CL-350

CL-350 SUPPLEMENTAL MANUAL

PERFORMANCE 10

LOFT.AERO

This page intentionally left blank

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

TABLE OF CONTENTS

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

INTRODUCTION

INTRODUCTION TO PERFORMANCE DATA

STANDARD PERFORMANCE CONDITIONS

The data in this chapter present the general performance information and must be used when determining the airplane performance using the Computerized Airplane Flight Manual (CAFM) for the Challenger 350 Model BD−100−1A10 airplane, fitted with two AS907−2−1A engines.

The CAFM has been approved by Transport Canada to generate airplane performance information for Chapter 6 and Chapter 7. Any modification to the approved CAFM software application, or subsequent revision to the generated output, will cancel the airworthiness approval of this information, unless the change is approved by Transport Canada. This provision remains applicable regardless of any approval statement printed on a generated output.

The most current approved version of the CAFM software and its corresponding database/data files must be verified to be applicable to the particular airplane model and configuration as follows:

CERTIFICATION BASIS				
AIRPLANE MODEL	ENGINE MODEL	PERFORMANCE OPTIONS	ITEM	PART NUMBER
BD−100 −1A10	AS907−2−1A	None	CAFM Software	SW0000001 −00322
			Performance Data File	SW0000002 −00501
			Aircraft Database	SW0000003 −00306
			Configuration File	Customer Dependent

All performance data are based on the following performance conditions:

1. Minimum guaranteed rated thrust including installation, bleed air, and accessory losses.
2. Full temperature and altitude accountability within the operational limits for which the airplane is certified.

NOTE:
- Should OAT or altitude be below the lowest value shown on the performance charts, use performance at the lowest value shown.
- Performance data may be interpolated, or use the next higher weight, temperature and/or altitude.

INTRODUCTION

3. Wing flap positions are as follows:
   - Takeoff .... 10° and 20°
   - Final Segment .... 0°
   - En Route .... 0°
   - Approach .... 10°
   - Landing .... 30°
4. Thrust settings (N_1) from either the CAFM 'Thrust Settings' calculator or from AFM tables, as indicated by the N_1 bugs.
5. All takeoff and landing performance is based on a paved, hard runway surface.
6. Automatic Ground Lift Dumping operational.
7. Wet runway takeoff performance accounts for the use of thrust reversers down to 40 KIAS, followed by idle reverse down to a complete stop.
8. ICAO standard atmosphere conditions (ISA), with corrections for non–standard conditions, when applicable.
9. Maximum nominal brake operating pressure of 3,000 psi.
10. Wind speed is measured at a height of 10 meters (33 feet) above the surface.
11. For weights below 27,400 lb (12,429 kg), use performance data for a weight of 27,400 lb (12,429 kg).
12. The performance data have been certified based on the following:
    (a) A minimum takeoff safety speed (V_2) of 1.155 of the stall speed (V_{SR}) for flap 20°, and of 1.19 for flap 10°.
    (b) A minimum landing reference speed (V_{REF}) of 1.23 V_{SR}.
13. CAFM outputs can include warning or error messages in the Messages View pane:
    (a) Warning (yellow color coding): the CAFM output data is valid for use and a warning is issued because CAFM could not meet one of the input requirements. Additionally, warnings may be provided to give more information on the result. Finally, warnings are also issued when the temperature is within the 5 °C band outside the certified temperature envelope. In this case, the output data may be used for interpolation purposes only.
    (b) Error (red color coding): the CAFM is unable to calculate, no data is provided and an error message provides information on the error encountered by the CAFM.

INTRODUCTION

STANDARD PERFORMANCE PROCEDURES

ENGINE–OUT TAKEOFF – ACCELERATE GO

1. Set thrust levers to takeoff (TO) thrust detent, then release the brakes.
2. The pilot recognizes the engine failure at or after V_1.
3. Continue to accelerate to V_R and rotate smoothly toward the flight director single engine pitch attitude. Adjust pitch attitude to achieve V_2 at a height of 35 feet above the runway. Adjust pitch attitude as necessary to maintain V_2.
4. Retract the landing gear when a positive rate of climb is established.

CAUTION: Do not extrapolate above limits (2% up and down runway gradient, and 10 knot tailwind).

ENGINE–OUT TAKEOFF – ACCELERATE STOP

1. Set thrust levers to takeoff (TO) thrust detent, then release the brakes.
2. The pilot recognizes the engine failure and reduces both thrust levers to IDLE at or before V_1.
3. Simultaneously, initiate maximum braking.
4. Deploy thrust reversers, if necessary.
5. Spoilers are automatically deployed (Ground Lift Dumping).
6. Select Idle Reverse Thrust at 40 KIAS.
7. Maintain maximum braking until airplane comes to a complete stop.

MULTI–ENGINE TAKEOFF

1. Set thrust levers to takeoff (TO) thrust detent, then release the brakes.
2. Rotate smoothly at V_R toward the flight director all engine pitch attitude. Adjust pitch attitude to achieve a minimum of V_2 +10 KIAS at a height of 35 feet above the runway. Adjust pitch attitude as necessary to maintain the speed reached at 35 feet.
3. Retract the landing gear when a positive rate of climb is established.

ROLLING TAKEOFF

In the applicable CAFM calculators, set the 'Rolling Takeoff' toggle to 'Yes' in order to obtain the corresponding rolling takeoff performance.

From Runway Centerline:

1. Brakes – Release.
2. Thrust Levers – Promptly Select TO Thrust.
3. Follow the performance takeoff procedure.

INTRODUCTION

LANDING

1. Approach at V_{REF} with flaps and gear down using thrust to maintain a 3 degree glideslope.
2. Briskly reduce the thrust levers to IDLE at 50 feet above the runway threshold.
3. A firm touchdown with minimal flare should be accomplished.
4. Apply maximum braking after nosewheel touchdown until airplane comes to a complete stop.
5. Deploy thrust reversers, if necessary.
6. Spoilers are automatically deployed (Ground Lift Dumping).
7. Select Idle Reverse Thrust at 40 KIAS.

VARIABLE FACTORS AFFECTING PERFORMANCE

Some performance data presented in this section exceed the weight/temperature/altitude limits established in the LIMITATIONS section of this manual. These data are presented for reference only.

Details of variables affecting performance are given within the charts to which they apply or in the applicable CAFM calculators. Conditions which relate to all performance calculations are:

1. Effect of humidity.
2. Wind corrections on performance charts or as CAFM calculator inputs are to be taken as the reported winds at the Tower height of 33 ft (10 m). Factors for 50% headwind component and 150% tailwind component have been applied as prescribed in pertinent regulations.

ENGINE BLEED CONFIGURATIONS

Performance data are presented for the following engine bleed configurations:

1. Engine Bleed OFF (Zero engine bleed).
2. Engine Bleed ON (ECS is ON and Anti−Ice is OFF).
3. Engine Bleed ON, Engine Anti−Ice ON (ECS is ON and engine cowl Anti−Ice is ON).
4. Engine Bleed ON, Engine Anti−Ice and Wing Anti−Ice ON (ECS is ON and all Anti−Ice devices are ON).

Two other engine bleed configurations are available for dispatch. For the following configurations, use the associated performance data:

- Engine Anti−Ice ON: the data from configuration 3 above are to be used.
- Engine Anti−Ice and Wing Anti−Ice ON: the data from configuration 4 above are to be used.

INTRODUCTION

APU USAGE

All performance information presented are valid for both APU ON or APU OFF. There are no performance penalties associated with APU usage.

DEFINITIONS

These definitions apply to terms used throughout this manual.

AIRSPEEDS

CAS	Calibrated Airspeed – The airspeed indicator reading corrected for instrument and position error. KCAS is calibrated airspeed expressed in knots.
IAS	Indicated Airspeed – The airspeed indicator reading as installed in the airplane. KIAS is indicated airspeed expressed in knots. The information in this manual is presented in terms of indicated airspeed, unless otherwise stated, and assumes zero instrument error.
M	Calibrated Mach Number – The Mach number reading corrected for instrument and position error.
M_I	Indicated Mach Number – The Machmeter reading as installed in the airplane. Zero instrument error is assumed for presentations in this manual.
V_A	Maneuvering Speed – V_A is the highest speed that full aileron and rudder control can be applied without overstressing the aircraft.
V_{EF}	Engine Failure Speed – The speed at which the engine actually fails during a takeoff roll.
V_{ENR}	The Flap 0 En–Route climb speed. This speed is used following an engine failure during flight.
V_{FE}	Maximum Flap Extended Speed – The maximum speed permissible with the wing flaps in a prescribed extended position.
V_{FTO}	Final Takeoff Climb Speed – The flaps 0 speed attained at the end of the flight path acceleration segment during a continued takeoff following an engine failure, and is the speed scheduled for the final segment climb.

