CFM56-3 Line Maintenance Course

Volume II

Document: CFM3LMV2
Revised: January 96

Published by:
CFMI Customer Training Programs
GE Aircraft Engines
Customer Technical Education Center
123 Merchant Street
Cincinnati, Ohio 45246

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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

AC	Alternating Current
ACARS	Aircraft Communication Addressing and Reporting System
AD	Airworthiness Directive
ADC	Air Data Computer
ADEPT	Airline Data Engine Performance Trend
ADIRS	Air Data and Inertial Reference System
AGB	Accessory Gearbox
AIDS	Aircraft Integrated Data System
ALF	Aft Looking Forward
AOG	Aircraft On Ground
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio Inc.
ARP	Aero Recommended Practice
ATA	Air Transport Association
AVM	Aircraft Vibration Monitoring
BITE	Built In Test Equipment
BSI	Borescope Inspection
BTU	British Thermal Unit
C	Celsius/Centigrade (degrees)
CAD	Computer Assisted Design
CBP	Compressor Bleed Pressure
CCW	Counter Clockwise
CDP	Compressor Discharge Pressure
CESM	Commercial Engine Service Memorandum
CFM	Commercial Fan Motor
CFMI	Commercial Fan Motor International
CIP	Compressor Inlet Pressure
CIT	Compressor Inlet Temperature
cm.g	centimeter grams
CODEP	Common Deposition
CRT	Cathode Ray Tube
CSD	Constant Speed Drive
CSI	Cycles Since Installation
CSN	Cycles Since New
CTEC	Customer Technical Education Center
CW	Clockwise
DC	Direct Current
DGAC	Direction Generale de l'Aviation Civile
DOD	Domestic Object Damage
EBU	Engine Buildup Unit
ECAM	Electronic Centralized Aircraft Monitoring
EFH	Engine Flight Hours
EFIS	Electronic Flight Instrument System
EGT	Engine Gas Temperature
EICAS	Engine Indicating and Crew Alerting System
EIS	Electronic Instrument System
EMF	ElectroMotive Force
ESN	Engine Serial Number
F	Fahrenheit (Degrees)
F/I	Flight Idle
FAA	Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FAR	Federal Aviation Regulation

FEIM	Field Engineering Investigation Memo
FFCCV	Fan Frame Compressor Case Vertical
FIT	Fan Inlet Temperature
FLA	Forward Looking Aft
FMV	Fuel Metering Valve
FN	Net Thrust
FOD	Foreign Object Damage
FPI	Fluorescent Penetrant Inspection
g.in	gram inches
G/I	Ground Idle
GEAE	General Electric Aircraft Engines
GEM	Ground-based Engine Monitoring
GPH	Gallons Per Hour
GPM	Gallons Per Minute
HC	Hydro-Carbons
HCF	High Cycle Fatigue
HP	High Pressure
HPC	High Pressure Compressor
HPCR	High Pressure Compressor Rotor
HPT	High Pressure Turbine
HPTCC	High Pressure Turbine Clearance Control
HPTCCV	High Pressure Turbine Clearance Control Valve
HPTN	High Pressure Turbine Nozzle
HPTR	High Pressure Turbine Rotor
Hz	Hertz
I/O	Input/Output
IAS	Indicated Air Speed
ID	Inside Diameter
IDG	Integrated Drive Generator
IFSD	In-flight Shutdown
IGB	Inlet Gearbox
IGV	Inlet Guide Vane
in.	inches
IPB	Illustrated Parts Breakdown
IPC	Illustrated Parts Catalog
ips	Inches Per Second
K	Kelvin (Degrees)
	One Thousand
KIAS	Indicated Air Speed in Knots
kPa	Kilo Paschal
Kv	Kilovolts
L/E	Leading Edge
lbs.	Pounds, Weight
LCD	Liquid Crystal Display
LCF	Low Cycle Fatigue
LP	Low Pressure
LPC	Low Pressure Compressor
LPT	Low Pressure Turbine
LPTN	Low Pressure Turbine Nozzle
LPTR	Low Pressure Turbine Rotor
LRU	Line Replaceable Unit
LVDT	Linear Variable Differential Transducer
mA	Milliamperes (Current)
MCD	Magnetic Chip Detector
MCL	Maximum Climb

MCR	Maximum Cruise
MCT	Maximum Continuous
MEC	Main Engine Control
mils D.A.	Mils Double Amplitude
mm	Millimeters
MN	Mach Number
MPA	Maximum Power Assurance
MTBF	Mean Time Between Failures
MTBO	Mean Time Between Overhaul
MTBR	Mean Time Between Removals
mV	Millivolts
mVDC	Millivolts Direct Current
N1	Actual Fan Speed
N1*	Desired Fan Speed
N1K	Corrected Fan Speed
N2	Actual Core Speed
N2*	Desired Core Speed
N2K	Corrected Core Speed
NLR	Speed Low Pressure Rotor
OAT	Outside Air Temperature
OD	Outside Diameter
OGV	Outlet Guide Vane
OVBD	Overboard
P6 - Pb	CIT Signal Pressure Differential
P7 - Pb	FIT Signal Pressure Differential
Pb	Bypass Pressure
Pc	Regulated Servo Pressure
Pcr	Case Regulated Pressure
Pf	Heated Servo Pressure
PIREPS	Pilot Reports
PLA	Power Lever Angle
PMC	Power Management Control
PPH	Pounds Per Hour
PPH	Pounds Per Hour
PRSOV	Pressure Regulating Shutoff Valve
Ps	Pump Supply Pressure
Ps12	Fan Inlet Static Air Pressure
Ps13	Fan Outlet Static Air Pressure
Ps3	Compressor Discharge Pressure
psi	Pounds Per Square Inch
psia	Pounds Per Square Inch Absolute
psid	Pounds Per Square Inch Differential
Pt2.5	High Pressure Compressor Inlet Total Air Pressure
QAD	Quick Attach Detach
Qty.	Quantity
R	Rankin (degrees)
RPM	Revolutions Per Minute
RTV	Room Temperature Vulcanizing
RVDT	Rotary Variable Differential Transducer
S/B	Service Bulletin
S/R	Service Request
SER	Service Evaluation Request
sfc	Specific Fuel Consumption

SG	Specific Gravity
SGA	Specific Gravity Adjustment
SLS	Sea Level Standard
SLSD	Sea Level Standard Day
SN	Serial Number
SNECMA	Societe d'Etude et de Construction de Moteurs d'Aviation
STP	Standard Temperature and Pressure
SVR	Shop Visit Rate
T/E	Trailing Edge
T/O	Takeoff
T/R	Thrust Reverser
T12	Fan Inlet Total Air Temperature (Electrical)
T2.0	Fan Inlet Temperature (Hydromechanical)
T2.5	High Pressure Compressor Inlet Air Temperature
T4.95	Exhaust Gas Temperature
TAI	Thermal Anti-Ice
TAT	Total Air Temperature
TBC	Thermal Barrier Coating The Boeing Company
TBD	To Be Determined
TBO	Time Between Overhaul
TC1	Turbine Clearance Control (5th Stage Signal)
TC2	Turbine Clearance Control (9th Stage Signal)
TC3	Turbine Clearance Control (Timer Signal)
TCCV	Turbine Clearance Control Valve
TEMPER	Turbine Engine Modular Performance Estimating Routine
TGB	Transfer Gearbox
TMC	Torque Motor Current
TRF	Turbine Rear Frame
Ts5	Turbine Clearance Control (5th Stage Signal with Timer)
Ts9	Turbine Clearance Control (9th Stage Signal with Timer)
TSI	Time Since Installation
TSN	Time Since New
TSO	Time Since Overhaul
UER	Unscheduled Engine Removal
USAF	United States Air Force
USN	United States Navy
VBV	Variable Bleed Valve
VDC	Volts Direct Current
VIB	Vibration
VMC	Visual Meteorological Condition
VSV	Variable Stator Vane
Wf	Fuel Flow
YTD	Year to Date

