed)

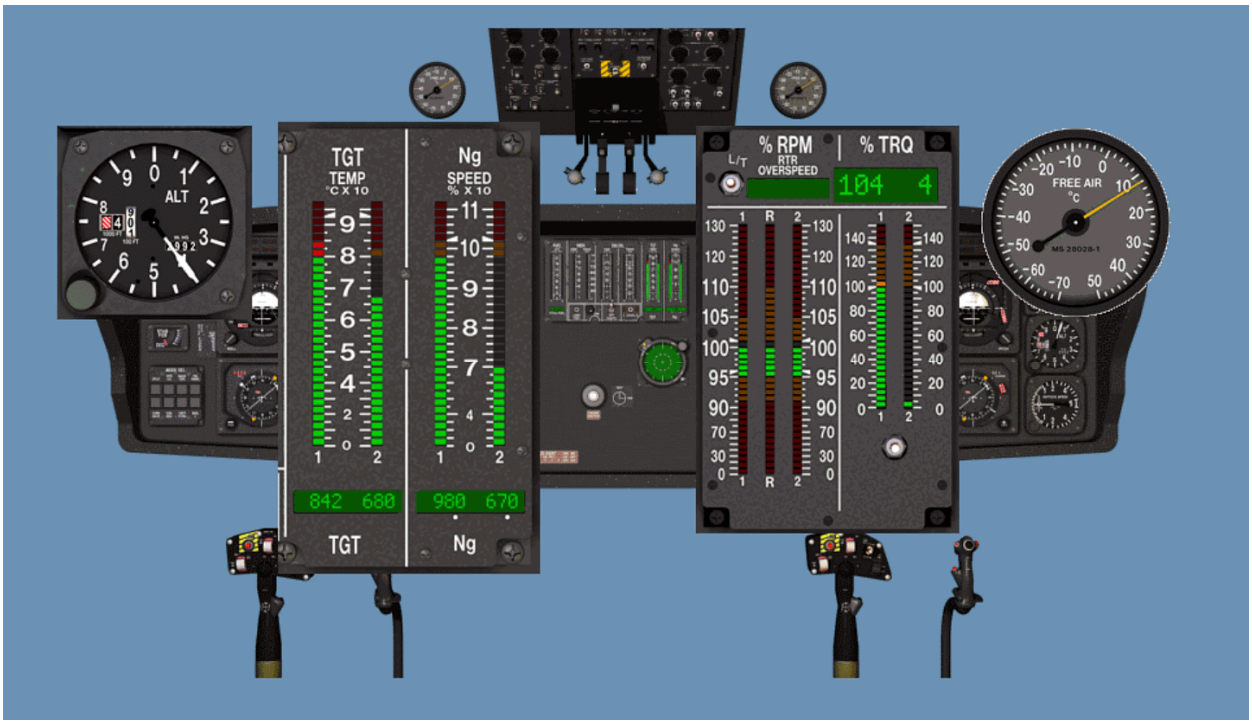


(o) The PCL of the No. 2 engine, the engine not being checked, has been retarded until the RPMR of the No. 2 engine has been reduced by 2%.

(p) Observe the TGT on the engine being checked.

(q) Slowly advance the PCL of the engine not being checked only enough to reestablish % RPMR to 100% without any change in TGT on the engine being checked.

Frame #0565 (RPMR/TRQ)

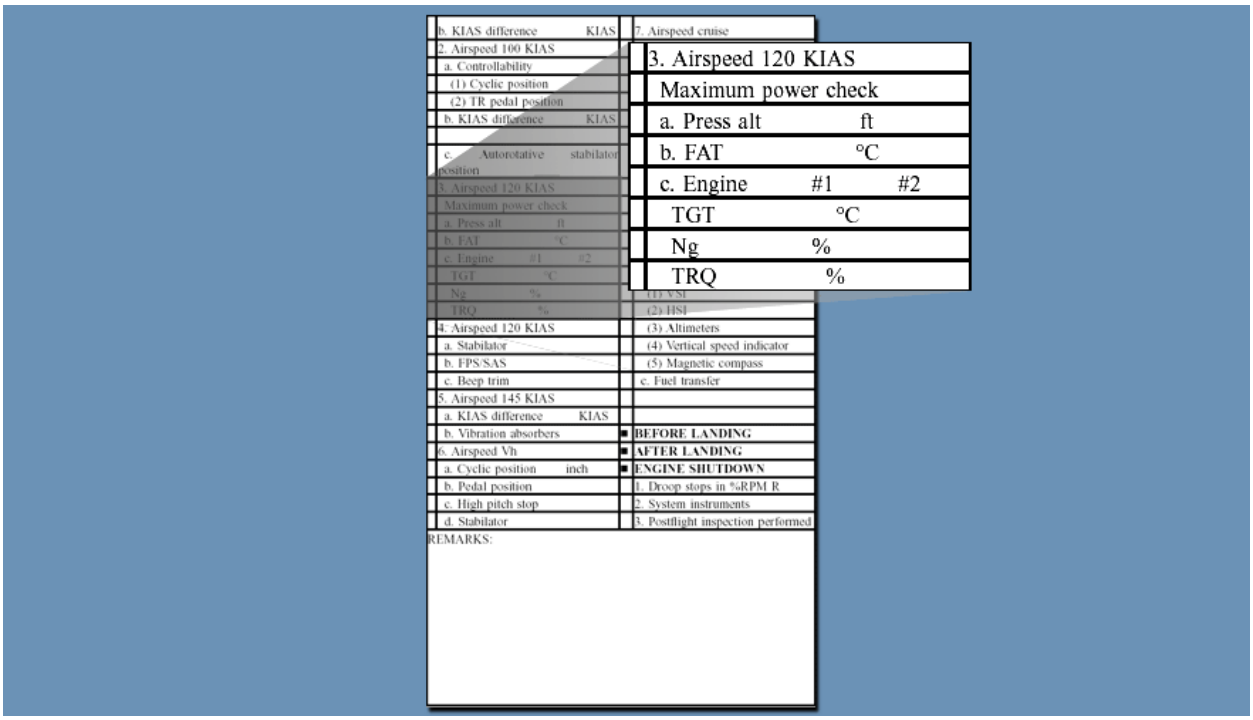


(r) Once the PCL of the engine not being checked has been advanced enough to reestablish % RPMR to 100%, without any change in TGT on the engine being checked, data must be recorded.

(s) Record the FAT and PA, and the NG, TGT, and % TRQ for the No. 1 engine.