INTRODUCTION

V_{LE}	Maximum Landing Gear Extended Speed – The maximum speed at which the aircraft can be flown with the landing gear extended.
V_{LO}	Maximum Landing Gear Operating Speed – The maximum speed at which the landing gear can be extended or retracted.
V_{MO}/M_{MO}	Maximum Operating Limit Speed – The speed that may not be deliberately exceeded in any flight condition except where specifically authorized for flight test or pilot training. V_{MO} is expressed in knots. M_{MO} is expressed in Mach number.
V_{MCA}	Minimum Control Speed, Air – The minimum flight speed at which the airplane is controllable with up to 5° of bank when one engine suddenly becomes inoperative and the remaining engine is operating at APR thrust.
V_{MCG}	Minimum Control Speed, Ground – The minimum speed on the ground at which control can be maintained using aerodynamic controls alone and wings level, when one engine suddenly becomes inoperative and the remaining engine is operating at APR thrust.
V_{MCL}	Minimum Control Speed, Landing – The minimum flight speed during landing approach at which the airplane is controllable with up to 5° of bank when one engine suddenly becomes inoperative and the remaining engine is operating at APR thrust. Roll rate requirements can also have an impact on V_{MCL}.
V_1	Takeoff Decision Speed – The speed at which the pilot may decide to continue the takeoff, or decide to stop. Takeoff distances are determined based on the selected V_1 speed (see Distances definitions below).
V_{1MBE}	Maximum V_1 for brake energy – The maximum speed on the ground from which a stop can be accomplished within the energy capabilities of the brakes. V_1 may not exceed V_{1MBE}.
V_{1MCG}	Minimum V_1 limited by control on the ground – The takeoff decision speed following an engine failure at V_{MCG}. V_1 may not be less than V_{1MCG}.

INTRODUCTION

V_R	Rotation Speed – The speed at which rotation is initiated during takeoff to attain takeoff performance.
V_2	Takeoff Safety Speed – The actual speed at 35 feet above the runway surface as demonstrated in flight during single–engine takeoff.
V_{2GA}	Go–Around Speed (approach climb) – The airspeed used for approach climb gradient (airplane in the Flaps 10 / Gear Up approach climb configuration).
V_{REF}	Landing Approach Speed – The airspeed used for landing climb gradient (airplane in the Flaps 30 / Gear Down landing configuration) and the airspeed used for approach and landing.
V_{SR}	Reference Stall Speed – The reference stall speed upon which all performance data is based.

DISTANCES

Accelerate–Stop Distance

The accelerate–stop distance is the horizontal distance from brake release to the point at which the airplane comes to a complete stop on a takeoff during which the pilot rejects the takeoff at or below V_1. The CAFM determines the accelerate–stop distance as the greater of the single engine and all–engine accelerate–stop distances:

1) Single engine accelerate–stop distance: one engine fails during acceleration before V_1, recognition occurs before or at V_1 and the pilot aborts the takeoff before or at V_1.
2) All–engine accelerate–stop distance: with all engines operative, the pilot aborts the takeoff before or at V_1.

Engine–Out Accelerate–Go Takeoff Distance

The engine–out accelerate–go takeoff distance is the horizontal distance from brake release to the point at which the airplane attains a height of 35 feet (15 feet for wet and contaminated runways) above the runway surface, on a takeoff during which one engine fails, recognition occurs at or above V_1 and the pilot continues the takeoff.

INTRODUCTION

Engine–Out Accelerate–Go Takeoff Run

The engine–out accelerate–go takeoff run is:

- the horizontal distance from brake release to the mid point between lift–off and a height of 35 feet above the runway surface on a dry runway or
- the horizontal distance from start to a height of 15 feet above the runway surface on wet or contaminated runways,

on a takeoff during which one engine fails, recognition occurs at or above V_1 and the pilot continues the takeoff.

All–Engines Accelerate–Go Takeoff Distance

The factored all–engine takeoff distance is the horizontal distance from brake release to the point at which the airplane attains a height of 35 feet above the runway surface. It is noted that the CAFM all–engine takeoff distance already includes the regulatory 115% factor.

All–Engines Accelerate–Go Takeoff Run

The factored all–engine takeoff run is the horizontal distance from brake release to the mid point between lift–off and a height of 35 feet above the runway surface. It is noted that the CAFM all–engine takeoff run already includes the regulatory 115% factor.

Takeoff Distance (Takeoff Field Length Limitation)

The takeoff distances presented in the CAFM TAKEOFF calculators are based on a smooth or grooved, paved runway. Takeoff distances are given for selected inputs of airplane weight, atmospheric temperature, pressure altitude, reported wind, and runway gradient. The Takeoff Distance must be selected as the greatest of the following distances:

1) The factored all–engine accelerate–go takeoff distance.
2) The accelerate–stop distance.
3) The engine–out accelerate–go takeoff distance.

Optimum Takeoff Distance can be obtained by selecting the balanced V_1 option in the Full Takeoff calculator. V_1 is then optimized to balance the accelerate–stop distance with the engine–out accelerate–go distance. Note that limitations on V_1 (minimum V_1/V_R, V_{1MCG}, V_R or V_{1MBE}) can prevent balancing.

INTRODUCTION

Takeoff Run	The Takeoff Run must be selected as the greatest of the following distances: 1) The factored all−engine accelerate−go takeoff run. 2) The accelerate−stop distance. 3) The engine−out accelerate−go takeoff run. The clearway available on a specific runway can then be accounted for by comparing the takeoff distance and the takeoff run data provided by the CAFM. The maximum usable clearway cannot exceed the difference between the takeoff distance and the takeoff run. This last verification must be done separately for the all−engine accelerate−go takeoff distance and the engine−out accelerate−go takeoff distance.
Actual Landing Distance	The actual landing distances presented in the CAFM are based on a smooth, paved runway. The actual landing distance is equal to the horizontal distance from a point 50 feet above the touchdown point on the runway surface to the point at which the airplane would come to a full stop on the runway.
Factored Landing Distance	The factored dry landing distances presented in the CAFM are equal to the actual landing distance divided by 0.60 (multiplied by 1.67). The wet landing distance is the factored dry landing distance multiplied by 1.15.

METEOROLOGICAL

ISA	International Standard Atmosphere.
OAT	Outside ambient air temperature obtained from ground meteorological sources.
SAT	Static Air Temperature − The total air temperature obtained from onboard temperature measurement adjusted for compressibility effects.
Altitude	All altitudes given in this section are pressure altitudes unless otherwise stated.

INTRODUCTION

Wind	The wind velocities, in knots, as inputs to the CAFM or on applicable charts, are to be understood as the headwind or tailwind components of the actual winds at 33 feet (10 meters) above the runway surface (reported tower winds).
Demonstrated Crosswind	The demonstrated crosswind velocity is the velocity of the reported tower winds (measured at a 33 feet (10 meter) height) for which adequate control of the airplane during takeoff and landing (including the use of thrust reversers) was actually demonstrated on a dry runway during certification tests.

MISCELLANEOUS

Position Error Correction	Position Error Correction – A correction applied to indicated airspeed, Mach number or altitude to eliminate the effect of the location of the static pressure source on the instrument reading. Any change in the airspeed–altitude system external to the airplane, or locating any external object near the pressure pickup sources, requires calibration of the system and revision of the charts.
Maximum Takeoff Brake Energy	The maximum brake energy with maximum effort braking allowed during a rejected takeoff. This is presented in the CAFM as the maximum V_1 allowed limited by brake energy. Note that, after the stop, wheel fuse plugs may release and brake and tire damage will occur.
Maximum Landing Brake Energy	The maximum landing brake energy is defined as the highest brake energy that can be achieved without wheel fuse plug release or tire damage. Maximum landing brake energy is obtained at landing weights presented on the QUICK TURNAROUND chart for the specified conditions. Maximum effort stops in which the landing weight exceeds the QUICK TURNAROUND weight may cause excessive brake wear and, after the stop, may cause wheel fuse plug release and tire damage.
Runway Gradient	Change in runway elevation per 100 feet of runway length. The values given are positive for uphill gradients and negative for downhill gradients.

INTRODUCTION

Gradient of Climb	The ratio of the change in height during a portion of the climb to the horizontal distance traversed in the same time interval.
Gross Climb Gradient	The climb gradient that the airplane can actually achieve given ideal conditions.
Net Climb Gradient	The gross climb gradient reduced by 0.8% during the takeoff phase and 1.1% en route.
One Engine Inoperative (OEI)	One of the two engines has failed during the takeoff segment.
All Engine Operative (AEO)	Both engines operate normally.

CERTIFICATED NOISE LEVELS

The noise levels of the BD−100 aircraft are in compliance with the requirements of:

- AWM Chapter 516, Change 516−7
- FAR 36 Amendment 36−28, Stage 4
- ICAO Annex 16, Volume I, Amendment 7, Chapter 4.