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POWER ASSURANCE CHECK EXAMPLES

POWER ASSURANCE CHECK EXAMPLE #1

Engine Conditions

CFM56-3C-1 @ 23.5K Pounds Thrust.
Ambient Temperature (OAT) = 90°F (32°C)
Use MPA Fan Speed (for this example 85% N_1)

Procedure

Record the following from the MPA Test Table @ 85% N_1 Fan Speed:

- OAT
- N_1 target
- For 23.5K pounds thrust, EGT maximum
- For CFM56-3C-1 engines, N_2 maximum

OAT = 90°F

N_1 TARGET = 87.3%

FOR 23.5K POUNDS THRUST, EGT MAXIMUM = 799°C

FOR CFM56-3C-1 ENGINES, N_2 MAXIMUM = 97.6%

POWER ASSURANCE CHECK EXAMPLE #1

POWER ASSURANCE CHECK EXAMPLE #1

Procedure

Set N_1 target, after the engine operation is stable for four minutes and record N_1, N_2 and EGT.

N_1 = 87.0%

N_2 = 95.5%

EGT = 785°C

POWER ASSURANCE CHECK EXAMPLE #1

POWER ASSURANCE CHECK EXAMPLE #1

Procedure

Adjust the recorded parameters to the N_1 target:
Use the N_1 difference: (N_1 target - N_1 record)

For each 0.1% N_1 positive difference (N_1 target > N_1 record) adjust as follows:

- add 1.0°C to the EGT record.
- add 0.045% to the N_2 record.

For each 0.1% N_1 negative difference (N_1 target < N_1 record) adjust as follows:

- subtract 1.0°C to the EGT record.
- subtract 0.045% to the N_2 record.

N_1 TARGET - N_1 RECORD	= DIFFERENCE
	= 87.3 - 87.0
	= 0.3%
N_2 ADJUSTMENT	= N_2 RECORDED + (0.3/0.1) (0.045)
	= 95.5 + (3 X .0045)
	= 95.5 + 0.1
	= 95.6%
EGT ADJUSTMENT	= EGT RECORDED + (0.3/0.1) (1)
	= 785 + (3 X 1)
	= 785 + 3
	= 788°C.

POWER ASSURANCE CHECK EXAMPLE #1

POWER ASSURANCE CHECK EXAMPLE #1

Procedure

EGT adjustment for the HPTCC timer:

- The EGT limits include the effects of the timer at this thrust rating.
- No more adjustment is necessary.

EGT adjustment for the altitude:

- No adjustment is necessary for the altitude at this thrust rating.

N_2 adjustment for the thrust rating:

- No adjustment is necessary at this thrust rating.

Compare the adjusted parameters to the determined limits.

Record the N_2 margin and the EGT margin.

N_2 MAXIMUM	= 97.6%
EGT MAXIMUM	= 799°C
N_2 MARGIN	= N_2 MAXIMUM - N_2 ADJUSTMENT = 97.6 - 95.6 = 2.0%
EGT MARGIN	= EGT MAXIMUM - EGT RECORD = 799 - 788 = 11°C.

POWER ASSURANCE CHECK EXAMPLE #1

POWER ASSURANCE CHECK EXAMPLE #2

Engine Conditions

CFM56-3C-1 Engine @ 22K Pounds Thrust
Ambient Temperature (OAT) = 90°F (32°C)
Use MPA Fan Speed (for this example 85% N_1)

Procedure

Record the following from the MPA Test Table @ 85% N_1 Fan Speed:

- OAT
- N_1 target
- For 22K pounds thrust, EGT maximum
- For CFM56-3C-1 engines, N_2 maximum

OAT = 90°F

N_1 TARGET = 87.3%

FOR 22K POUNDS THRUST, EGT MAXIMUM = 803°C

FOR CFM56-3C-1 ENGINES, N_2 MAXIMUM = 97.6%

POWER ASSURANCE CHECK EXAMPLE #2

POWER ASSURANCE CHECK EXAMPLE #2

Procedure

Set N_1 target, after the engine operation is stable for four minutes and record N_1, N_2 and EGT.

N_1 = 87.0%

N_2 = 95.5%

EGT = 785°C

POWER ASSURANCE CHECK EXAMPLE #2

POWER ASSURANCE CHECK EXAMPLE #2

Procedure

Adjust the recorded parameters to the N_1 target:
Use the N_1 difference: (N_1 target - N_1 record)

For each 0.1% N_1 positive difference (N_1 target > N_1 record) adjust as follows:

- add 1.0°C to the EGT record.
- add 0.045% to the N_2 record.

For each 0.1% N_1 negative difference (N_1 target < N_1 record) adjust as follows:

- subtract 1.0°C to the EGT record.
- subtract 0.045% to the N_2 record.

N_1 TARGET-N_1 RECORD	= DIFFERENCE = 87.3 - 87.0 = 0.3%
N_2 ADJUSTMENT	= N_2 RECORDED + (0.3/0.1) (0.045) = 95.5 + (3 X .0045) = 95.5 + 0.1 = 95.6%
EGT ADJUSTMENT	= EGT RECORDED + (0.3/0.1) (1) = 785 + (3 X 1) = 785 + 3 = 788°C.

POWER ASSURANCE CHECK EXAMPLE #2

POWER ASSURANCE CHECK EXAMPLE #2

Procedure

EGT adjustment for the HPTCC timer:

- Increase the EGT margin by 17°C.
- If the timer is deactivated in service, do not increase the EGT margin.

EGT adjustment for the altitude:

- No adjustment is necessary for the altitude at this thrust rating.

N_2 adjustment for the thrust rating:

- No adjustment is necessary at this thrust rating.

Compare the adjusted parameters to the determined limits.

Record the N_2 margin and the EGT margin.