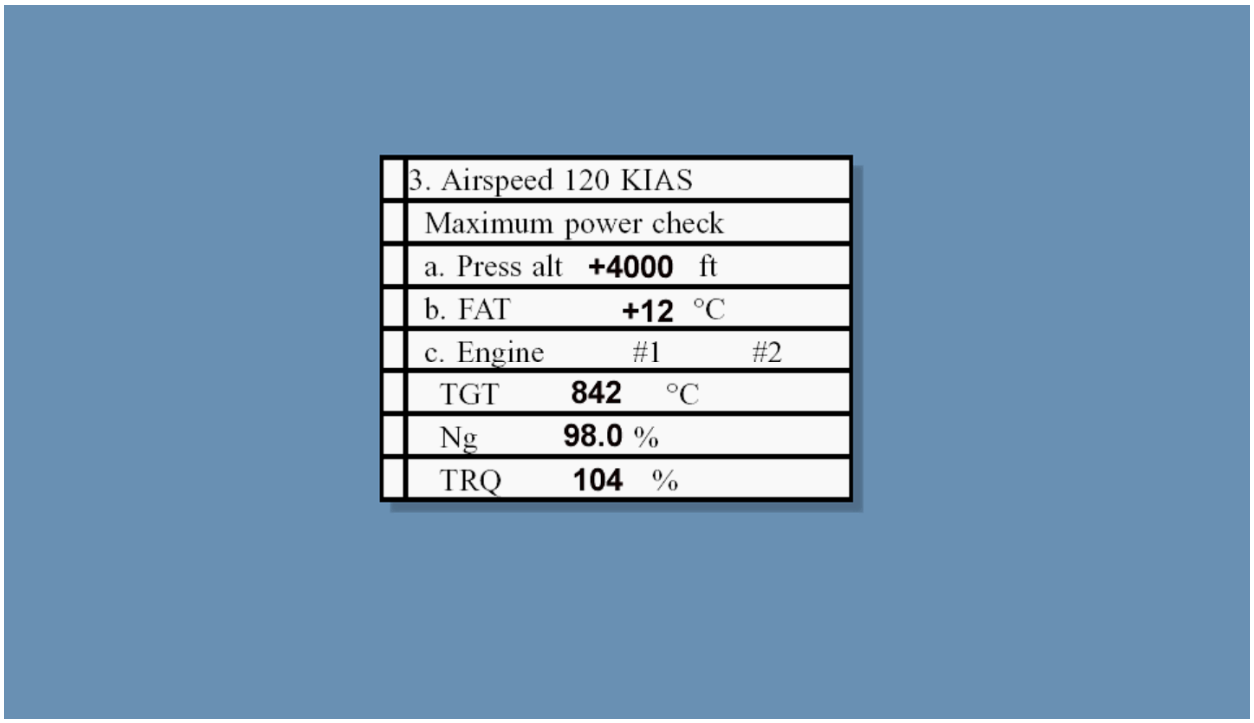
(t) The recorded FAT is +12 ºC, PA 4000', NG 102.2%, TGT 842 ºC, and TRQ is 104% for the No. 1 engine.

Frame #0570 (Maintenance Test Flight Check Sheet)



(u) The recorded values are to be annotated on the Maintenance Test Flight (MTF) check sheet under the maximum power portion.

Frame #0575 (MTF Check Sheet)



AIRCRAFT DATA

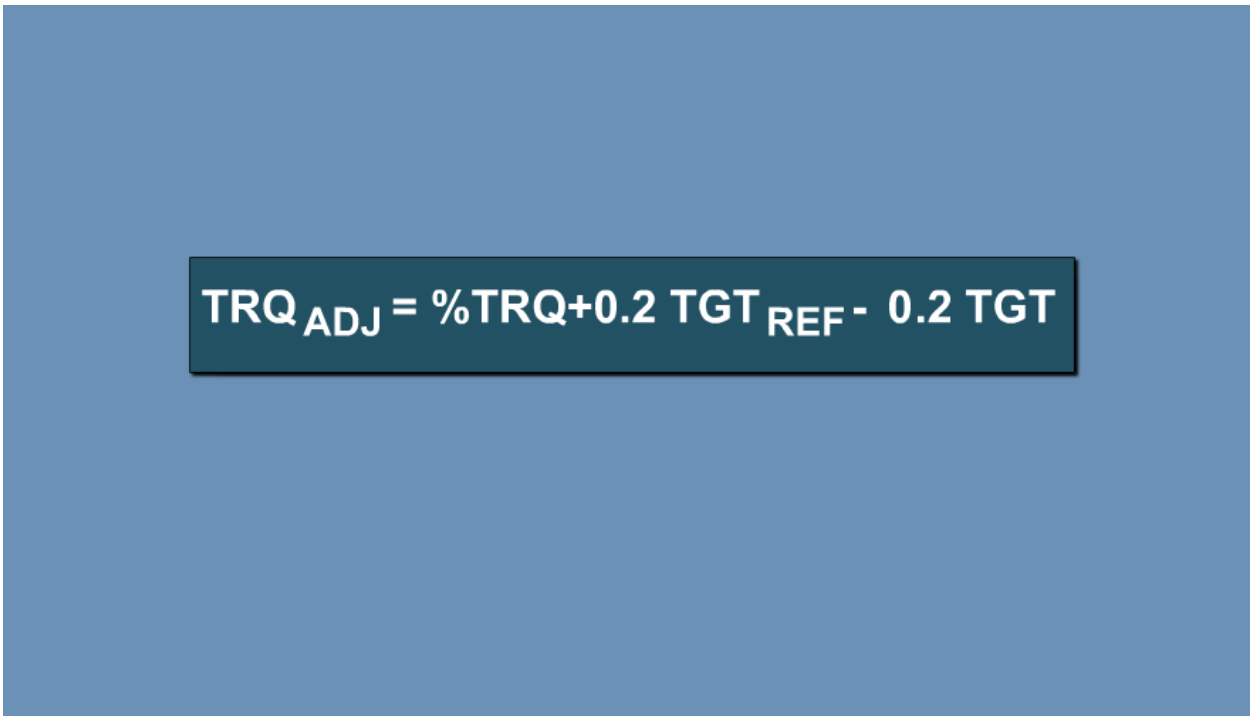
- No HIRSS
- PA = +4000 ft
- FAT = +12 ºC

.

No. 1 ENGINE DATA

- TGT = 842 ºC
- NG = 98.0%
- TRQ = 104%
- ECU = G09

Frame #0580 (Adjusted Torque)



(v) Based on the acquired data, the first step is to find the Adjusted Torque (TRQADJ).

(w) Adjusted torque is the observed TRQ corrected for cold free air temperatures.

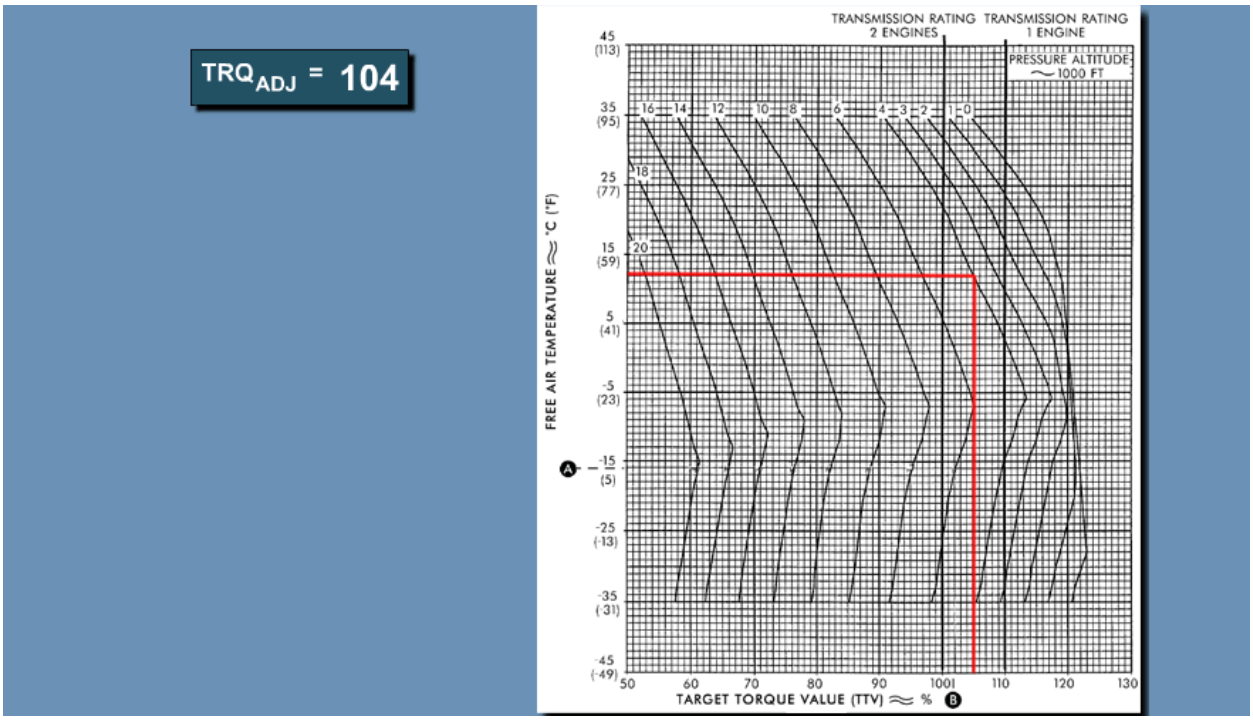
(x) The amount of correction varies from "none" at temperatures warmer than -12 ºC (UH-60A), -14 ºC (UH-60L), to a variable amount at temperatures colder than -12 ºC (UH-60A), -14 ºC (UH-60L).