These noise values are stated for reference conditions of standard atmospheric pressure at sea level, 25 °C ambient temperature, 70% relative humidity, and zero wind.

AIRCRAFT CONFIGURATION

TAKEOFF

Flyover and lateral noise levels were determined for the following conditions:

Maximum takeoff weight .... 40,600 lb (18,416 kg)

Climb speed .... V_2+10 KIAS

Flaps setting .... 10°

APU .... off

Air−conditioning pack .... on

Wing and engine anti−ice .... off

Normal takeoff thrust (both engines operating).

INTRODUCTION

LANDING

Approach noise levels were determined for the following conditions:

Glideslope .... 3 degrees

Landing gear .... Down

Landing Weight .... 34,150 lb (15,490 kg)

Approach speed .... V_{REF}+10 KIAS

Flaps setting .... 30°

APU .... On

Air–Conditioning pack .... On

Wing and engine anti–icing .... Off

CERTIFICATED NOISE LEVELS

The demonstrated effective perceived noise levels (EPNdB), noise limits of and margins of compliance are listed below:

MEASUREMENT POINTS	ACTUAL NOISE LEVEL IN EPNDB	MAXIMUM ALLOWABLE REQUIREMENT (EPNDB)	MARGINS (EPNDB)
Flyover	75.7	89.0	13.3
Lateral	89.1	94.0	4.9
Approach	89.5	98.0	8.5

Compliance to ICAO Annex 16 Chapter 4 and FAR 36 Stage 4 has been demonstrated with a 16.7 dB margin.

No determination has been made that the noise levels of this aircraft are or should be acceptable or unacceptable for operation at, into, or out of any airport.

Effectivity:

FAA Certified Airplanes:

The above noise levels also comply with part 36, Appendix B, Stage 4 maximum noise level requirements and were obtained by analysis of approved data from noise tests conducted under the provisions of part 36, Amendment 36–28. The noise measurement and evaluation procedures used to obtain these noise levels are considered by the FAA to be equivalent to the Chapter 4 noise level required by the International Civil Aviation Organization (ICAO) in Annex 16, Volume 1, Appendix 2, Amendment 7, effective March 21, 2002.

INTRODUCTION

MINIMUM CONTROL SPEED AIR V_{MCA}

The values of V_{MCA} for each takeoff flap configuration are:

V_{MCA}

- Flaps 10° .... 110 KIAS
- Flaps 20° .... 109 KIAS

MINIMUM CONTROL SPEED GROUND V_{MCG}

The values of V_{MCG} for each takeoff flap configuration are:

V_{MCG}

- Flaps 10° .... 115 KIAS
- Flaps 20° .... 114 KIAS

MINIMUM CONTROL SPEED LANDING V_{MCL}

The values of V_{MCL} for the different flap configurations are:

V_{MCL}

- Flaps 10° .... 115 KIAS
- Flaps 20° .... 112 KIAS
- Flaps 30° .... 107 KIAS

MAXIMUM CROSSWIND

The maximum demonstrated crosswind component for takeoff is 28 kts and for landing is 24 kts, and is not considered limiting. Landings have been performed at an approach speed of V_{REF} + 1/2 of the gust; a maximum of 10 kts gust factor should be used.

Effectivity:

For aircraft on the Russian Federation (RF) and Commonwealth of Independent States (CIS) countries' registry:

The maximum demonstrated crosswind component for takeoff is 28 kts and for landing is 24 kts. Landings have been performed at an approach speed of VREF +1/2 of the gust; a maximum of 10 kts gust factor should be used.

MAXIMUM TAILWIND

The maximum tailwind component for takeoff and landing (at 33 feet [10 meters] tower height) is 10 knots.

INTRODUCTION

GENERAL

NOTE: In the CAFM calculator, temperature selection can be made in either the Outside Air Temperature (OAT) mode (°C or °F) or Deviation from International Standard Atmosphere mode (DISA).

RELATION OF TEMPERATURE (°C) TO ISA

ALTITUDE ~ 1000 FT	-50°C	-40°C	-30°C	-20°C	-10°C	ISA	+10°C	+20°C	+30°C
51	-106.5	-96.5	-86.5	-76.5	-66.5	**-56.5**	-46.5	-36.5	-26.5
37	-106.5	-96.5	-86.5	-76.5	-66.5	**-56.5**	-46.5	-36.5	-26.5
35	-104.2	-94.2	-84.2	-74.2	-64.2	**-54.2**	-44.2	-34.2	-24.2
33	-100.3	-90.3	-80.3	-70.3	-60.3	**-50.3**	-40.3	-30.3	-20.3
31	-96.3	-86.3	-76.3	-66.3	-56.3	**-46.3**	-36.3	-26.3	-16.3
30	-94.4	-84.4	-74.4	-64.4	-54.4	**-44.4**	-34.4	-24.4	-14.4
29	-92.4	-82.4	-72.4	-62.4	-52.4	**-42.4**	-32.4	-22.4	-12.4
28	-90.4	-80.4	-70.4	-60.4	-50.4	**-40.4**	-30.4	-20.4	-10.4
27	-88.4	-78.4	-68.4	-58.4	-48.4	**-38.4**	-28.4	-18.4	-8.4
26	-86.5	-76.5	-66.5	-56.5	-46.5	**-36.5**	-26.5	-16.5	-6.5
25	-84.5	-74.5	-64.5	-54.5	-44.5	**-34.5**	-24.5	-14.5	-4.5
24	-82.5	-72.5	-62.5	-52.5	-42.5	**-32.5**	-22.5	-12.5	-2.5
23	-80.5	-70.5	-60.5	-50.5	-40.5	**-30.5**	-20.5	-10.5	-0.5
22	-78.6	-68.6	-58.6	-48.6	-38.6	**-28.6**	-18.6	-8.6	1.4
21	-76.6	-66.6	-56.6	-46.6	-36.6	**-26.6**	-16.6	-6.6	3.4
20	-74.6	-64.6	-54.6	-44.6	-34.6	**-24.6**	-14.6	-4.6	5.4
19	-72.6	-62.6	-52.6	-42.6	-32.6	**-22.6**	-12.6	-2.6	7.4
18	-70.6	-60.6	-50.6	-40.6	-30.6	**-20.6**	-10.6	-0.6	9.4
16	-66.7	-56.7	-46.7	-36.7	-26.7	**-16.7**	-6.7	3.3	13.3
14	-62.7	-52.7	-42.7	-32.7	-22.7	**-12.7**	-2.7	7.3	17.3
12	-58.8	-48.8	-38.8	-28.8	-18.8	**-8.8**	1.2	11.2	21.2
10	-54.8	-44.8	-34.8	-24.8	-14.8	**-4.8**	5.2	15.2	25.2
8	-50.8	-40.8	-30.8	-20.8	-10.8	**-0.8**	9.2	19.2	29.2
6	-46.9	-36.9	-26.9	-16.9	-6.9	**3.1**	13.1	23.1	33.1
4	-42.9	-32.9	-22.9	-12.9	-2.9	**7.1**	17.1	27.1	37.1
2	-39.0	-29.0	-19.0	-9.0	1.0	**11.0**	21.0	31.0	41.0
S.L.	-35.0	-25.0	-15.0	-5.0	5.0	**15.0**	25.0	35.0	45.0
	-50°C	-40°C	-30°C	-20°C	-10°C	ISA	+10°C	+20°C	+30°C

CFM0601_IMP_001

Figure 06–01–1

INTRODUCTION

NOTE: This table can only be used to convert units of Outside Air Temperature (OAT) data , not units of Deviation from International Standard Atmosphere (DISA).

TEMPERATURE CONVERSION

- To convert from Celsius to Fahrenheit, find, in bold face columns, the number representing the Celsius temperature to be converted. The equivalent Fahrenheit temperature is read in the adjacent column headed °F.
- To convert from Fahrenheit to Celsius, find, in bold face columns, the number representing the Fahrenheit temperature to be converted. The equivalent Celsius temperature is read in the adjacent column headed °C.