N_2 MAXIMUM	= 97.6%
EGT MAXIMUM	= 803°C
N_2 MARGIN	= N_2 MAXIMUM - N_2 ADJUSTMENT = 97.6 - 95.6 = 2.0%
EGT MARGIN	= EGT MAXIMUM - EGT RECORD = 803 - 788 = 15°C = 15°C + 17°C (TIMER ADJUSTMENT) = 32°C

POWER ASSURANCE CHECK EXAMPLE #2

POWER ASSURANCE CHECK EXAMPLE #3

Engine Conditions

CFM56-3C-1 Engine @ 20K Pounds Thrust
Ambient Temperature (OAT) = 90°F (32°C)
Use MPA Fan Speed (for this example 85% N_1)

Procedure

Record the following from the MPA Test Table @ 85% N_1 Fan Speed:

- OAT
- N_1 target
- For 20K pounds thrust, EGT maximum
- For CFM56-3C-1 engines, N_2 maximum

OAT = 90°F

N_1 target = 87.3%

For 20K pounds thrust, EGT maximum = 848°C

For CFM56-3C-1 engines, N_2 maximum = 97.6%

POWER ASSURANCE CHECK EXAMPLE #3

POWER ASSURANCE CHECK EXAMPLE #3

Procedure

Set N_1 target, after the engine operation is stable for four minutes make a record of N_1, N_2 and EGT.

N_1 = 87.0%

N_2 = 95.5%

EGT = 785°C

POWER ASSURANCE CHECK EXAMPLE #3

POWER ASSURANCE CHECK EXAMPLE #3

Procedure

Adjust the recorded parameters to the N_1 target:
Use the N_1 difference: (N_1 target - N_1 record)

For each 0.1% N_1 positive difference (N_1 target > N_1 record) adjust as follows:

- add 1.0°C to the EGT record.
- add 0.045% to the N_2 record.

For each 0.1% N_1 negative difference (N_1 target < N_1 record) adjust as follows:

- subtract 1.0°C to the EGT record.
- subtract 0.045% to the N_2 record.

N_1 TARGET - N_1 RECORD	= DIFFERENCE
	= 87.3 - 87.0
	= 0.3%
EGT ADJUSTMENT	= EGT RECORDED + (0.3/0.1) (1)
	= 785 + (3 X 1)
	= 785 + 3
	= 788°C.
N_2 ADJUSTMENT	= N_2 RECORDED + (0.3/0.1) (0.045)
	= 95.5 + (3 X .0045)
	= 95.5 + 0.1
	= 95.6%

POWER ASSURANCE CHECK EXAMPLE #3

POWER ASSURANCE CHECK EXAMPLE #3

Procedure

EGT adjustment for the HPTCC timer:

- Increase the EGT margin by 17°C.
- If the timer is deactivated in service, do not increase the EGT margin.

EGT adjustment for the altitude:

- There is an altitude effect for this thrust rating.
- The MPA tables are for sea level.
- For 4,000 feet and above operation, decrease the EGT margin by 44°C.

N_2 adjustment for the thrust rating:

- Increase the N_2 margin by 0.6%.

Compare the adjusted parameters to the determined limits.

Record the N_2 margin and the EGT margin.

N_2 MAXIMUM	= 97.6%
EGT MAXIMUM	= 848°C
N_2 MARGIN	= N_2 MAXIMUM - N_2 ADJUSTMENT = 97.6 - 95.6 = 2.0% = 2.0% + 0.6% (THRUST RATING) = 2.6%
EGT MARGIN	= EGT MAXIMUM - EGT RECORD = 848 - 788 = 60°C = 60°C + 17°C (TCC TIMER) = 77°C = 77°C - 44°C (ALTITUDE) = 33°C (4000 FEET AND ABOVE)

POWER ASSURANCE CHECK EXAMPLE #3

POWER ASSURANCE CHECK EXAMPLE #4

Engine Conditions

CFM56-3C-1 Engine @ 18.5K Pounds Thrust)
Ambient Temperature (OAT) = 90°F (32°C)
Use MPA Fan Speed (for this example 85% N_1)

Procedure

Record the following from the MPA Test Table @ 85% N_1 Fan Speed:

- OAT
- N_1 target
- For 18.5K pounds thrust, EGT maximum
- For CFM56-3C-1 engines, N_2 maximum

OAT = 90°F

N_1 TARGET = 87.3%

FOR 18.5K POUNDS THRUST, EGT MAXIMUM = 874°C

FOR CFM56-3C-1 ENGINES, N_2 MAXIMUM = 97.6%

POWER ASSURANCE CHECK EXAMPLE #4

POWER ASSURANCE CHECK EXAMPLE #4

Procedure

Set N_1 target, after the engine operation is stable for four minutes and record N_1, N_2 and EGT.

N_1 = 87.0%

N_2 = 95.5%

EGT = 785°C

POWER ASSURANCE CHECK EXAMPLE #4

POWER ASSURANCE CHECK EXAMPLE #4

Procedure

Adjust the recorded parameters to the N_1 target:
Use the N_1 difference: (N_1 target - N_1 record)

For each 0.1% N_1 positive difference (N_1 target > N_1 record) adjust as follows:

- add 1.0°C to the EGT record.
- add 0.045% to the N_2 record.

For each 0.1% N_1 negative difference (N_1 target < N_1 record) adjust as follows:

- subtract 1.0°C to the EGT record.
- subtract 0.045% to the N_2 record.

N_1 TARGET - N_1 RECORD	= DIFFERENCE
	= 87.3 - 87.0
	= 0.3%
N_2 ADJUSTMENT	= N_2 RECORDED + (0.3/0.1) (0.045)
	= 95.5 + (3 X .0045)
	= 95.5 + 0.1
	= 95.6%
EGT ADJUSTMENT	= EGT RECORDED + (0.3/0.1) (1)
	= 785 + (3 X 1)
	= 785 + 3
	= 788°C.

POWER ASSURANCE CHECK EXAMPLE #4

POWER ASSURANCE CHECK EXAMPLE #4

Procedure

EGT adjustment for the HPTCC timer:

- Increase the EGT margin by 17°C.
- If the timer is deactivated in service, do not increase the EGT margin.

EGT adjustment for the altitude:

- There is an altitude effect for this thrust rating.
- The MPA tables are for sea level.
- For 4,000 feet and above operation, decrease the EGT margin by 44°C.

N_2 adjustment for the thrust rating:

- Increase the N_2 margin by 1.3%.

Compare the adjusted parameters to the determined limits.

Record the N_2 margin and the EGT margin.

N_2 MAXIMUM	**= 97.6%**
EGT MAXIMUM	**= 874°C**
N_2 MARGIN	**= N_2 MAXIMUM - N_2 ADJUSTMENT** **= 97.6 - 95.6** **= 2.0%** **= 2.0% + 1.3% (THRUST RATING)** **= 3.3%**
EGT MARGIN	**= EGT MAXIMUM - EGT RECORD** **= 874 - 788** **= 86°C** **= 86°C + 17°C (TCC TIMER)** **= 103°C** **= 103°C - 44°C (ALTITUDE)** **= 59°C (4000 FEET AND ABOVE)**

POWER ASSURANCE CHECK EXAMPLE #4

POWER ASSURANCE CHECK EXAMPLE #5

Engine Conditions

CFM56-3B-2 Engine @ 22K Pounds Thrust
Ambient Temperature (OAT) = 90°F (32°C)
Use MPA Fan Speed (for this example 85% N_1)

Procedure

From the MPA Test Table (85% N_1 Fan Speed):

- OAT
- N_1 target
- For 22K pounds thrust, EGT maximum
- For CFM56-3B-2 engines, N_2 maximum

OAT = 90°F

N_1 TARGET = 87.3%

FOR 22K POUNDS THRUST, EGT MAXIMUM = 803°C

FOR CFM56-3B-2 ENGINES, N_2 MAXIMUM = 97.9%

POWER ASSURANCE CHECK EXAMPLE #5

POWER ASSURANCE CHECK EXAMPLE #5

Procedure

Set N_1 target, after the engine operation is stable for four minutes and record N_1, N_2 and EGT.