(y) The amount depends on the TGT observed during the check procedures.

(z) This value is calculated by using the formula above.

(aa) Since the FAT is above -12 ºC, the TRQADJ is 104.

Frame #0585 (Target Torque Value)



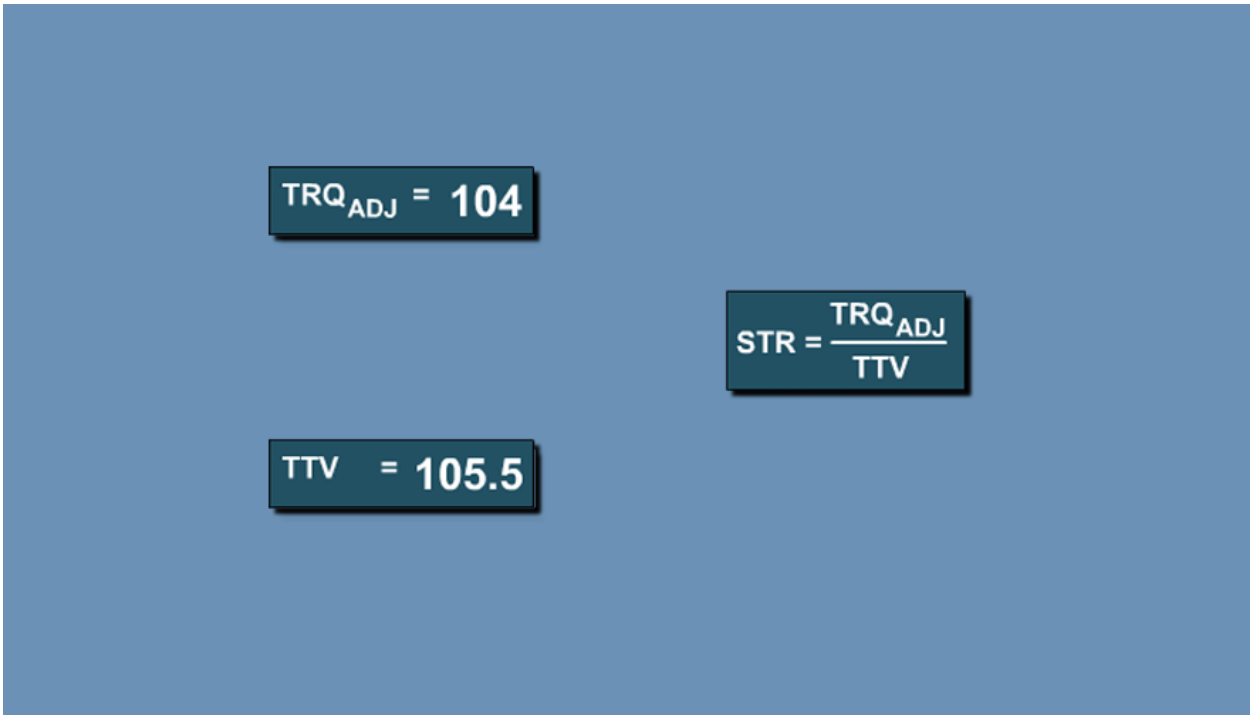
(bb) The second step is to use the Target Torque Value (TTV) chart found in the TM.

1) Locate the recorded FAT on the left side of the chart, move right to the intersection of +12 ºC line and the 4000 foot PA line.

2) From the intersection point, move straight down to read to TTV at the bottom of the chart.

3) The TTV for this reading is 105.5.

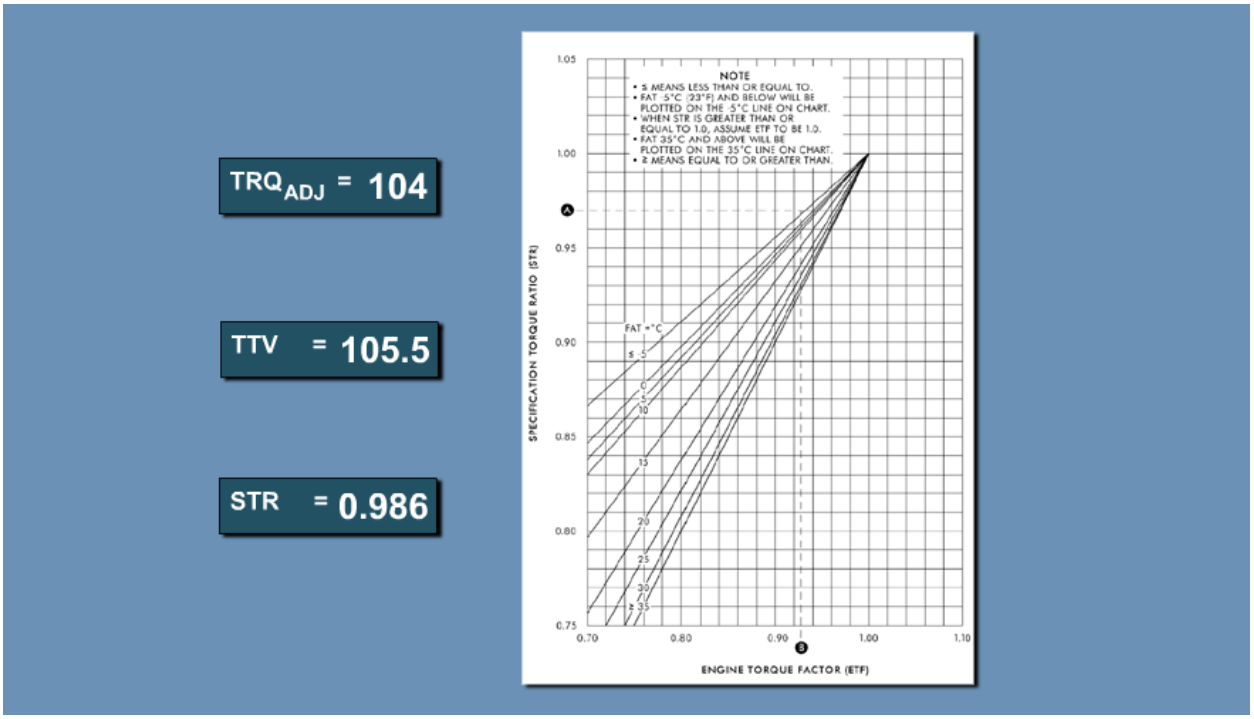
Frame #0590 (Specification Torque Ratio)



(cc) The third step is to determine the Specification Torque Ratio (STR) by applying the TRQADJ and the TTV to the STR formula.

1) Based on the given information, the STR is 0.986 for this engine.