°F	◄►	°C	°F	◄►	°C	°F	◄►	°C	°F	◄►	°C	°F	◄►	°C
-148.0	**-100**	-73.3	-58.0	**-50**	-45.6	32.0	**0**	-17.8	122.0	**50**	10.0	212.0	**100**	37.8
-146.2	**-99**	-72.8	-56.2	**-49**	-45.0	33.8	**1**	-17.2	123.8	**51**	10.6	213.8	**101**	38.3
-144.4	**-98**	-72.2	-54.4	**-48**	-44.4	35.6	**2**	-16.7	125.6	**52**	11.1	215.6	**102**	38.9
-142.6	**-97**	-71.7	-52.6	**-47**	-43.9	37.4	**3**	-16.1	127.4	**53**	11.7	217.4	**103**	39.4
-140.8	**-96**	-71.1	-50.8	**-46**	-43.3	39.2	**4**	-15.6	129.2	**54**	12.2	219.2	**104**	40.0
-139.0	**-95**	-70.6	-49.0	**-45**	-42.8	41.0	**5**	-15.0	131.0	**55**	12.8	221.0	**105**	40.6
-137.2	**-94**	-70.0	-47.2	**-44**	-42.2	42.8	**6**	-14.4	132.8	**56**	13.3	222.8	**106**	41.1
-135.4	**-93**	-69.4	-45.4	**-43**	-41.7	44.6	**7**	-13.9	134.6	**57**	13.9	224.6	**107**	41.7
-133.6	**-92**	-68.9	-43.6	**-42**	-41.1	46.4	**8**	-13.3	136.4	**58**	14.4	226.4	**108**	42.2
-131.8	**-91**	-68.3	-41.8	**-41**	-40.6	48.2	**9**	-12.8	138.2	**59**	15.0	228.2	**109**	42.8
-130.0	**-90**	-67.8	-40.0	**-40**	-40.0	50.0	**10**	-12.2	140.0	**60**	15.6	230.0	**110**	43.3
-128.2	**-89**	-67.2	-38.2	**-39**	-39.4	51.8	**11**	-11.7	141.8	**61**	16.1	231.8	**111**	43.9
-126.4	**-88**	-66.7	-36.4	**-38**	-38.9	53.6	**12**	-11.1	143.6	**62**	16.7	233.6	**112**	44.4
-124.6	**-87**	-66.1	-34.6	**-37**	-38.3	55.4	**13**	-10.6	145.4	**63**	17.2	235.4	**113**	45.0
-122.8	**-86**	-65.6	-32.8	**-36**	-37.8	57.2	**14**	-10.0	147.2	**64**	17.8	237.2	**114**	45.6
-121.0	**-85**	-65.0	-31.0	**-35**	-37.2	59.0	**15**	-9.4	149.0	**65**	18.3	239.0	**115**	46.1
-119.2	**-84**	-64.4	-29.2	**-34**	-36.7	60.8	**16**	-8.9	150.8	**66**	18.9	240.8	**116**	46.7
-117.4	**-83**	-63.9	-27.4	**-33**	-36.1	62.6	**17**	-8.3	152.6	**67**	19.4	242.6	**117**	47.2
-115.6	**-82**	-63.3	-25.6	**-32**	-35.6	64.4	**18**	-7.8	154.4	**68**	20.0	244.4	**118**	47.8
-113.8	**-81**	-62.8	-23.8	**-31**	-35.0	66.2	**19**	-7.2	156.2	**69**	20.6	246.2	**119**	48.3
-112.0	**-80**	-62.2	-22.0	**-30**	-34.4	68.0	**20**	-6.7	158.0	**70**	21.1	248.0	**120**	48.9
-110.2	**-79**	-61.7	-20.2	**-29**	-33.9	69.8	**21**	-6.1	159.8	**71**	21.7	249.8	**121**	49.4
-108.4	**-78**	-61.1	-18.4	**-28**	-33.3	71.6	**22**	-5.6	161.6	**72**	22.2	251.6	**122**	50.0
-106.6	**-77**	-60.6	-16.6	**-27**	-32.8	73.4	**23**	-5.0	163.4	**73**	22.8	253.4	**123**	50.6
-104.8	**-76**	-60.0	-14.8	**-26**	-32.2	75.2	**24**	-4.4	165.2	**74**	23.3	255.2	**124**	51.1
-103.0	**-75**	-59.4	-13.0	**-25**	-31.7	77.0	**25**	-3.9	167.0	**75**	23.9	257.0	**125**	51.7
-101.2	**-74**	-58.9	-11.2	**-24**	-31.1	78.8	**26**	-3.3	168.8	**76**	24.4	258.8	**126**	52.2
-99.4	**-73**	-58.3	-9.4	**-23**	-30.6	80.6	**27**	-2.8	170.6	**77**	25.0	260.6	**127**	52.8
-97.6	**-72**	-57.8	-7.6	**-22**	-30.0	82.4	**28**	-2.2	172.4	**78**	25.6	262.4	**128**	53.3
-95.8	**-71**	-57.2	-5.8	**-21**	-29.4	84.2	**29**	-1.7	174.2	**79**	26.1	264.2	**129**	53.9
-94.0	**-70**	-56.7	-4.0	**-20**	-28.9	86.0	**30**	-1.1	176.0	**80**	26.7	266.0	**130**	54.4
-92.2	**-69**	-56.1	-2.2	**-19**	-28.3	87.8	**31**	-0.6	177.8	**81**	27.2	267.8	**131**	55.0
-90.4	**-68**	-55.6	-0.4	**-18**	-27.8	89.6	**32**	0.0	179.6	**82**	27.8	269.6	**132**	55.6
-88.6	**-67**	-55.0	1.4	**-17**	-27.2	91.4	**33**	0.6	181.4	**83**	28.3	271.4	**133**	56.1
-86.8	**-66**	-54.4	3.2	**-16**	-26.7	93.2	**34**	1.1	183.2	**84**	28.9	273.2	**134**	56.7
-85.0	**-65**	-53.9	5.0	**-15**	-26.1	95.0	**35**	1.7	185.0	**85**	29.4	275.0	**135**	57.2
-83.2	**-64**	-53.3	6.8	**-14**	-25.6	96.8	**36**	2.2	186.8	**86**	30.0	276.8	**136**	57.8
-81.4	**-63**	-52.8	8.6	**-13**	-25.0	98.6	**37**	2.8	188.6	**87**	30.6	278.6	**137**	58.3
-79.6	**-62**	-52.2	10.4	**-12**	-24.4	100.4	**38**	3.3	190.4	**88**	31.1	280.4	**138**	58.9
-77.8	**-61**	-51.7	12.2	**-11**	-23.9	102.2	**39**	3.9	192.2	**89**	31.7	282.2	**139**	59.4
-76.0	**-60**	-51.1	14.0	**-10**	-23.3	104.0	**40**	4.4	194.0	**90**	32.2	284.0	**140**	60.0
-74.2	**-59**	-50.6	15.8	**-9**	-22.8	105.8	**41**	5.0	195.8	**91**	32.8	285.8	**141**	60.6
-72.4	**-58**	-50.0	17.6	**-8**	-22.2	107.6	**42**	5.6	197.6	**92**	33.3	287.6	**142**	61.1
-70.6	**-57**	-49.4	19.4	**-7**	-21.7	109.4	**43**	6.1	199.4	**93**	33.9	289.4	**143**	61.7
-68.8	**-56**	-48.9	21.2	**-6**	-21.1	111.2	**44**	6.7	201.2	**94**	34.4	291.2	**144**	62.2
-67.0	**-55**	-48.3	23.0	**-5**	-20.6	113.0	**45**	7.2	203.0	**95**	35.0	293.0	**145**	62.8
-65.2	**-54**	-47.8	24.8	**-4**	-20.0	114.8	**46**	7.8	204.8	**96**	35.6	294.8	**146**	63.3
-63.4	**-53**	-47.2	26.6	**-3**	-19.4	116.6	**47**	8.3	206.6	**97**	36.1	296.6	**147**	63.9
-61.6	**-52**	-46.7	28.4	**-2**	-18.9	118.4	**48**	8.9	208.4	**98**	36.7	298.4	**148**	64.4
-59.8	**-51**	-46.1	30.2	**-1**	-18.3	120.2	**49**	9.4	210.2	**99**	37.2	300.2	**149**	65.0

CFM0601_IMP_002

Figure 06–01–2

INTRODUCTION

NOTE: Linear conversion from imperial units (feet) to metric units (meters) and vice versa, is automatically accomplished in the CAFM upon selection of the desired unit of measure.

LINEAR CONVERSION

- **To convert from meters to feet, find, in the bold face columns, the** number of meters to be converted. The equivalent number of feet is read in the adjacent column headed FEET.
- **To convert from feet to meters, find, in the bold face columns, the** number of feet to be converted. The equivalent number of meters is read in the adjacent column headed METERS.