N_1 = 87.0%

N_2 = 95.5%

EGT = 780°C

POWER ASSURANCE CHECK EXAMPLE #5

POWER ASSURANCE CHECK EXAMPLE #5

Procedure

Adjust the recorded parameters to the N_1 target:
Use the N_1 difference: (N_1 target - N_1 record)

For each 0.1% N_1 positive difference (N_1 target > N_1 record) adjust as follows:

- add 1.0°C to the EGT record.
- add 0.045% to the N_2 record.

For each 0.1% N_1 negative difference (N_1 target < N_1 record) adjust as follows:

- subtract 1.0°C to the EGT record.
- subtract 0.045% to the N_2 record.

N_1 TARGET - N_1 RECORD	= DIFFERENCE = 87.3 - 87.0 = 0.3%
N_2 ADJUSTMENT	= N_2 RECORDED + (0.3/0.1) (0.045) = 95.5 + (3 X .0045) = 95.5 + 0.1 = 95.6%
EGT ADJUSTMENT = 780 + (3 X 1)	= EGT RECORDED + (0.3/0.1) (1) = 780 + 3 = 783°C.

POWER ASSURANCE CHECK EXAMPLE #5

POWER ASSURANCE CHECK EXAMPLE #5

Procedure

EGT adjustment for the HPTCC timer:

- Increase the EGT margin by 17°C.
- If the timer is deactivated in service, do not increase the EGT margin.

EGT adjustment for the altitude:

- No adjustment is necessary for the altitude at this thrust rating.

N_2 adjustment for the thrust rating:

- No adjustment is necessary at this thrust rating.

Compare the adjusted parameters to the determined limits.

Record the N_2 margin and the EGT margin.

N_2 MAXIMUM	= 97.6%
EGT MAXIMUM	= 803°C
N_2 MARGIN	= N_2 MAXIMUM - N_2 ADJUSTMENT = 97.9 - 95.6 = 2.3%
EGT MARGIN	= EGT MAXIMUM - EGT RECORD = 803 - 783 = 20°C = 20°C + 17°C (TCC TIMER) = 37°C

POWER ASSURANCE CHECK EXAMPLE #5

POWER ASSURANCE CHECK EXAMPLE #6

Engine Conditions

CFM56-3B-2 Engine @ 20K Pounds Thrust
Ambient Temperature (OAT) = 90°F (32°C)
Use MPA Fan Speed (for this example 85% N_1)

Procedure

From the MPA Test Table (85% N_1 Fan Speed):

- OAT
- N_1 target
- For 20K pounds thrust, EGT maximum
- For CFM56-3B-2 engines, N_2 maximum

OAT = 90°F

N_1 TARGET = 87.3%

FOR 20K POUNDS THRUST, EGT MAXIMUM = 848°C

FOR CFM56-3B-2 ENGINES, N_2 MAXIMUM = 97.9%

POWER ASSURANCE CHECK EXAMPLE #6

POWER ASSURANCE CHECK EXAMPLE #6

Procedure

Set N_1 target, after the engine operation is stable for four minutes and record N_1, N_2 and EGT.

N_1 = 87.0%

N_2 = 95.5%

EGT = 785°C

POWER ASSURANCE CHECK EXAMPLE #6

POWER ASSURANCE CHECK EXAMPLE #6

Procedure

Adjust the recorded parameters to the N_1 target:
Use the N_1 difference: (N_1 target - N_1 record)

For each 0.1% N_1 positive difference (N_1 target > N_1 record) adjust as follows:

- add 1.0°C to the EGT record.
- add 0.045% to the N_2 record.

For each 0.1% N_1 negative difference (N_1 target < N_1 record) adjust as follows:

- subtract 1.0°C to the EGT record.
- subtract 0.045% to the N_2 record.

N_1 TARGET - N_1 RECORD	= DIFFERENCE
	= 87.3 - 87.0
	= 0.3%
N_2 ADJUSTMENT	= N_2 RECORDED + (0.3/0.1) (0.045)
	= 95.5 + (3 X .0045)
	= 95.5 + 0.1
	= 95.6%
EGT ADJUSTMENT	= EGT RECORDED + (0.3/0.1) (1)
	= 785 + (3 X 1)
	= 785 + 3
	= 788°C.

POWER ASSURANCE CHECK EXAMPLE #6

POWER ASSURANCE CHECK EXAMPLE #6

Procedure

EGT adjustment for the HPTCC timer:

- Increase the EGT margin by 17°C.
- If the timer is deactivated in service, do not increase the EGT margin.

EGT adjustment for the altitude:

- There is an altitude effect for this thrust rating.
- The MPA tables are for sea level.
- If the route structure of the airplane includes an airport at 4,000 feet and above, decrease the EGT margin by 44°C.

N_2 adjustment for the thrust rating:

- Increase the N_2 margin by 0.6%.

Compare the adjusted parameters to the determined limits.

Record the N_2 margin and the EGT margin.

N_2 MAXIMUM	= 97.9%
EGT MAXIMUM	= 874°C
N_2 MARGIN	= N_2 MAXIMUM - N_2 ADJUSTMENT = 97.9 - 95.6 = 2.3% = 2.3% + 0.6% (THRUST RATING) = 2.9%
EGT MARGIN	= EGT MAXIMUM - EGT RECORD = 848 - 788 = 60°C = 60°C + 17°C (TCC TIMER) = 77°C = 77°C - 44°C (ALTITUDE) = 33°C (4000 FEET AND ABOVE)

POWER ASSURANCE CHECK EXAMPLE #6

POWER ASSURANCE CHECK EXAMPLE #7

Engine Conditions

CFM56-3-B1 Engine @ 20K Pounds Thrust
Ambient Temperature (OAT) = 90°F (32°C)
Use MPA Fan Speed (for this example 85% N_1)

Procedure

From the MPA Test Table (85% N_1 Fan Speed):

- OAT
- N_1 target
- For 20K pounds thrust, EGT maximum
- For CFM56-3-B1 engines, N_2 maximum

OAT = 90°F

N_1 TARGET = 87.3%

FOR 20K POUNDS THRUST, EGT MAXIMUM = 848°C

FOR CFM56-3-B1 ENGINES, N_2 MAXIMUM = 98.6%

POWER ASSURANCE CHECK EXAMPLE #7

POWER ASSURANCE CHECK EXAMPLE #7

Procedure

Set N_1 target, after the engine operation is stable for four minutes and record N_1, N_2 and EGT.