Frame (0595 (Engine Torque Factor)



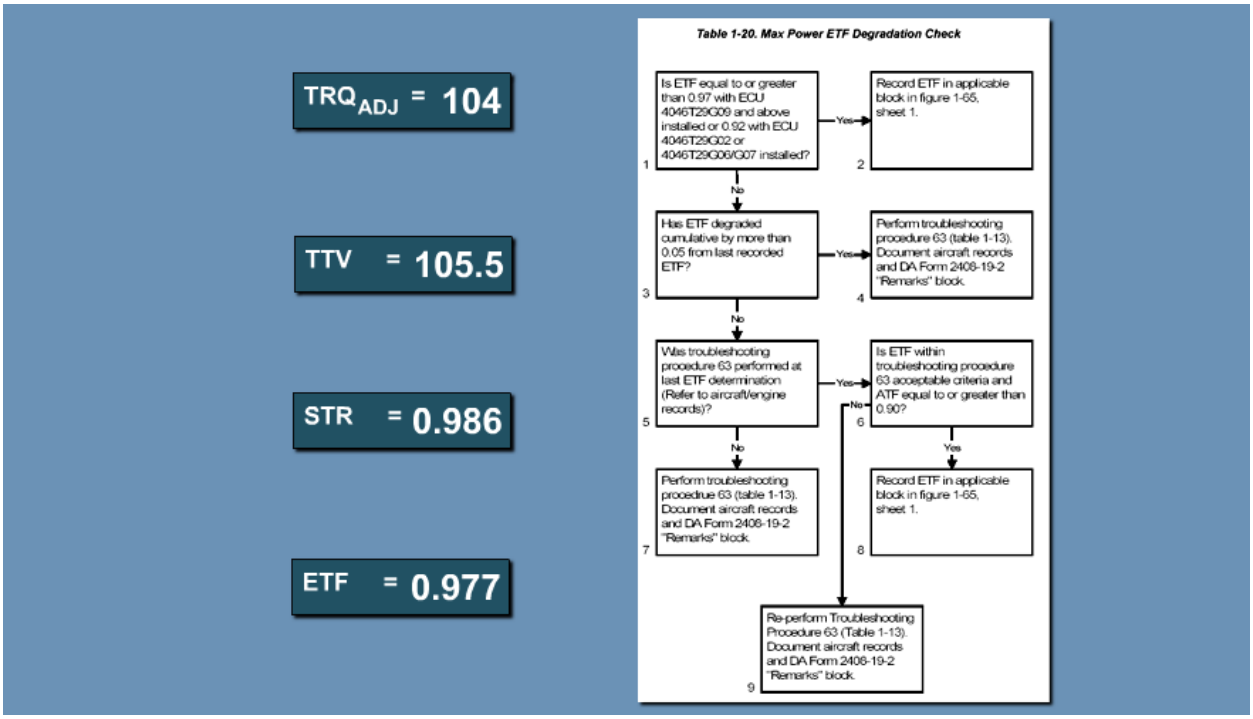
(dd) The fourth step is to determine the Engine Torque Factor (ETF) of the engine being checked using the newly acquired data, STR 0.986, with the FAT of +12 ºC.

1) Find the STR on the left side of the chart, read to the right where the FAT is.

2) Move down to the bottom of the chart to the ETF.

3) The ETF of this engine is 0.98.

Frame #0600 (Table 1-20 Max Power ETF Degradation Check)

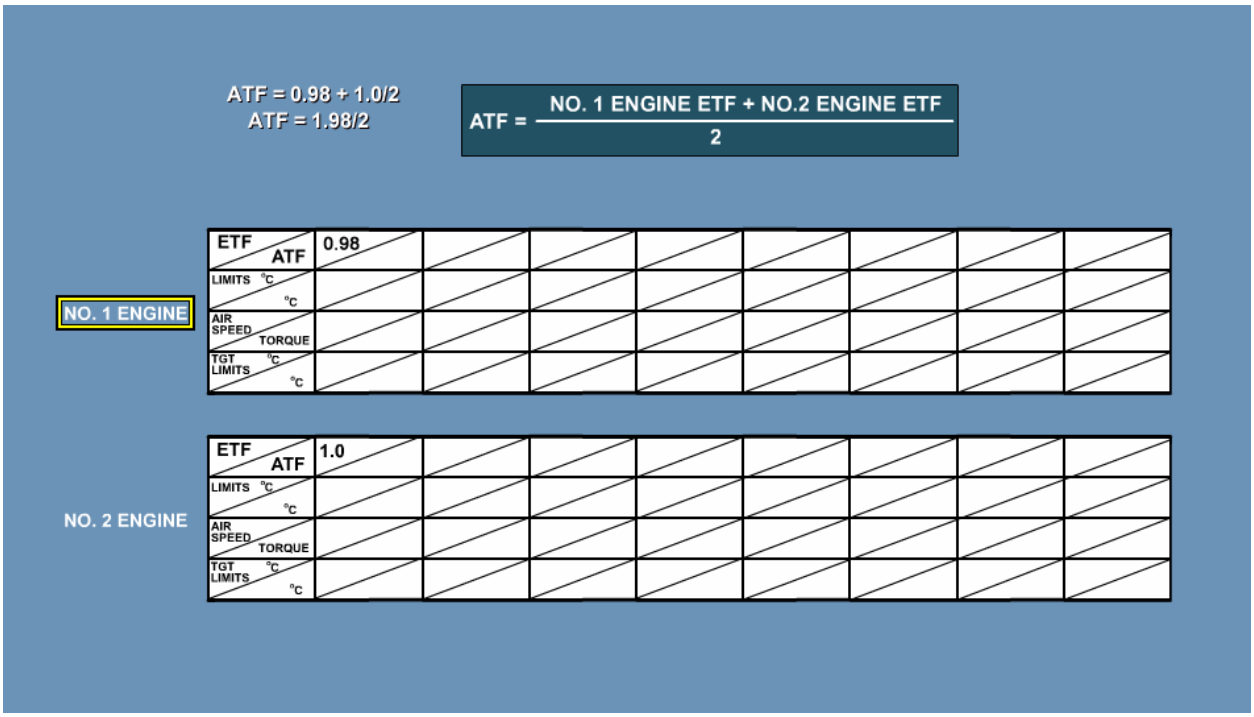


(ee) Once all the calculations are complete, check the final data for the engine being evaluated with the Maximum Power ETF Degradation Check chart, verifying that the engine is within limits.

1) This engine is equipped with an Electronic Control Unit (ECU) type G09, the ETF is equal to or greater than 0.97.