METERS	◀ ▶	FEET	METERS	◀ ▶	FEET	METERS	◀ ▶	FEET
304.8	**1000**	3280.8	1341.1	**4400**	14435.5	2377.5	**7800**	25590.2
335.3	**1100**	3608.9	1371.6	**4500**	14763.6	2407.9	**7900**	25918.3
365.8	**1200**	3937.0	1402.1	**4600**	15091.7	2438.4	**8000**	26246.4
396.2	**1300**	4265.0	1432.6	**4700**	15419.8	2468.9	**8100**	26574.5
426.7	**1400**	4593.1	1463.1	**4800**	15747.8	2499.4	**8200**	26902.6
457.2	**1500**	4921.2	1493.5	**4900**	16075.9	2529.9	**8300**	27230.6
487.7	**1600**	5249.3	1524.0	**5000**	16404.0	2560.4	**8400**	27558.7
518.2	**1700**	5577.4	1554.5	**5100**	16732.1	2590.8	**8500**	27886.8
548.6	**1800**	5905.4	1585.0	**5200**	17060.2	2621.3	**8600**	28214.9
579.1	**1900**	6233.5	1615.5	**5300**	17388.2	2651.8	**8700**	28543.0
609.6	**2000**	6561.6	1645.9	**5400**	17716.3	2682.3	**8800**	28871.0
640.1	**2100**	6889.7	1676.4	**5500**	18044.4	2712.8	**8900**	29199.1
670.6	**2200**	7217.8	1706.9	**5600**	18372.5	2743.2	**9000**	29527.2
701.0	**2300**	7545.8	1737.4	**5700**	18700.6	2773.7	**9100**	29855.3
731.5	**2400**	7873.9	1767.9	**5800**	19028.6	2804.2	**9200**	30183.4
762.0	**2500**	8202.0	1798.3	**5900**	19356.7	2834.7	**9300**	30511.4
792.5	**2600**	8530.1	1828.8	**6000**	19684.8	2865.2	**9400**	30839.5
823.0	**2700**	8858.2	1859.3	**6100**	20012.9	2895.6	**9500**	31167.6
853.5	**2800**	9186.2	1889.8	**6200**	20341.0	2926.1	**9600**	31495.7
883.9	**2900**	9514.3	1920.3	**6300**	20669.0	2956.6	**9700**	31823.8
914.4	**3000**	9842.4	1950.7	**6400**	20997.1	2987.1	**9800**	32151.8
944.9	**3100**	10170.5	1981.2	**6500**	21325.2	3017.6	**9900**	32479.9
975.4	**3200**	10498.6	2011.7	**6600**	21653.3	3048.0	**10000**	32808.0
1005.9	**3300**	10826.6	2042.2	**6700**	21981.4	3352.8	**11000**	36088.8
1036.3	**3400**	11154.7	2072.7	**6800**	22309.4	3657.6	**12000**	39369.6
1066.8	**3500**	11482.8	2103.1	**6900**	22637.5	3962.4	**13000**	42650.4
1097.3	**3600**	11810.9	2133.6	**7000**	22965.6	4267.3	**14000**	45931.2
1127.8	**3700**	12139.0	2164.1	**7100**	23293.7	4572.1	**15000**	49212.0
1158.3	**3800**	12467.0	2194.6	**7200**	23621.8	4876.9	**16000**	52492.8
1188.7	**3900**	12795.1	2225.1	**7300**	23949.8	5181.7	**17000**	55773.6
1219.2	**4000**	13123.2	2255.5	**7400**	24277.9	5486.5	**18000**	59054.4
1249.7	**4100**	13451.3	2286.0	**7500**	24606.0	5791.3	**19000**	62335.2
1280.2	**4200**	13779.4	2316.5	**7600**	24934.1	6096.1	**20000**	65616.0
1310.7	**4300**	14107.4	2347.0	**7700**	25262.2	6400.9	**21000**	68896.8

CFM0601_IMP_003

Figure 06–01–3

VOLUME CONVERSION

LITERS/GALLONS

VOLUME CONVERSION - Liters/U.S. Gallons

- Liters to U.S. Gallons - find liters in the bold face column and read the equivalent number of U.S. gallons in the adjacent GALLONS column.
- U.S. Gallons to Liters - find U.S. gallons in the bold face column and read the equivalent number of liters in the adjacent LITERS column.

LITERS	◀ ▶	GALLONS	LITERS	◀ ▶	GALLONS	LITERS	◀ ▶	GALLONS	LITERS	◀ ▶	GALLONS
18.9	**5**	1.3	7760.1	**2050**	541.6	15520.2	**4100**	1083.1	23280.3	**6150**	1624.7
189.3	**50**	13.2	7949.4	**2100**	554.8	15709.5	**4150**	1096.3	23469.5	**6200**	1637.9
378.5	**100**	26.4	8138.6	**2150**	568.0	15898.7	**4200**	1109.5	23658.8	**6250**	1651.1
567.8	**150**	39.6	8327.9	**2200**	581.2	16088.0	**4250**	1122.7	23848.1	**6300**	1664.3
757.1	**200**	52.8	8517.2	**2250**	594.4	16277.3	**4300**	1135.9	24037.4	**6350**	1677.5
946.4	**250**	66.0	8706.4	**2300**	607.6	16466.5	**4350**	1149.1	24226.6	**6400**	1690.7
1135.6	**300**	79.3	8895.7	**2350**	620.8	16655.8	**4400**	1162.4	24415.9	**6450**	1703.9
1324.9	**350**	92.5	9085.0	**2400**	634.0	16845.1	**4450**	1175.6	24605.2	**6500**	1717.1
1514.2	**400**	105.7	9274.3	**2450**	647.2	17034.3	**4500**	1188.8	24794.4	**6550**	1730.3
1703.4	**450**	118.9	9463.5	**2500**	660.4	17223.6	**4550**	1202.0	24983.7	**6600**	1743.5
1892.7	**500**	132.1	9652.8	**2550**	673.6	17412.9	**4600**	1215.2	25173.0	**6650**	1756.7
2082.0	**550**	145.3	9842.1	**2600**	686.8	17602.2	**4650**	1228.4	25362.3	**6700**	1770.0
2271.2	**600**	158.5	10031.3	**2650**	700.1	17791.4	**4700**	1241.6	25551.5	**6750**	1783.2
2460.5	**650**	171.7	10220.6	**2700**	713.3	17980.7	**4750**	1254.8	25740.8	**6800**	1796.4
2649.8	**700**	184.9	10409.9	**2750**	726.5	18170.0	**4800**	1268.0	25930.1	**6850**	1809.6
2839.1	**750**	198.1	10599.2	**2800**	739.7	18359.2	**4850**	1281.2	26119.3	**6900**	1822.8
3028.3	**800**	211.3	10788.4	**2850**	752.9	18548.5	**4900**	1294.4	26308.6	**6950**	1836.0
3217.6	**850**	224.5	10977.7	**2900**	766.1	18737.8	**4950**	1307.7	26497.9	**7000**	1849.2
3406.9	**900**	237.8	11167.0	**2950**	779.3	18927.1	**5000**	1320.9	26687.1	**7050**	1862.4
3596.1	**950**	251.0	11356.2	**3000**	792.5	19116.3	**5050**	1334.1	26876.4	**7100**	1875.6
3785.4	**1000**	264.2	11545.5	**3050**	805.7	19305.6	**5100**	1347.3	27065.7	**7150**	1888.8
3974.7	**1050**	277.4	11734.8	**3100**	818.9	19494.9	**5150**	1360.5	27255.0	**7200**	1902.0
4164.0	**1100**	290.6	11924.0	**3150**	832.1	19684.1	**5200**	1373.7	27444.2	**7250**	1915.2
4353.2	**1150**	303.8	12113.3	**3200**	845.4	19873.4	**5250**	1386.9	27633.5	**7300**	1928.5
4542.5	**1200**	317.0	12302.6	**3250**	858.6	20062.7	**5300**	1400.1	27822.8	**7350**	1941.7
4731.8	**1250**	330.2	12491.9	**3300**	871.8	20251.9	**5350**	1413.3	28012.0	**7400**	1954.9
4921.0	**1300**	343.4	12681.1	**3350**	885.0	20441.2	**5400**	1426.5	28201.3	**7450**	1968.1
5110.3	**1350**	356.6	12870.4	**3400**	898.2	20630.5	**5450**	1439.7	28390.6	**7500**	1981.3
5299.6	**1400**	369.8	13059.7	**3450**	911.4	20819.8	**5500**	1452.9	28579.9	**7550**	1994.5
5488.8	**1450**	383.0	13248.9	**3500**	924.6	21009.0	**5550**	1466.2	28769.1	**7600**	2007.7
5678.1	**1500**	396.3	13438.2	**3550**	937.8	21198.3	**5600**	1479.4	28958.4	**7650**	2020.9
5867.4	**1550**	409.5	13627.5	**3600**	951.0	21387.6	**5650**	1492.6	29147.7	**7700**	2034.1
6056.7	**1600**	422.7	13816.8	**3650**	964.2	21576.8	**5700**	1505.8	29336.9	**7750**	2047.3
6245.9	**1650**	435.9	14006.0	**3700**	977.4	21766.1	**5750**	1519.0	29526.2	**7800**	2060.5
6435.2	**1700**	449.1	14195.3	**3750**	990.6	21955.4	**5800**	1532.2	29715.5	**7850**	2073.8
6624.5	**1750**	462.3	14384.6	**3800**	1003.9	22144.7	**5850**	1545.4	29904.7	**7900**	2087.0
6813.7	**1800**	475.5	14573.8	**3850**	1017.1	22333.9	**5900**	1558.6	30094.0	**7950**	2100.2
7003.0	**1850**	488.7	14763.1	**3900**	1030.3	22523.2	**5950**	1571.8	30283.3	**8000**	2113.4
7192.3	**1900**	501.9	14952.4	**3950**	1043.5	22712.5	**6000**	1585.0			
7381.6	**1950**	515.1	15141.6	**4000**	1056.7	22901.7	**6050**	1598.2			
7570.8	**2000**	528.3	15330.9	**4050**	1069.9	23091.0	**6100**	1611.4			

CFM0601_IMP_004

Figure 06–01–4

Challenger 350

PERFORMANCE

INTRODUCTION

POUNDS/GALLONS

NOTE: This table is based on a fuel density of 6.75 lb / US gallon.