N_1 = 87.0%

N_2 = 95.5%

EGT = 780°C

POWER ASSURANCE CHECK EXAMPLE #7

POWER ASSURANCE CHECK EXAMPLE #7

Procedure

Adjust the recorded parameters to the N_1 target:
Use the N_1 difference: (N_1 target - N_1 record)

For each 0.1% N_1 positive difference (N_1 target > N_1 record) adjust as follows:

- add 1.0°C to the EGT record.
- add 0.045% to the N_2 record.

For each 0.1% N_1 negative difference (N_1 target < N_1 record) adjust as follows:

- subtract 1.0°C to the EGT record.
- subtract 0.045% to the N_2 record.

N_1 TARGET - N_1 RECORD	= DIFFERENCE
	= 87.3 - 87.0
	= 0.3%
N_2 ADJUSTMENT	= N_2 RECORDED + (0.3/0.1) (0.045)
	= 95.5 + (3 X .0045)
	= 95.5 + 0.1
	= 95.6%
EGT ADJUSTMENT	= EGT RECORDED + (0.3/0.1) (1)
	= 780 + (3 X 1)
	= 780 + 3
	= 783°C.

POWER ASSURANCE CHECK EXAMPLE #7

POWER ASSURANCE CHECK EXAMPLE #7

Procedure

EGT adjustment for the HPTCC timer:

- The timer is not available, no adjustment is necessary.

EGT adjustment for the altitude:

- There is an altitude effect for this thrust rating.
- The MPA tables are for sea level.
- If the route structure of the airplane includes an airport at 4,000 feet and above, decrease the EGT margin by 44°C.

N_2 adjustment for the thrust rating:

- No adjustment is necessary at this thrust rating.

Compare the adjusted parameters to the determined limits.

Record the N_2 margin and the EGT margin.

N_2 MAXIMUM	= 98.6%
EGT MAXIMUM	= 848°C
N_2 MARGIN	= N_2 MAXIMUM - N_2 ADJUSTMENT = 98.6 - 95.6 = 3.0%
EGT MARGIN	= EGT MAXIMUM - EGT RECORD = 848 - 783 = 65°C = 65°C - 44°C (ALTITUDE) = 21°C (4000 FEET AND ABOVE)

POWER ASSURANCE CHECK EXAMPLE #7

POWER ASSURANCE CHECK EXAMPLE #8

Engine Conditions

CFM56-3-B1 Engine @ 18.5K Pounds Thrust
Ambient Temperature (OAT) = 90°F (32°C)
Use MPA Fan Speed (for this example 85% N_1)

Procedure

From the MPA Test Table (85% N_1 Fan Speed):

- OAT
- N_1 target
- For 18.5K pounds thrust, EGT maximum
- For CFM56-3-B1 engines, N_2 maximum

OAT = 90°F

N_1 TARGET = 87.3%

FOR 18.5K POUNDS THRUST, EGT MAXIMUM = 874°C

FOR CFM56-3-B1 ENGINES, N_2 MAXIMUM = 98.6%

POWER ASSURANCE CHECK EXAMPLE #8

POWER ASSURANCE CHECK EXAMPLE #8

Procedure

Set N_1 target, after the engine operation is stable for four minutes and record N_1, N_2 and EGT.

N_1 = 87.0%

N_2 = 95.5%

EGT = 780°C

POWER ASSURANCE CHECK EXAMPLE #8

POWER ASSURANCE CHECK EXAMPLE #8

Procedure

Adjust the recorded parameters to the N_1 target:
Use the N_1 difference: (N_1 target - N_1 record)

For each 0.1% N_1 positive difference (N_1 target > N_1 record) adjust as follows:

- add 1.0°C to the EGT record.
- add 0.045% to the N_2 record.

For each 0.1% N_1 negative difference (N_1 target < N_1 record) adjust as follows:

- subtract 1.0°C to the EGT record.
- subtract 0.045% to the N_2 record.

N_1 TARGET - N_1 RECORD	= DIFFERENCE
	= 87.3 - 87.0
	= 0.3%
N_2 ADJUSTMENT	= N_2 RECORDED + (0.3/0.1) (0.045)
	= 95.5 + (3 X .0045)
	= 95.5 + 0.1
	= 95.6%
EGT ADJUSTMENT	= EGT RECORDED + (0.3/0.1) (1)
	= 780 + (3 X 1)
	= 780 + 3
	= 783°C.

POWER ASSURANCE CHECK EXAMPLE #8

POWER ASSURANCE CHECK EXAMPLE #8

Procedure

EGT adjustment for the HPTCC timer:

- The timer is not available, no adjustment is necessary.

EGT adjustment for the altitude:

- There is an altitude effect for this thrust rating.
- The MPA tables are for sea level.
- If the route structure of the airplane includes an airport at 4,000 feet and above, decrease the EGT margin by 44°C.

N_2 adjustment for the thrust rating:

- Increase the N_2 margin by 0.7%.

Compare the adjusted parameters to the determined limits.

Record the N_2 margin and the EGT margin.

N_2 MAXIMUM	= 98.6%
EGT MAXIMUM	= 874°C
N_2 MARGIN	= N_2 MAXIMUM - N_2 ADJUSTMENT = 98.6 - 95.6 = 3.0% = 3.0% + 0.7% (THRUST RATING) = 3.7%
EGT MARGIN	= EGT MAXIMUM - EGT RECORD = 874 - 783 = 91°C = 91°C - 44°C (ALTITUDE) = 47°C (4000 FEET AND ABOVE)

POWER ASSURANCE CHECK EXAMPLE #8

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TRIM TABLE EXAMPLES

TRIM TABLE USAGE

Description

The CFM56-3 trim tables provide the following information:

- Low Idle (%N_2)
- High Idle (%N_2)
- Part Power PMC OFF (%N_2)
- Part Power PMC ON (%N_1)
- Static Take Off PMC ON/OFF (%N_1)
- Accel Check Target (%N_1)

OAT °F (°C)	POWER SETTING	BAROMETER (INCHES OF MERCURY)									
		31.0	30.5	30.0	29.5	29.0	28.5	28.0	27.5	27.0	26.5
60 (16)	LOW IDLE (%N2)	60.8	60.8	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5
	HIGH IDLE (%N2)	69.9	69.9	69.9	70.0	70.2	70.3	70.5	70.6	70.7	70.8
	P-P PMC OFF (%N2)	88.9	89.1	89.3	89.5	89.7	89.9	90.1	90.3	90.4	90.6
	P-P PMC ON (%N1)	71.9	72.1	72.4	72.7	73.0	73.2	73.5	73.8	74.1	74.3
	STATIC T.O. PMC ON/OFF (%N1)	90.5	90.9	91.3	91.7	92.1	92.4	92.8	93.3	93.7	94.3
	ACCEL CHECK TARGET (%N1)	88.6	89.1	89.5	90.0	90.4	90.8	91.2	91.6	92.1	92.6
62 (17)	LOW IDLE (%N2)	60.9	60.9	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6
	HIGH IDLE (%N2)	70.0	70.0	70.0	70.1	70.3	70.5	70.6	70.8	70.9	71.0
	P-P PMC OFF (%N2)	89.1	89.3	89.5	89.7	89.9	90.1	90.3	90.4	90.6	90.8
	P-P PMC ON (%N1)	72.0	72.3	72.6	72.8	73.1	73.4	73.7	73.9	74.2	74.5
	STATIC T.O. PMC ON/OFF (%N1)	90.6	91.1	91.5	91.9	92.3	92.6	93.0	93.4	93.9	94.5
	ACCEL CHECK TARGET (%N1)	88.8	89.3	89.7	90.1	90.6	91.0	91.4	91.8	92.2	92.8
64 (18)	LOW IDLE (%N2)	61.0	61.0	61.0	61.1	61.2	61.3	61.4	61.6	61.7	61.8
	HIGH IDLE (%N2)	70.2	70.2	70.2	70.3	70.4	70.6	70.8	70.9	71.0	71.1
	P-P PMC OFF (%N2)	89.2	89.5	89.7	89.9	90.1	90.3	90.5	90.6	90.9	90.9
	P-P PMC ON (%N1)	72.2	72.4	72.7	73.0	73.3	73.5	73.8	74.1	74.3	74.6