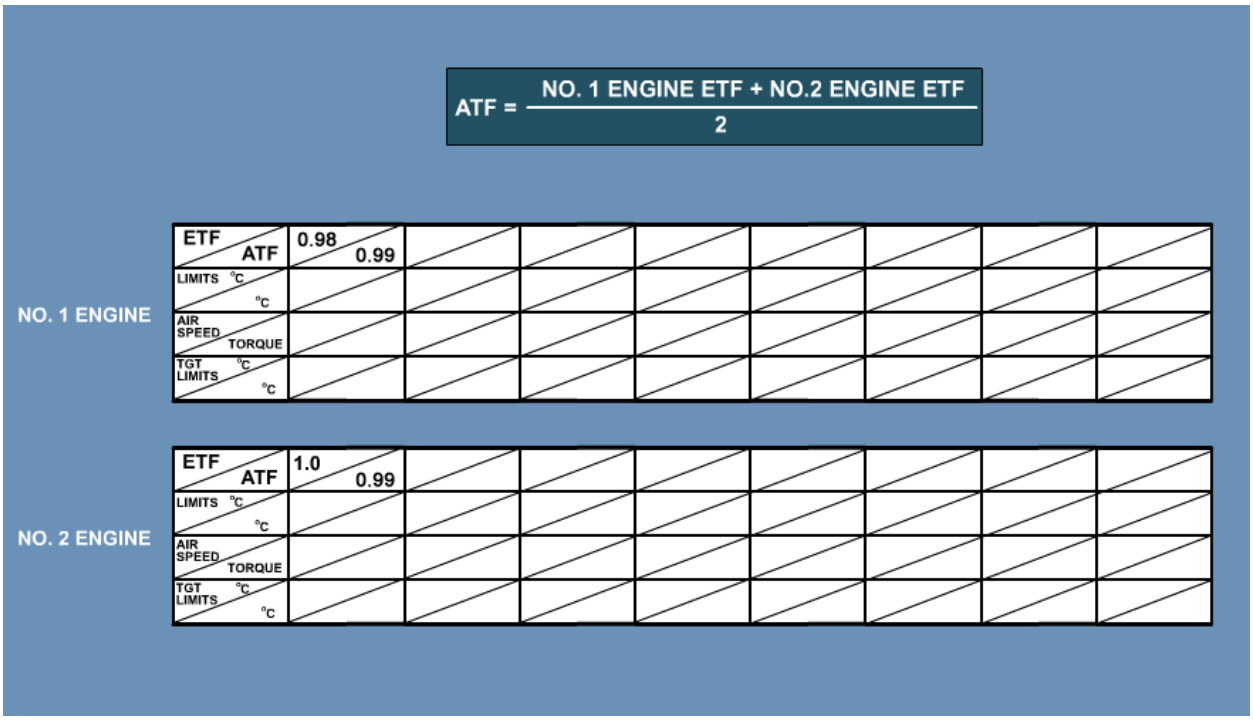
2) Based on that information and the use of the Max Power ETF Degradation chart, this engine is within limits.

Frame #0605 (Calculate ATF)



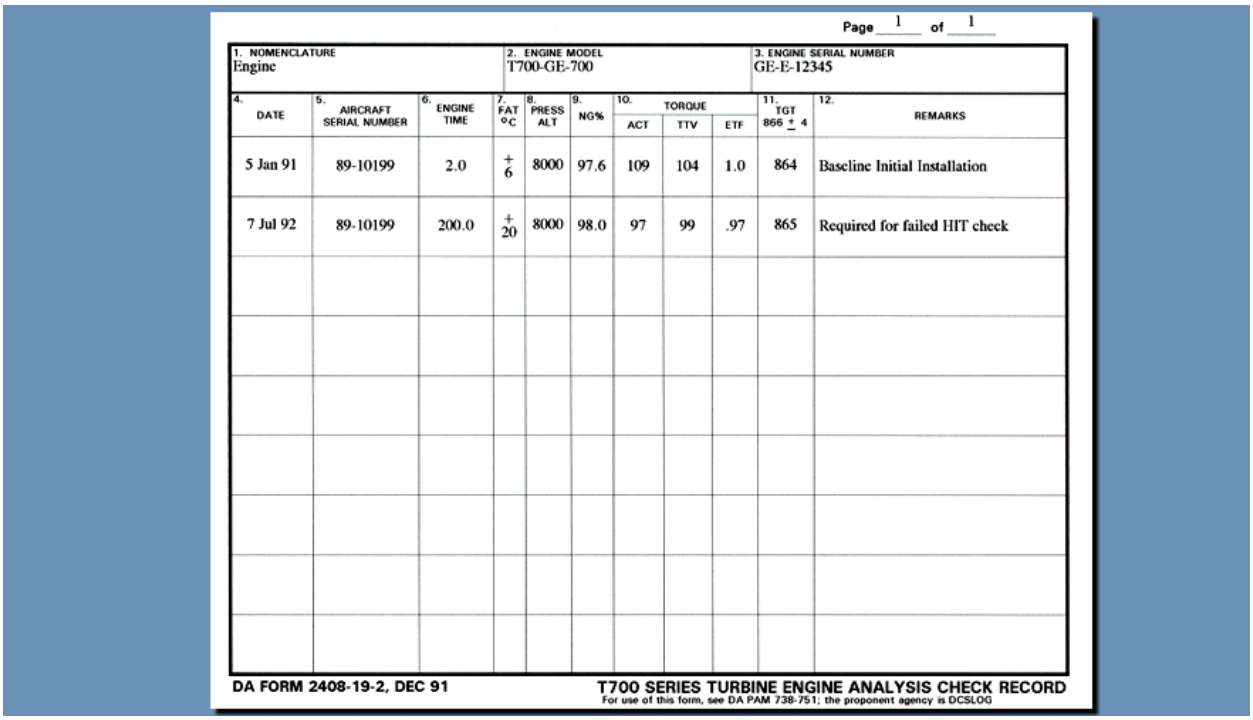
(ff) With the new ETF for the No. 1 engine, and a known ETF for the No. 2 engine, use the ATF formula to calculate the ATF.

Frame #0605 (Calculate ATF)



1) The ATF for this aircraft, with these engines installed is 0.99.

Frame #0610 (Engine Historical Data Sheet)



Page 1 of 1

1. NOMENCLATURE	2. ENGINE MODEL	3. ENGINE SERIAL NUMBER
Engine	T700-GE-700	GE-E-12345

4. DATE	5. AIRCRAFT SERIAL NUMBER	6. ENGINE TIME	7. FAT °C	8. PRESS ALT	9. NG%	10. TORQUE ACT	TTV	ETF	11. TGT 865 ± 4	12. REMARKS
5 Jan 91	89-10199	2.0	+6	8000	97.6	109	104	1.0	864	Baseline Initial Installation
7 Jul 92	89-10199	200.0	+20	8000	98.0	97	99	.97	865	Required for failed HIT check

DA FORM 2408-19-2, DEC 91

T700 SERIES TURBINE ENGINE ANALYSIS CHECK RECORD

For use of this form, see DA PAM 738-751; the proponent agency is DCSLOG

(gg) The final step requires entering the new data into the historical records for that serial number engine.

(hh) The form, DA FORM 2408-19-2, is located and maintained in the quality control shop. Each time the data recorded on this form changes, the form must be updated.

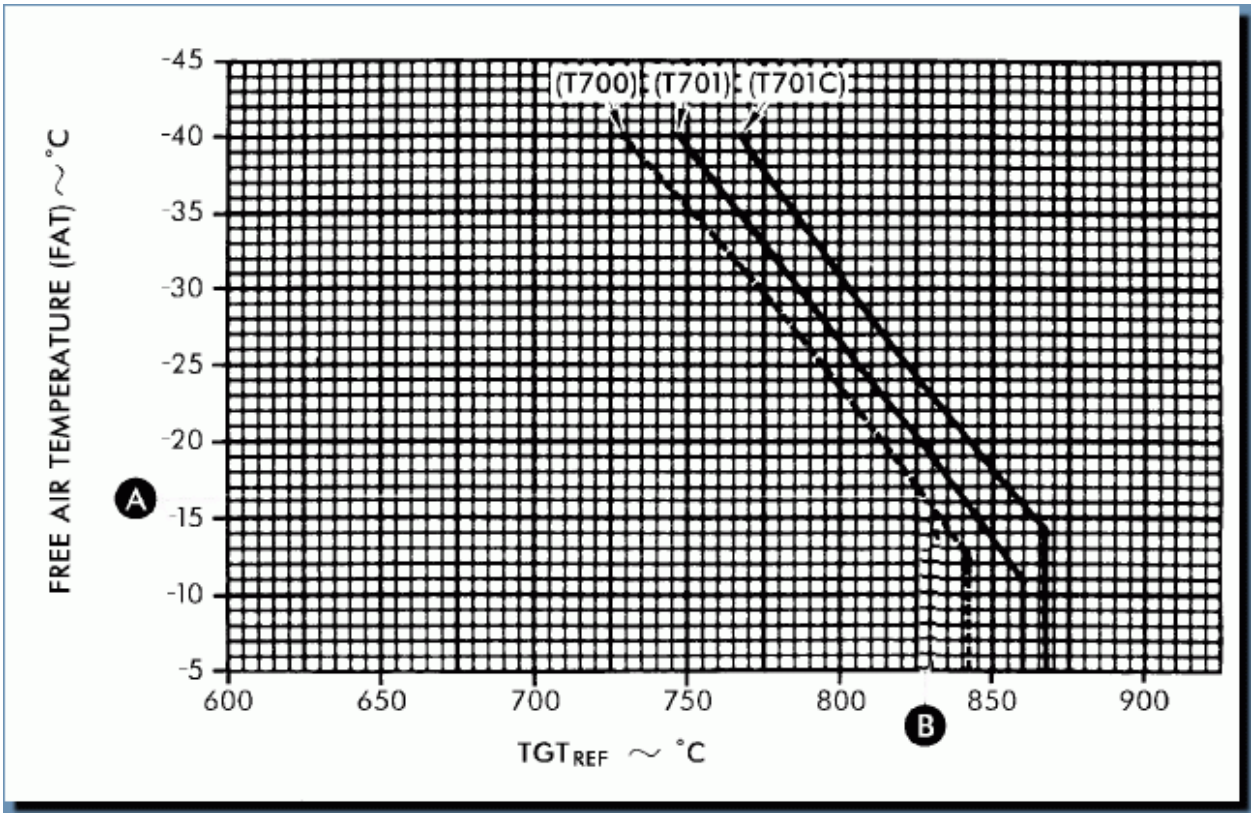
Frame #0611 (Torque Adjustment)