VOLUME CONVERSION - Pounds/U.S. Gallons

- Pounds to U.S. Gallons - find pounds in the bold face column and read the equivalent number of U.S. gallons in the adjacent GALLONS column.
- U.S. Gallons to Pounds - find U.S. gallons in the bold face column and read the equivalent number of pounds in the adjacent POUNDS column.

POUNDS	◀ ▶	GALLONS	POUNDS	◀ ▶	GALLONS	POUNDS	◀ ▶	GALLONS	POUNDS	◀ ▶	GALLONS
6.75	**1**	0.15	27675	**4100**	607.4	55350	**8200**	1214.8	83025	**12300**	1822.2
675	**100**	14.8	28350	**4200**	622.2	56025	**8300**	1229.6	83700	**12400**	1837.0
1350	**200**	29.6	29025	**4300**	637.0	56700	**8400**	1244.4	84375	**12500**	1851.9
2025	**300**	44.4	29700	**4400**	651.9	57375	**8500**	1259.3	85050	**12600**	1866.7
2700	**400**	59.3	30375	**4500**	666.7	58050	**8600**	1274.1	85725	**12700**	1881.5
3375	**500**	74.1	31050	**4600**	681.5	58725	**8700**	1288.9	86400	**12800**	1896.3
4050	**600**	88.9	31725	**4700**	696.3	59400	**8800**	1303.7	87075	**12900**	1911.1
4725	**700**	103.7	32400	**4800**	711.1	60075	**8900**	1318.5	87750	**13000**	1925.9
5400	**800**	118.5	33075	**4900**	725.9	60750	**9000**	1333.3	88425	**13100**	1940.7
6075	**900**	133.3	33750	**5000**	740.7	61425	**9100**	1348.1	89100	**13200**	1955.6
6750	**1000**	148.1	34425	**5100**	755.6	62100	**9200**	1363.0	89775	**13300**	1970.4
7425	**1100**	163.0	35100	**5200**	770.4	62775	**9300**	1377.8	90450	**13400**	1985.2
8100	**1200**	177.8	35775	**5300**	785.2	63450	**9400**	1392.6	91125	**13500**	2000.0
8775	**1300**	192.6	36450	**5400**	800.0	64125	**9500**	1407.4	91800	**13600**	2014.8
9450	**1400**	207.4	37125	**5500**	814.8	64800	**9600**	1422.2	92475	**13700**	2029.6
10125	**1500**	222.2	37800	**5600**	829.6	65475	**9700**	1437.0	93150	**13800**	2044.4
10800	**1600**	237.0	38475	**5700**	844.4	66150	**9800**	1451.9	93825	**13900**	2059.3
11475	**1700**	251.9	39150	**5800**	859.3	66825	**9900**	1466.7	94500	**14000**	2074.1
12150	**1800**	266.7	39825	**5900**	874.1	67500	**10000**	1481.5	95175	**14100**	2088.9
12825	**1900**	281.5	40500	**6000**	888.9	68175	**10100**	1496.3			
13500	**2000**	296.3	41175	**6100**	903.7	68850	**10200**	1511.1			
14175	**2100**	311.1	41850	**6200**	918.5	69525	**10300**	1525.9			
14850	**2200**	325.9	42525	**6300**	933.3	70200	**10400**	1540.7			
15525	**2300**	340.7	43200	**6400**	948.1	70875	**10500**	1555.6			
16200	**2400**	355.6	43875	**6500**	963.0	71550	**10600**	1570.4			
16875	**2500**	370.4	44550	**6600**	977.8	72225	**10700**	1585.2			
17550	**2600**	385.2	45225	**6700**	992.6	72900	**10800**	1600.0			
18225	**2700**	400.0	45900	**6800**	1007.4	73575	**10900**	1614.8			
18900	**2800**	414.8	46575	**6900**	1022.2	74250	**11000**	1629.6			
19575	**2900**	429.6	47250	**7000**	1037.0	74925	**11100**	1644.4			
20250	**3000**	444.4	47925	**7100**	1051.9	75600	**11200**	1659.3			
20925	**3100**	459.3	48600	**7200**	1066.7	76275	**11300**	1674.1			
21600	**3200**	474.1	49275	**7300**	1081.5	76950	**11400**	1688.9			
22275	**3300**	488.9	49950	**7400**	1096.3	77625	**11500**	1703.7			
22950	**3400**	503.7	50625	**7500**	1111.1	78300	**11600**	1718.5			
23625	**3500**	518.5	51300	**7600**	1125.9	78975	**11700**	1733.3			
24300	**3600**	533.3	51975	**7700**	1140.7	79650	**11800**	1748.1			
24975	**3700**	548.1	52650	**7800**	1155.6	80325	**11900**	1763.0			
25650	**3800**	563.0	53325	**7900**	1170.4	81000	**12000**	1777.8			
26325	**3900**	577.8	54000	**8000**	1185.2	81675	**12100**	1792.6			
27000	**4000**	592.6	54675	**8100**	1200.0	82350	**12200**	1807.4			

CFM0601_IMP_005

Figure 06–01–5

INTRODUCTION

NOTE: Weight conversion from imperial units (lb) to metric units (kg) and vice versa, is automatically accomplished in the CAFM upon selection of the desired unit of measure.

WEIGHT CONVERSION

- To convert from kilograms to pounds, find, in the bold face columns, the number of kilograms to be converted. The equivalent number of pounds is read in the adjacent column headed POUNDS.
- To convert from pounds to kilograms, find, in the bold face columns, the number of pounds to be converted. The equivalent number of kilograms is read in the adjacent column headed KILOGRAMS.

KILOGRAMS	◀ ▶	POUNDS	KILOGRAMS	◀ ▶	POUNDS	KILOGRAMS	◀ ▶	POUNDS
4.5	**10**	22.0	208.7	**460**	1014.1	412.8	**910**	2006.2
9.1	**20**	44.1	213.2	**470**	1036.2	417.3	**920**	2028.2
13.6	**30**	66.1	217.7	**480**	1058.2	421.8	**930**	2050.3
18.1	**40**	88.2	222.3	**490**	1080.3	426.4	**940**	2072.3
22.7	**50**	110.2	226.8	**500**	1102.3	430.9	**950**	2094.4
27.2	**60**	132.3	231.3	**510**	1124.3	435.5	**960**	2116.4
31.8	**70**	154.3	235.9	**520**	1146.4	440.0	**970**	2138.5
36.3	**80**	176.4	240.4	**530**	1168.4	444.5	**980**	2160.5
40.8	**90**	198.4	244.9	**540**	1190.5	449.1	**990**	2182.6
45.4	**100**	220.5	249.5	**550**	1212.5	453.6	**1000**	2204.6
49.9	**110**	242.5	254.0	**560**	1234.6	499.0	**1100**	2425.1
54.4	**120**	264.6	258.6	**570**	1256.6	544.3	**1200**	2645.5
59.0	**130**	286.6	263.1	**580**	1278.7	589.7	**1300**	2866.0
63.5	**140**	308.6	267.6	**590**	1300.7	635.0	**1400**	3086.4
68.0	**150**	330.7	272.2	**600**	1322.8	680.4	**1500**	3306.9
72.6	**160**	352.7	276.7	**610**	1344.8	907.2	**2000**	4409.2
77.1	**170**	374.8	281.2	**620**	1366.9	1134.0	**2500**	5511.5
81.6	**180**	396.8	285.8	**630**	1388.9	1360.8	**3000**	6613.8
86.2	**190**	418.9	290.3	**640**	1410.9	1587.6	**3500**	7716.1
90.7	**200**	440.9	294.8	**650**	1433.0	1814.4	**4000**	8818.4
95.3	**210**	463.0	299.4	**660**	1455.0	2041.2	**4500**	9920.7
99.8	**220**	485.0	303.9	**670**	1477.1	2268.0	**5000**	11023.0
104.3	**230**	507.1	308.4	**680**	1499.1	2494.8	**5500**	12125.3
108.9	**240**	529.1	313.0	**690**	1521.2	2721.6	**6000**	13227.6
113.4	**250**	551.1	317.5	**700**	1543.2	2948.4	**6500**	14329.9
117.9	**260**	573.2	322.1	**710**	1565.3	3175.2	**7000**	15432.2
122.5	**270**	595.2	326.6	**720**	1587.3	3402.0	**7500**	16534.5
127.0	**280**	617.3	331.1	**730**	1609.4	3628.8	**8000**	17636.8
131.5	**290**	639.3	335.7	**740**	1631.4	3855.6	**8500**	18739.1
136.1	**300**	661.4	340.2	**750**	1653.4	4082.4	**9000**	19841.4
140.6	**310**	683.4	344.7	**760**	1675.5	4309.2	**9500**	20943.7
145.2	**320**	705.5	349.3	**770**	1697.5	4536.0	**10000**	22046.0
149.7	**330**	727.5	353.8	**780**	1719.6	4989.6	**11000**	24250.6
154.2	**340**	749.6	358.3	**790**	1741.6	5443.2	**12000**	26455.2
158.8	**350**	771.6	362.9	**800**	1763.7	5896.8	**13000**	28659.8
163.3	**360**	793.7	367.4	**810**	1785.7	6350.4	**14000**	30864.4
167.8	**370**	815.7	371.9	**820**	1807.8	6804.0	**15000**	33069.0
172.4	**380**	837.7	376.5	**830**	1829.8	7257.6	**16000**	35273.6
176.9	**390**	859.8	381.0	**840**	1851.9	7711.1	**17000**	37478.2
181.4	**400**	881.8	385.6	**850**	1873.9	8164.7	**18000**	39682.8
186.0	**410**	903.9	390.1	**860**	1896.0	8618.3	**19000**	41887.4
190.5	**420**	925.9	394.6	**870**	1918.0	9071.9	**20000**	44092.0
195.0	**430**	948.0	399.2	**880**	1940.0	9525.5	**21000**	46296.6
199.6	**440**	970.0	403.7	**890**	1962.1	9979.1	**22000**	48501.2
204.1	**450**	992.1	408.2	**900**	1984.1	10432.7	**23000**	50705.8