CFM56-3 TRIM TABLE

TRIM TABLE USAGE

Description

The Boeing 737-300/400/500 maintenance manual has 10 different trim table configurations. To determine which trim table configuration to use the following information should be obtained:

- Engine model
- Engine thrust rating
- PMC/MEC part numbers
- Incorporation of SB 73-017

With this information it can then be determined which trim table configuration is required by comparing the above data with the effectivity block.

EFFECTIVITY
CFM56-3-B1 ENGINES WITH
MEC P/N 9368M57PP09 AND
PMC P/N/ 7090M98G05 BEFORE THE
INCORPORATION OF CFMI SB 73-017

CFM56-3 TRIM TABLE EFFECTIVITY BLOCK

TRIM TABLE USAGE

Description

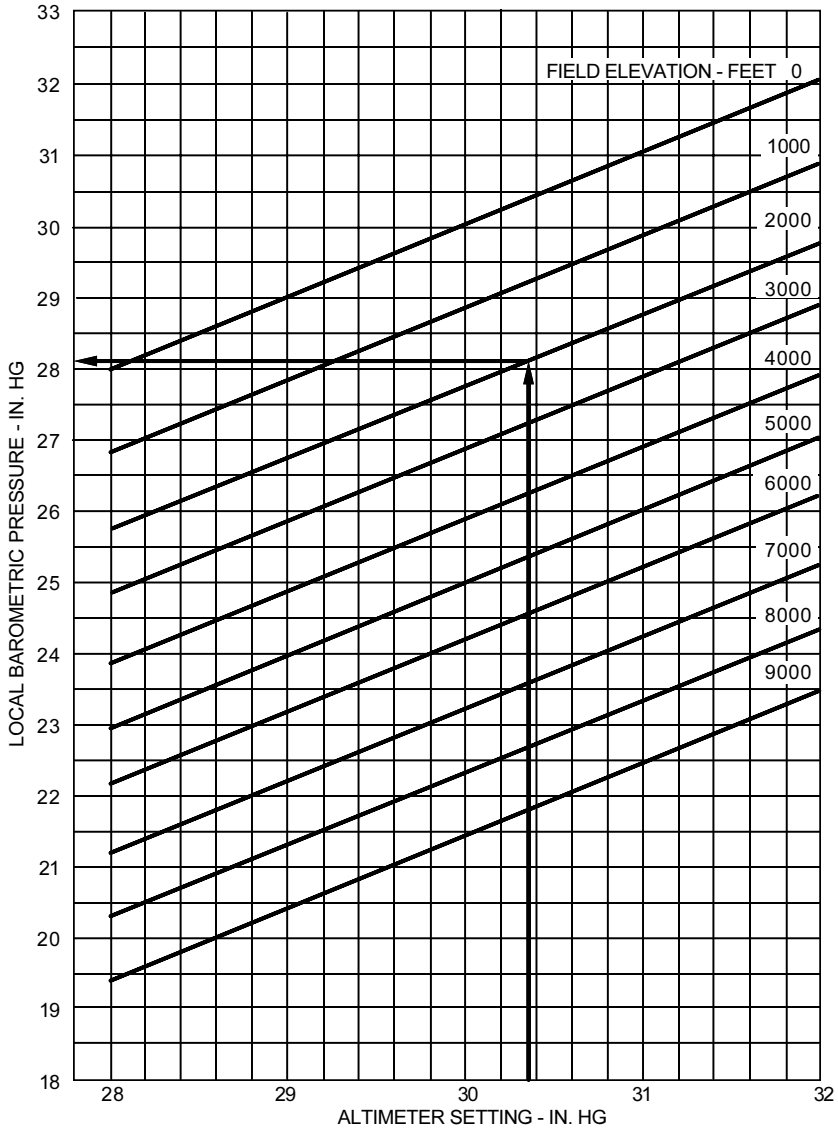
Before using the trim tables record the following:

- Ambient temperature (OAT)
- Barometric pressure

Do not use the flight deck temperature indicator as ambient temperature (OAT). Use a thermometer in the shade of the nose wheel well to obtain the required temperature.

To determine local barometric pressure convert the altimeter setting from the airport tower using the appropriate maintenance manual chart. See example below.

EXAMPLE:
ALTIMETER SETTING FROM TOWER IS 30.15 IN. HG
FIELD ELEVATION IS 2000 FT
LOCAL BAROMETRIC PRESSURE IS 28.05 IN. HG