$$TRQ_{ADJ} = \%TRQ + 0.2\,TGT_{REF} - 0.2\,TGT$$

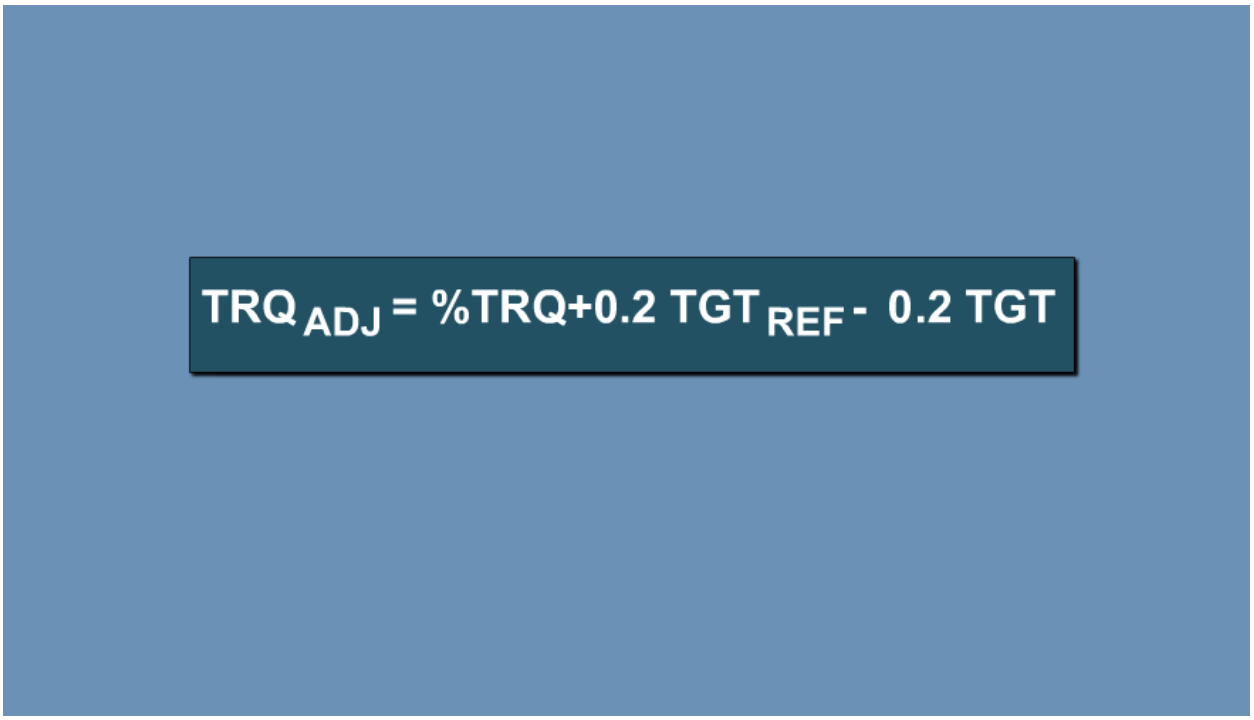
(ii) Conduct a second set of calculations for a Maximum Power Check with the provided information.

AIRCRAFT DATA	No. 1 ENGINE DATA
• No HIRSS	• T 700
• PA = +6000 ft	• TGT = 822 ºC
• FAT = -16 ºC	• TRQ = 101%
	• NG=99.8%
	• ECU = G07

Frame #0611 (Free Air Temperature Chart)



Frame #0612 (Torque Adjustment)

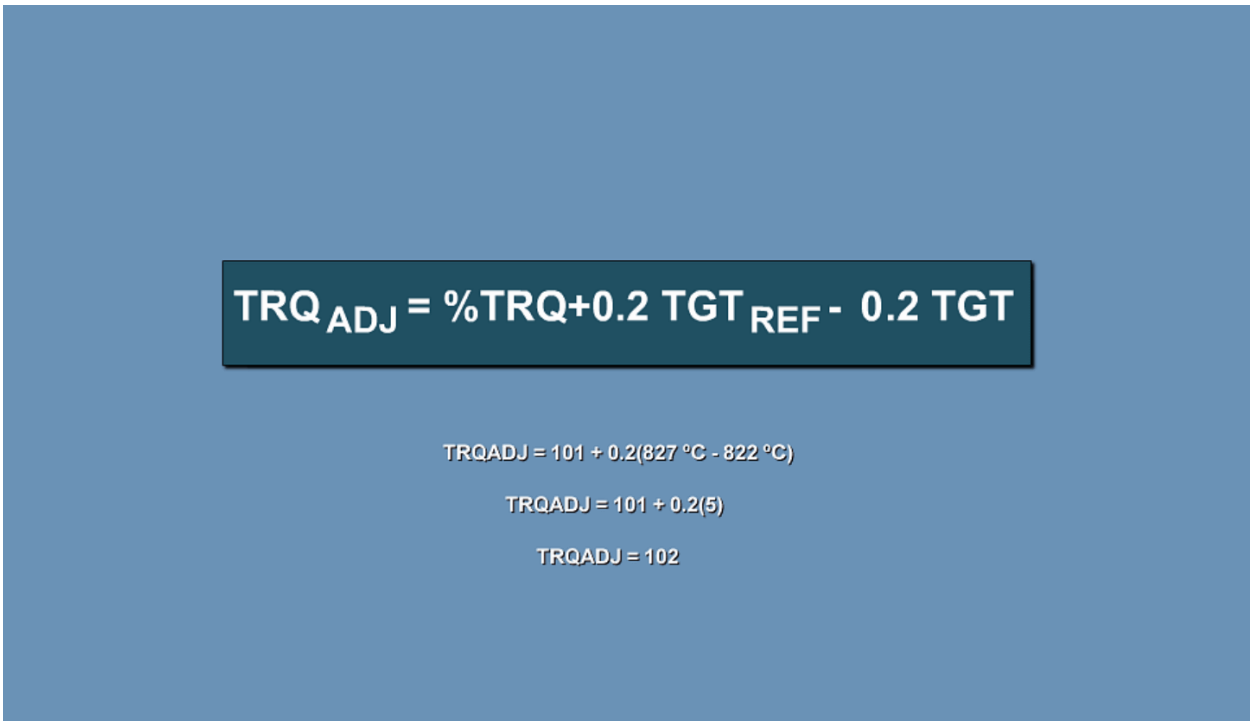


(jj) According to the TGTREF Chart, the TGTREF is 827 ºC.