CFM0601_IMP_006

Figure 06–01–6

INTRODUCTION

CONVERSION CHART FOR PRESSURE (inHG/ mbar-hPa)

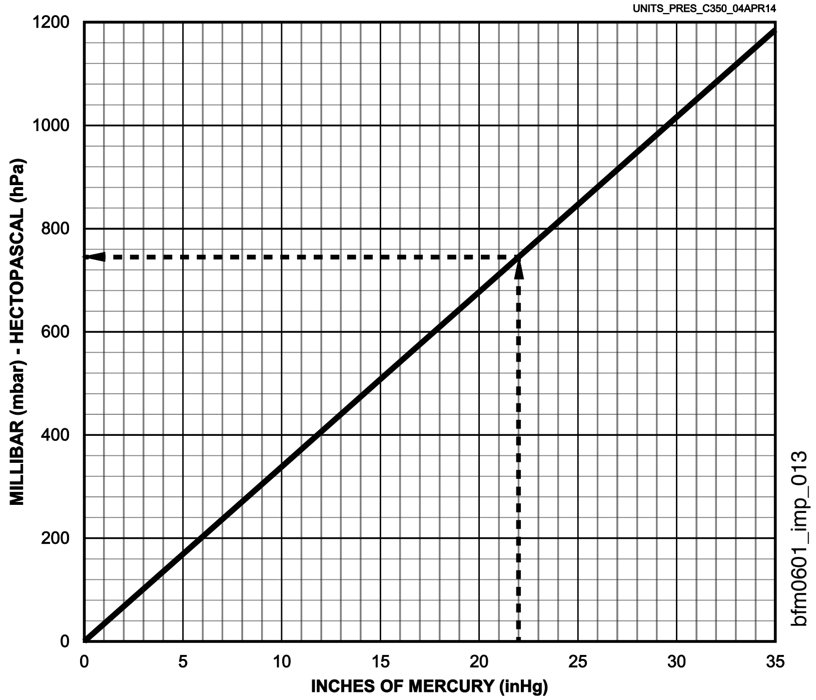


Figure 06–01–7

INTRODUCTION

CONVERSION CHART FOR VOLUME (US gal/ IMP gal / L)

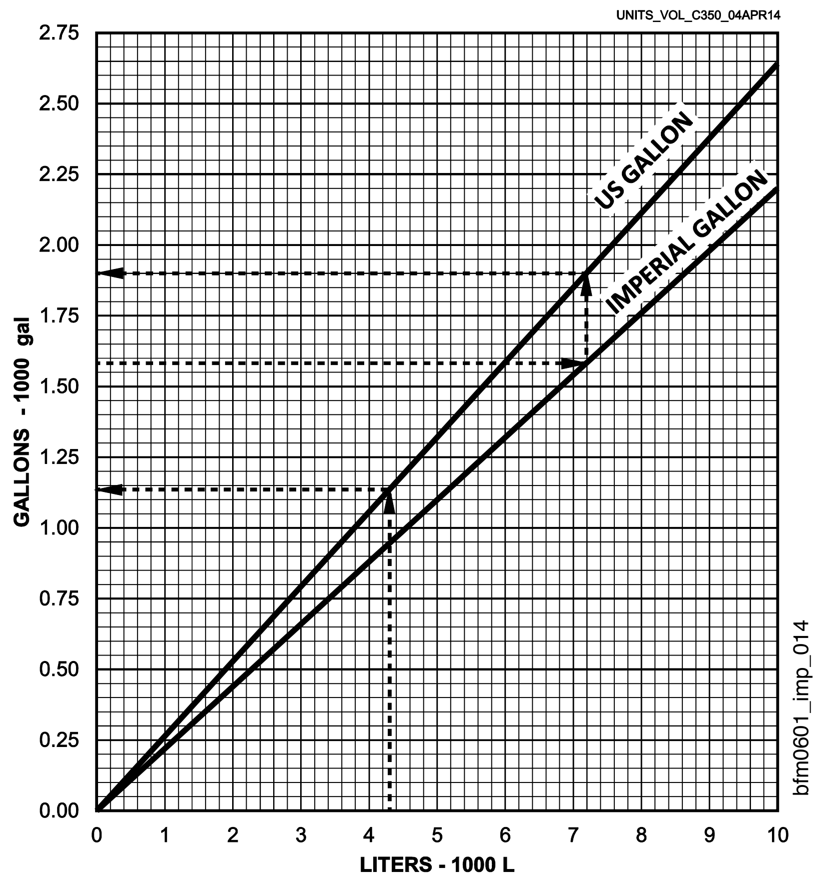


Figure 06–01–8

INTRODUCTION

AIRSPEED AND ALTITUDE POSITION ERROR PRIMARY FLIGHT DISPLAY

AIRSPEED POSITION ERROR CORRECTION ΔV				
INDICATED AIRSPEED (KIAS)	FLAPS / GEAR UP OR DOWN			
	0°	10°	20°	30°
110		0.8	0.9	0.9
120	-0.7	0.7	0.7	0.7
140	0.2	0.4	0.3	0.3
160	0.5	0.1	-0.2	-0.2
180	0.3	-0.1	-0.3	-0.5
200	0.3	-0.1	-0.3	
210	0.3	0.0	-0.2	

Calibrated Airspeed = Indicated Airspeed + ΔV (knots)
A positive value indicates that the indicator reads low

ALTITUDE POSITION ERROR CORRECTION ΔH				
INDICATED AIRSPEED (KIAS)	FLAPS / GEAR UP OR DOWN			
	0°	10°	20°	30°
110		8	9	9
120	-9	8	8	7
140	3	5	4	4
160	6	2	-2	-3
180	6	-2	-5	-7
200	6	-1	-5	
210	8	0	-2	

CALPRI_C350_04APR14

bfm0601_imp_007

Calibrated Pressure Altitude = Indicated Pressure Altitude + ΔH (ft)
A positive value indicates that the altimeter reads low

Figure 06–01–9

INTRODUCTION

AIRSPEED AND ALTITUDE POSITION ERRORS
STANDBY INDICATOR

AIRSPEED POSITION ERROR CORRECTION ΔV							
INDICATED AIRSPEED (KIAS)	FLAPS / GEAR						
	0°/UP	0°/DOWN	10°/UP	10°/DOWN	20°/UP	20°/DOWN	30°/DOWN
110			0.7	0.1	1.1	0.3	0.7
120	0.9	-0.4	0.8	0.0	1.1	0.1	0.5
140	1.2	-0.5	0.9	-0.1	0.9	-0.3	-0.1
160	1.3	-0.6	0.9	-0.3	0.6	-0.8	-1.1
180	1.5	-0.7	0.8	-0.6	0.2	-1.4	-2.2
200	1.5	-0.9	0.6	-1.0	-0.4	-2.0	
210	1.5	-1.0	0.6	-1.2	-0.7	-2.4	

Calibrated Airspeed = Indicated Airspeed + ΔV (knots)
A positive value indicates that the indicator reads low