ALTIMETER SETTING CONVERSION TO LOCAL BAROMETRIC PRESSURE

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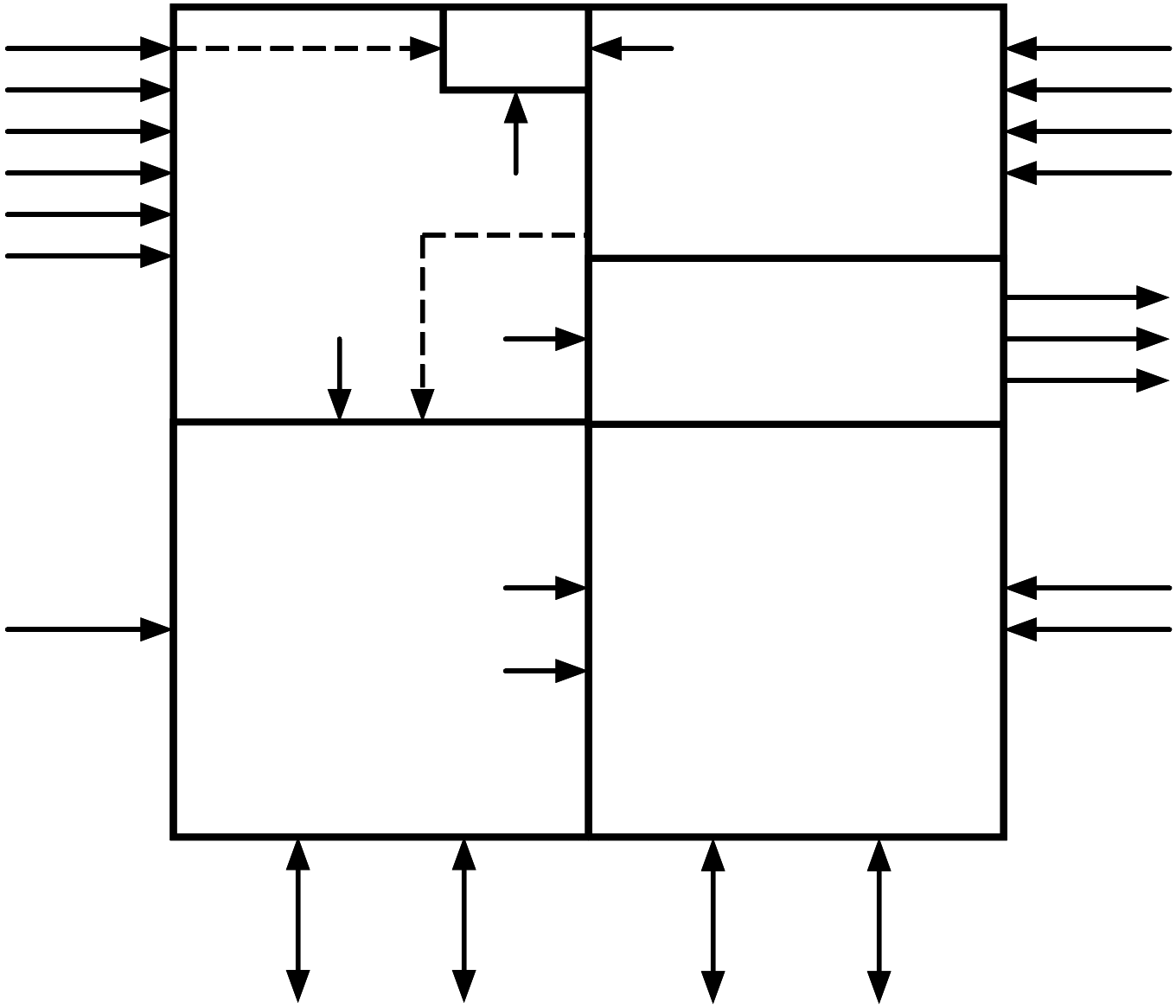
SYSTEMS REVIEW - PMC/MEC EXERCISE

MEC REVIEW EXERCISE

General

Following the instructors guidance have your team complete the MEC System Exercise.

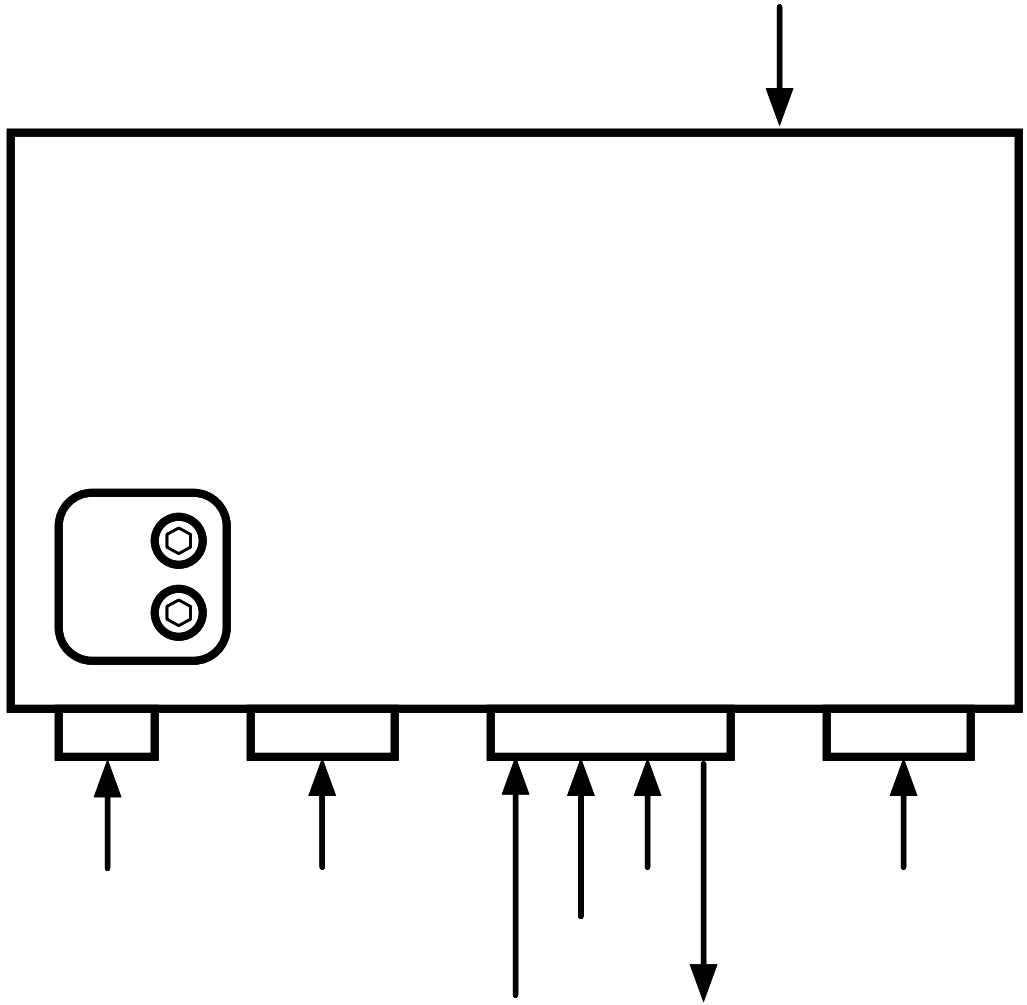


MEC SYSTEM EXERCISE

PMC REVIEW EXERCISE

General

Following the instructors guidance have your team complete the PMC System Exercise.



PMC SYSTEM EXERCISE

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DIAGNOSTIC TOOLS - GROUND RUN EXERCISE

GROUND RUNS - EXAMPLE 1

Pilot Report

"Two-knob throttle stagger, No. 1 throttle leading." (This is a CFM56-3C engine, operated at 22,000 lbs. thrust.)

Ground Run Data

From the pilot report, there is no indication of whether the stagger occurs during one phase of flight, or all phases of flight. Therefore, we choose to run an idle check (for speed differences at idle) and a part power trim check. If the N_1K/N_2K can be assessed at the part power stop, an MPA run will not be run since high EGT is not an issue.