(kk) Using this information, complete the formula above for TRQADJ.

AIRCRAFT DATA	#1 ENGINE DATA	CALCULATED/CHART DATA
• No HIRSS	• T 700	• TGTREF = 827 ºC
• PA = +6000 ft	• TGT = 822 ºC	
• FAT = -16 ºC	• TRQ = 101%	
	• ECU = G07	

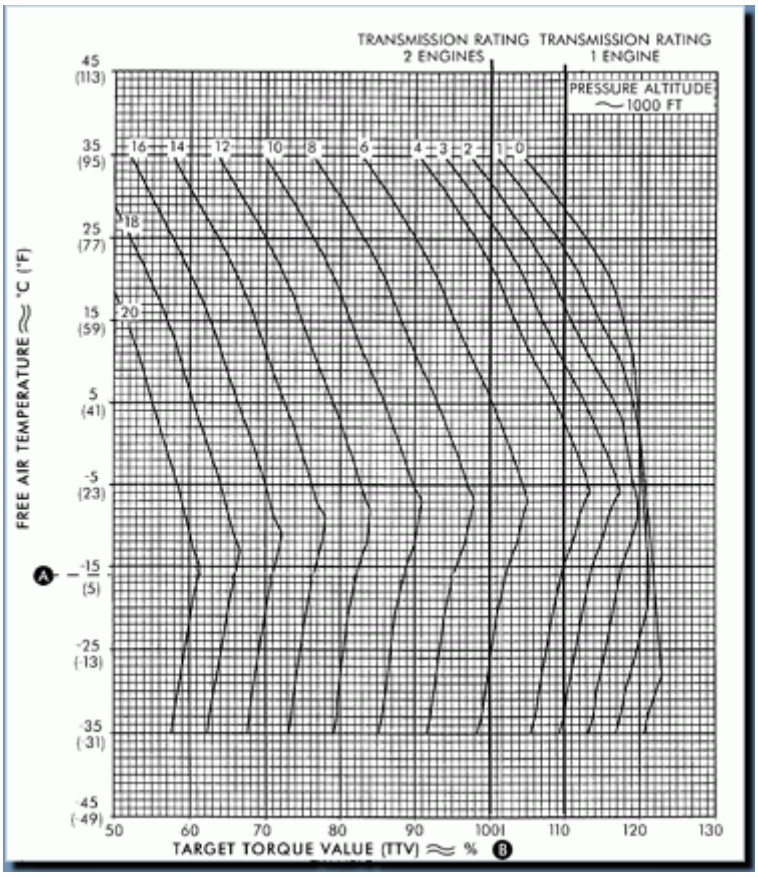
Frame #0612 (Torque Adjustment 2)



(II) Using the formula, the TRQADJ is 102.

AIRCRAFT DATA DATA	No. 1 ENGINE DATA	CALCULATED/CHART
• No HIRSS	• T700	• TGTREF =827 ºC
• PA = +6000 ft	• TGT = 822 ºC	• TRQADJ = 102
• FAT = -16º C	• TRQ = 101%	
	• ECU = G07	

Frame #0613 (Free Air Temperature)



(mm) Use the TTV chart with the given data to find the TTV.

AIRCRAFT DATA DATA	No. 1 ENGINE DATA	CALCULATED/CHART
• No HIRSS	• T700	• TGTREF =827 ºC
• PA = +6000 ft	• TGT = 822 ºC	• TRQADJ = 102
• FAT = -16 ºC	• TRQ = 101%	• TTV = 101.5%
	• ECU = G07	

(nn) Using FAT of –16 ºC and PA of +6000 ft, the TTV is 101.5%.

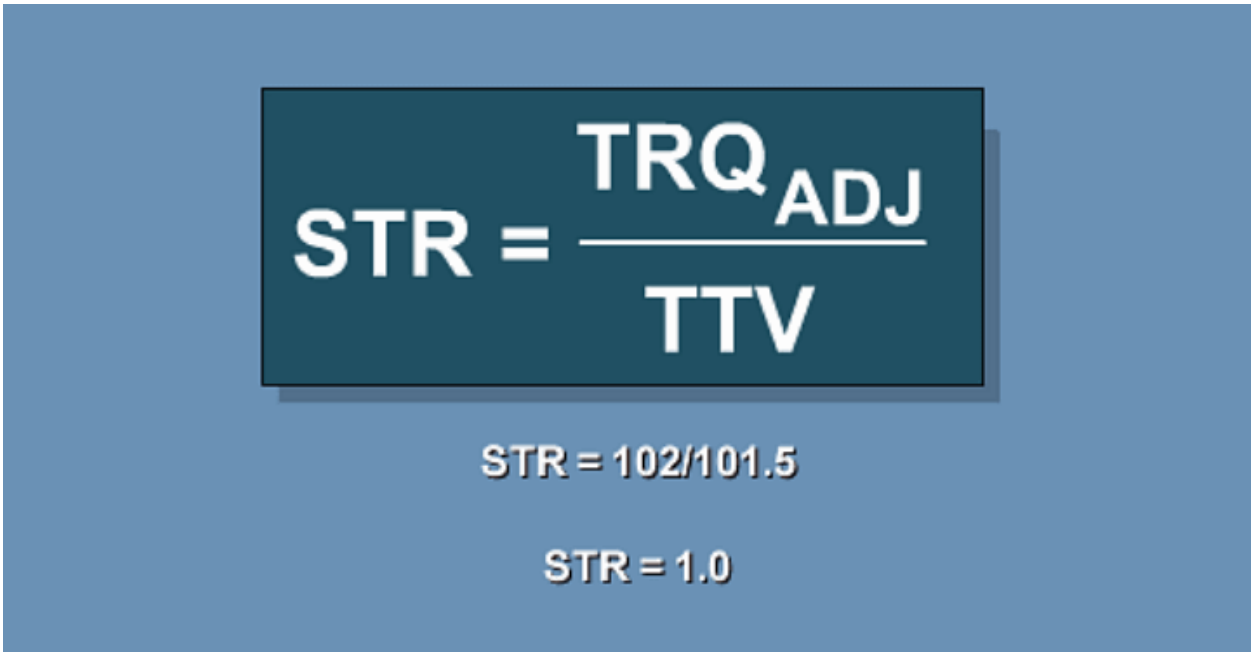
Frame #0614 (Calculate the STR)

$$STR = \frac{TRQ_{ADJ}}{TTV}$$

(oo) Using the formula provided, calculate the STR.

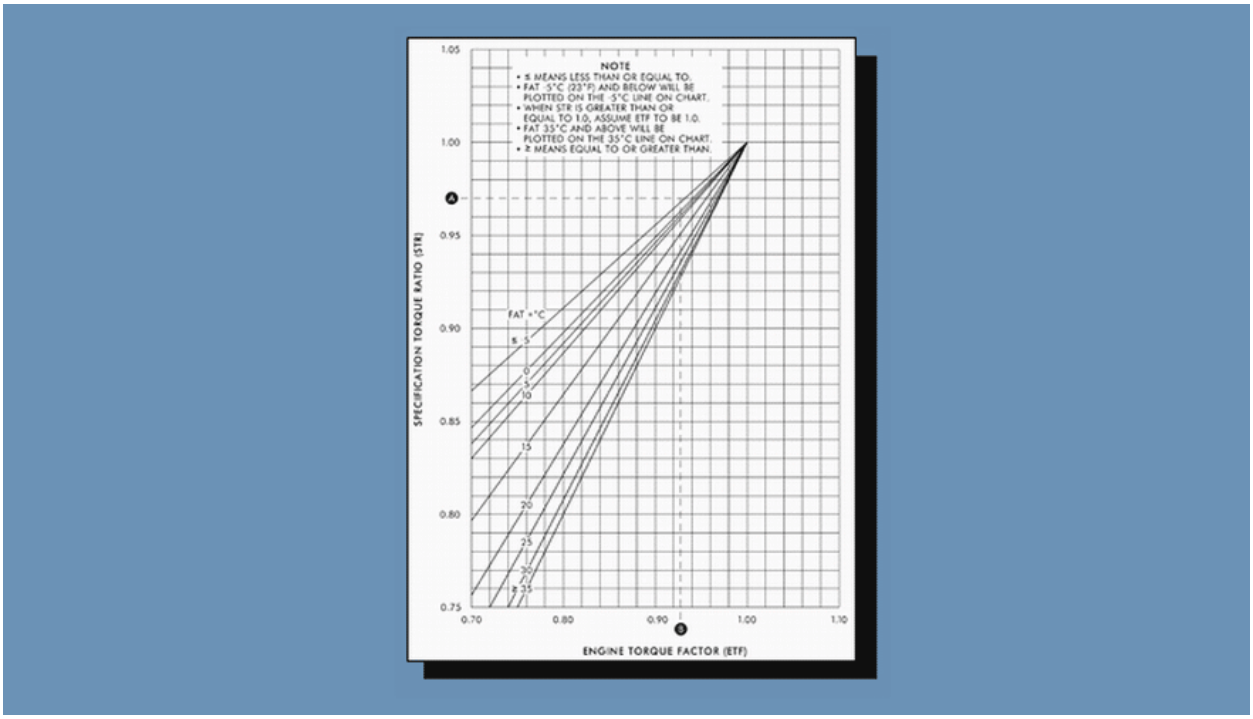
AIRCRAFT DATA DATA	No. 1 ENGINE DATA	CALCULATED/CHART
• No HIRSS	• T700	• TGTREF =827 ºC
• PA = +6000 ft	• TGT = 822 ºC	• TRQADJ = 102
• FAT = -16 ºC	• TRQ = 101%	• TTV = 101.5%
	• ECU = G07	• STR = 1.0

Frame #0614 (Calculate the STR 2)



(pp) Using the formula, the STR is 1.0.

Frame #0615 (Calculate ETF)



(qq) Using the ETF chart, and given data, find the ETF.

AIRCRAFT DATA DATA	No. 1 ENGINE DATA	CALCULATED/CHART
• No HIRSS	• T700	• TGTREF =827 ºC
• PA = +6000 ft	• TGT = 822 ºC	• TRQADJ = 102
• FAT = -16 ºC	• TRQ = 101%	• TTV = 101.5%
	• ECU = G07	• STR = 1.0
		• ETF = 1.0

1) Using the chart, the ETF is 1.0.

CHECK ON LEARNING

1. According to the Design Specifications, the Barometric Altimeter setting used to establish the engine performance data is _____.

2. The _____ provides an accurate indication of available power by incorporating ambient temperature effects on degraded engine performance.

3. The effect of cold free air temperatures and high air density is the explanation for what?

4. A Maximum Power Check is required when an engine fails a HIT Check, during a general test flight, and _____.

SECTION V. -SUMMARY

1. REVIEW/SUMMARIZE:

You have completed the lesson on Maximum Power Check.
The Key Points to remember are:

- The ECU/DEC provide increased engine performance, controlling electrical functions, and transmitting operational information to the cockpit.
- An engines power can be affected by cold free air temperature and high air density resulting in overstated power.
- The Torque Factor Method provides an accurate indication of available power by incorporating ambient temperature effects on degraded engine performance.
- The three ways to obtain data, or information are: observed, chart, and calculated.
- Adjusted Torque is the observed torque corrected for cold free air temperatures.
- Specification Torque Ratio is the percentage of power that the engine developed during the Maximum Power Check in relation to what a specification engine would have developed.
- The Engine Torque Factor represents the individual engine power producing capabilities adjusted for temperature.
- Aircraft Torque Factor is the average of the two installed Engine Torque Factors.
- The Maximum Power Check provides an accurate indication of available power by incorporating ambient temperature effects into the power available calculation.
- A Maximum Power Check is done when an engine is installed/reinstalled, during a general test flight, and when the engine fails a HIT Check; unless the failed HIT Check is due to a dirty compressor or a faulty anti-ice start and bleed valve.
- The procedures for performing a Maximum Power Check can be found in the TM 1-2840-248-23 or TM 1-1520-237-MTF.

APPENDIX A

ILLUSTRATION LISTING

FRAME #	FRAME TITLE
0015	Main Menu
0025	Engine Manual Front Cover
0035	Table of Contents
0040	Figures
0045	Tables
0050	Appendices
0055	Glossary
0060	Index
0065	Chapters
0080	Section II
0085	Section III
0090	Section IV
0092	Section V
0095	Section VI
0105	Section VII
0115	Section VIII
0505	Turbine Engine Analysis Check Menu
0510	Design Specifications
0515	Increased Performance
0520	Overstated Power
0525	Torque Factor Method
0530	Free Air Temperature
0535	Charts
0536	ETF Chart
0537	TTV Chart
0538	TGTREF Chart
0540	Terms and Definition Menu
0541	Adjust Torque
0542	Specification Torque Ratio
0543	Aircraft Torque Factor
0545	Maximum Power Check
0550	Technical Manuals
0555	Maximum Power Check for #1 Engine
0560	Copilot Barometric Altimeter
0560	Pilot Airspeed Indicator
0560	Pilot Display Unit
0560	TGT Temp/Ng Speed
0565	RPM/TRQ
0570	Maintenance Test Flight Check Sheet
0575	Power Indications
0580	Adjusted Torque
0585	Target Torque Value
0590	Specification Torque Ratio
0595	Engine Torque Factor
0600	Table 1-20 Max Power ETF Degradation Check
0605	Calculate ATF
0610	Engine Historical Data Sheet
0611	Torque Adjustment
0612	Torque Adjustment

0613	Find The TTV
0614	Calculate the STR
0615	Calculate ETF
1005	MENU
1010	Turbine Engine
1015	Maintenance Test Pilot
1020	Health Indicator Test
1025	Health Indicator Test Baseline
1026	Health Indicator Test and Baseline Procedures
1027	HIT Baseline Procedures 1
1028	Anti-ice/Start Valve
1029	Hit Baseline Procedures 2
1030	HIT Baseline Procedures 3
1031	Engine Inlet Anti-ice Valve Check
1032	HIT Baseline Procedures 1
1033	HIT Baseline Procedures 2
1034	Maximum Power Check
1035	HIT Baseline Procedures 4
1035	RPM/TRQ
1036	HIT Baseline Procedures 5
1040	HIT Work Sheet
1045	HIT Baseline Procedures 6
1055	HIT Worksheet 2
1060	Pressure Altitude Chart
1060	Pressure Altitude Chart 2
1060	Pressure Altitude Chart 3
1060	Hit Log
1065	Health Indicator Test Log
1070	HIT Log
1070	Engine HIT Log 3
1075	HIT Worksheet 3
1075	HIT Log 2
1075	HIT Log 3
1080	Pressure Altitude Chart
1080	HIT Log 4
1080	HIT Log 5
1080	HIT Log 6

APPENDIX B

TEST AND TEST SOLUTIONS

1. This appendix is only used when the test and solutions are internal to the POI file.

   When the test and solutions are internal to the POI file, then the POI file becomes a FOR OFFICIAL USE ONLY document.