Observations

Findings

AMBIENT CONDITIONS: TEMPERATURE: 22°C PRESSURE: 29.0" Hg

IDLE DATA:

	ENGINE NO. 1	ENGINE NO. 2
N_1:	20.1	20.0
N_2:	62.0	61.4
EGT:	503	492
FUEL FLOW (W_f):	712	688
N_2 TARGET (FROM TRIM TABLE):		61.7 (+3/-1%)

PART POWER TRIM DATA:

	PMC OFF			PMC ON	
	ENGINE NO. 1	ENGINE NO. 2		ENGINE NO. 1	ENGINE NO. 2
N_1:	77.4	77.4	N_1:	72.2	74.2
N_2:	92.5	92.9	N_2:	89.7	92.0
EGT:	-	-	EGT:	-	-
FUEL FLOW (W_f) :	-	-	FUEL FLOW (W_f):	-	-
N_2 TARGET (FROM TRIM TABLE):		92.8 (± .5)	N_1 TARGET (FROM TRIM TABLE):		74.8 (± .1.5)

EXAMPLE NO. 1 DATA

GROUND RUNS - EXAMPLE 2

Pilot Report

"No. 2 EGT hit 936°C for three seconds on T/O. N_1 exceeded T/O target by 2.5%. Throttle retarded. Throttle stagger during flight, No. 1 leading." (This is a CFM56-3B-2 engine.)

Ground Run Data

Since the problem does not seem to be related to idle speed, or low speed engine health, it is not necessary to perform/record the low idle data.

Because there is a question regarding the T/O EGT health of the engine, it is decided that an MPA check is needed - which can also be used to assess N_1K/N_2K for VSV/VBV system anomalies. A part power trim check is also deemed necessary, as it will isolate whether a problem in the MEC or PMC systems is causing the high EGT (via improper N_1 or N_2 scheduling).

Observations:

Findings:

AMBIENT CONDITIONS: TEMPERATURE: 24°C PRESSURE: 29.5" Hg

PART POWER TRIM DATA:

	PMC OFF		PMC ON	
	ENGINE NO. 1	ENGINE NO. 2	ENGINE NO. 1	ENGINE NO. 2
N_1:	78.6	78.7	75.2	78.7
N_2:	92.7	92.9	91.8	92.9
EGT:	-	-	-	-
FUEL FLOW (W_f):	-	-	-	-
N_2 TARGET (FROM TRIM TABLE):		93.0 (±.5)		
N_1 TARGET (FROM TRIM TABLE):				74.8 (± .1.5)

MPA DATA:

	ENGINE NO. 1	ENGINE NO. 2
N_1:	86.3	86.3
N_2:	96.0	96.1
EGT:	762	772
FUEL FLOW (W_f) :	-	-
PMC ON/OFF:	ON	ON
MPA TARGET:	86.2	86.2
MAX EGT: (FROM MM TABLE)		777°C
MAX N_2: (FROM MM TABLE)		96.8%

EXAMPLE NO. 2 DATA

GROUND RUNS - EXAMPLE 3

Pilot Report

"No. 1 engine very slow to start - start aborted. Next start successful, but slow. No. 1 engine very slow on T/O throttle set from idle. Throttle stagger, No. 1 forward." (This is a CFM56-3B2 engine).

Ground Run Data

The No. 1 engine has about 1,000 cycles since previous shop visit, with a few previous reports of slow acceleration, but no reports of high T/O EGT.

Because of the write-ups for slow start/acceleration, a low idle check is scheduled. To check the MEC/PMC scheduling systems, a part power trim run is planned, and an MPA is performed to assess N_1K/N_2K and T/O EGT health. Additionally, an acceleration check from low idle to 40% N_1 is planned to assess how slow/fast the engines are accelerating.

Observations:

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Findings:

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AMBIENT CONDITIONS: TEMPERATURE: 8°C **PRESSURE: 28.5" Hg**

IDLE DATA:

	ENGINE NO. 1	ENGINE NO. 2
N_1:	19.6	20.4
N_2:	59.5	60.5
EGT:	515	490
FUEL FLOW (W_f):	806	688
N_2 TARGET (FROM TRIM TABLE):		60.3 (+3/-1%)

(NOTE: MAINTENANCE REPORTED NO. 1 START TIME WAS TWO MINUTES, WHILE NO. 2 START TIME WAS 75 SECONDS. BOTH ENGINES HAD BEEN SHUT DOWN FOR FOUR HOURS)

PART POWER TRIM DATA:

PMC OFF

	ENGINE NO. 1	ENGINE NO. 2
N_1:	74.0	77.3
N_2:	90.8	90.3
EGT:	-	-
FUEL FLOW (W_f):	-	-
N_2 TARGET (FROM TRIM TABLE):		90.6 (±.5)

PMC ON

	ENGINE NO. 1	ENGINE NO.2
N_1:	72.9	74.3
N_2:	90.2	89.0
EGT:	-	-
FUEL FLOW (W_f):	-	-
N_1 TARGET (FROM TRIM TABLE):		73.3 (±1.5)

MPA DATA:

	ENGINE NO. 1	ENGINE NO. 2
N_1:	84.0	84.0
N_2:	94.4	92.7
EGT:	712	701
FUEL FLOW (W_f):	-	-
PMC ON/OFF:	ON	ON
MPA TARGET:	84.0	84.0
MAXIMUM EGT: (FROM MM TABLE)		725°C
MAXIMUM N_2: (FROM MM TABLE)		94.4%

ACCELERATION TIMES FROM IDLE TO 40% N_1: NO. 1 ENGINE 13.2 SECONDS NO. 2 ENGINE 8.8 SECONDS

EXAMPLE NO. 3 DATA

GROUND RUNS - EXAMPLE 4

Pilot Report

"Throttle stagger in cruise, No. 1 throttle lagging. No. 1 has higher RPM on descent." (This is a CFM56-3C1 engine operated at 23.5K thrust).

Ground Run Data

Because of the reference to descent idle, a high idle speed check is performed, as well as low idle (to see if both idles are affected). A part power trim run will identify whether the MEC and PMC systems are scheduling properly. If any of the part power trim run data shows matched N_1's or matched N_2's, then an N_1K/N_2K assessment can be made at part power. If matched speeds are not available, an MPA run can be made to assess N_1K/N_2K.

Observations:

Findings:

AMBIENT CONDITIONS: TEMPERATURE: 34°C PRESSURE: 29.0" Hg

LOW IDLE DATA:

	ENGINE NO. 1	ENGINE NO. 2
N_1:	20.2	22.2
N_2:	60.9	63.6
EGT:	-	-
FUEL FLOW (W_f):	-	-
N_2 TARGET (FROM TRIM TABLE):		63.0 (+3/-1%)

HIGH IDLE DATA:

	ENGINE NO. 1	ENGINE NO. 2
N_1:	28.2	30.0
N_2:	71.1	73.5
EGT:	-	-
FUEL FLOW (W_f):	-	-
N_2 TARGET (FROM TRIM TABLE):		73.7 (±.7%)

PART POWER TRIM DATA:

PMC OFF

	ENGINE NO. 1	ENGINE NO. 2
N_1:	72.1	80.5
N_2:	92.0	94.7
EGT:	-	-
FUEL FLOW (W_f):	-	-
N_2 TARGET (FROM TRIM TABLE):		94.5 (±.5)

PMC ON

	ENGINE NO. 1	ENGINE NO.2
N_1:	75.3	76.2
N_2:	93.3	93.3
EGT:	-	-
FUEL FLOW (W_f):	-	-
N_1 TARGET (FROM TRIM TABLE):		76.4 (±.1.5)

EXAMPLE NO. 4 DATA

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