ALTITUDE POSITION ERROR CORRECTION ΔH							
INDICATED AIRSPEED (KIAS)	FLAPS / GEAR						
	0°/UP	0°/DOWN	10°/UP	10°/DOWN	20°/UP	20°/DOWN	30°/DOWN
110			7	2	12	0	7
120	9	-5	9	1	12	0	6
140	16	-6	12	-1	11	-3	-2
160	20	-8	14	-4	10	-10	-15
180	25	-12	15	-10	3	-22	-35
200	29	-16	13	-18	-7	-37	
210	31	-19	12	-22	-13	-45	

CALSTB_C350_04APR14

Calibrated Pressure Altitude = Indicated Pressure Altitude + ΔH (ft)
A positive value indicates that the altimeter reads low

bfm0601_imp_008

Figure 06–01–10

INTRODUCTION

WIND COMPONENTS

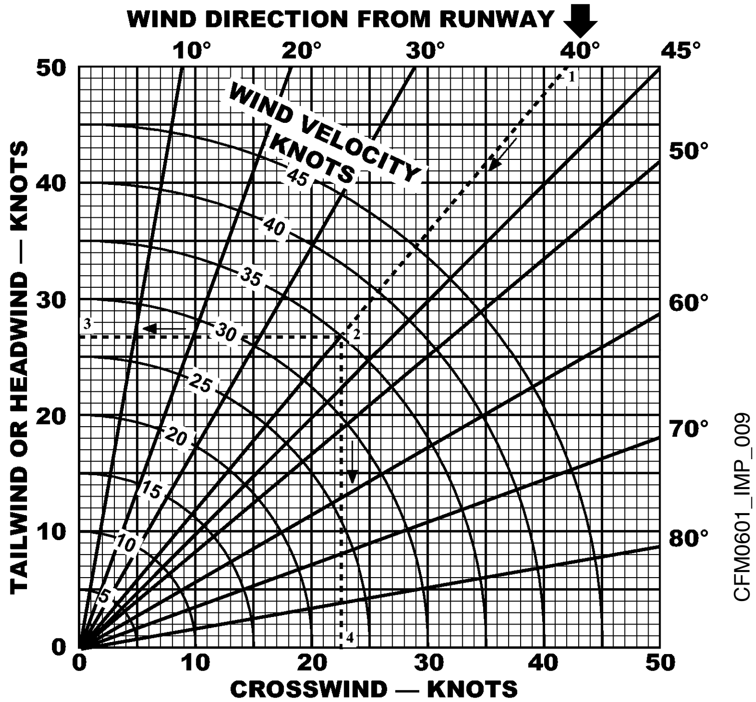


Figure 06–01–11

Conditions:

- Wind Velocity .... 35 Knots
- Wind Direction .... 300°
- Runway Heading .... 340°

Example:

1 Wind Direction from Runway (See Note) .... 40°
2 Wind Velocity .... 35 Knots
3 Headwind Component .... 26.7 Knots
4 Crosswind Component .... 22.5 Knots

NOTE: To calculate wind direction from runway, subtract wind direction from runway heading. Enter the chart at the absolute value of wind direction from runway.

INTRODUCTION

STALL SPEEDS

Stall speed calculations for various configurations (flap setting and landing gear position) are provided within the General Module, Stall Speeds calculator of the CAFM.

FLAP 0 STALL SPEEDS

The Flap 0 Stall Speeds presented on Fig. 06−01−12 supersede the corresponding speeds determined with the General Module, Stall Speeds calculator of the CAFM.

The stall speeds presented on the chart are given as a function of gross weight and landing gear position, and are valid for any altitude from Sea Level to 18000 ft.

MANEUVERING CAPABILITIES

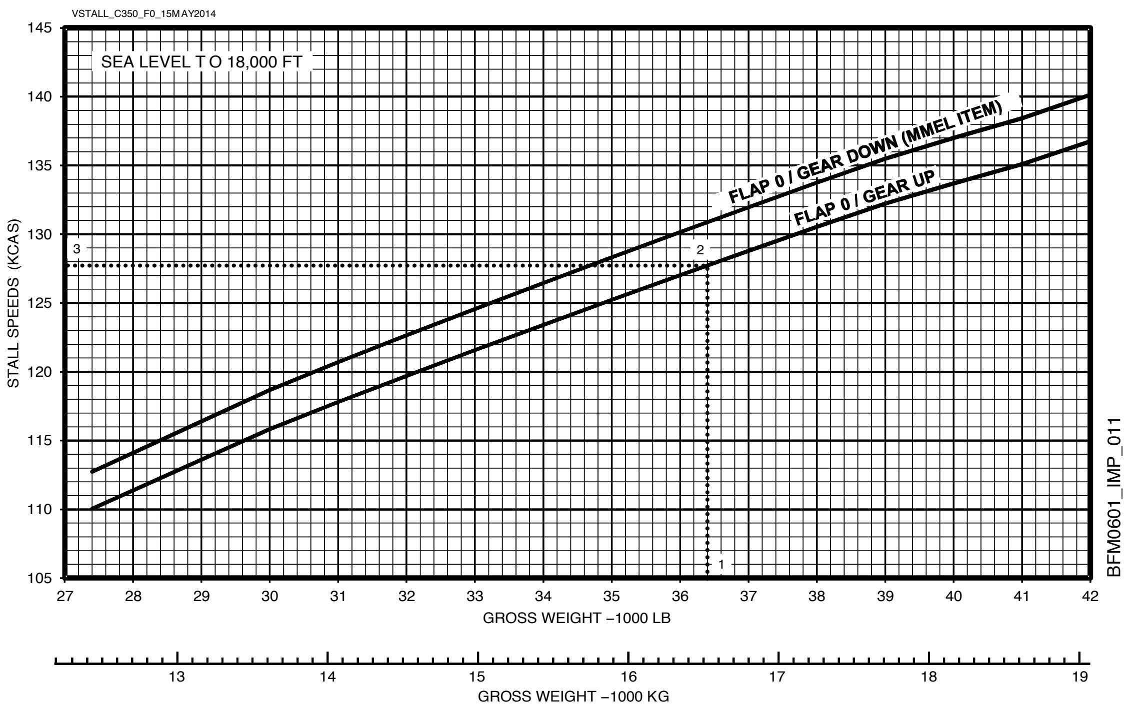
Maneuvering Capability calculations are presented within the General Module of the CAFM. These calculations establish the maneuvering margin for a given load factor, bank angle, weight, CG position, altitude and speed combination and is calculated relative to buffet onset or stick shaker activation, whichever occurs first.

This mode provides the following sub−calculations:

- Maximum altitude,
- Maximum weight,
- Minimum and Maximum Mach number, and
- Maximum load factor and bank angle.

THIS PAGE INTENTIONALLY LEFT BLANK

STALL SPEEDS



EXAMPLE:
1. Weight...........................36 400 lb (16 511 kg)
2. Flap setting...0 / UP
3. Stall speed..................................127.7 KCAS

Figure 06–01–12

INTRODUCTION

THIS PAGE INTENTIONALLY LEFT BLANK

THRUST

THRUST DATA

Engine fan speed N1 settings for the AS–907 engine, required for various ambient temperatures (Outside Air Temperature, OAT, for ground operations, and Static Air Temperature, SAT, for flight operations) and pressure altitudes, are presented in the Thrust Setting Module of the CAFM or in this section. These data correspond to the N1 thrust settings as calculated by the Full Authority Digital Engine Control (FADEC), for ground and flight operations.

A printout of the applicable thrust setting data generated from the CAFM or the Figures included in this section should be used by the flight crew as a means of verifying the accuracy of the thrust set by the FADEC for the particular phase of flight.

ACCEPTABLE TOLERANCE

THRUST SETTING	TOLERANCE
Takeoff from 0 to 60 KIAS	+/–0.5% N1
All–engine go–around	+/–0.4% N1
Single–engine go–around	+/–0.4% N1
Single–engine at the en route climb speed	+/–0.2% N1

THRUST

N1 THRUST SETTING

NOTE: The tables presented in Fig. 06−10−1 to Fig. 06−10−12 provide N1 settings for the following engine bleed configurations which are not provided in the CAFM Thrust Setting calculator:

- Engine Bleed Off, Engine Anti−Ice On
- Engine Bleed Off, Engine and Wing Anti−Ice On.

N1 setting tables are provided for the all engines takeoff, all engines go−around and single engine go−around conditions.

RATING	BLEED	N1 THRUST SETTING, REFER TO
TO (All Engines)	ENGINE BLEED OFF	CAFM
	ENGINE BLEED OFF, ENGINE A/I ON	Fig. 06−10−1 and Fig. 06−10−2
	ENGINE BLEED OFF, ENGINE AND WING A/I ON	Fig. 06−10−3 and Fig. 06−10−4
	ENGINE BLEED ON	CAFM
	ENGINE BLEED ON, ENGINE A/I ON	CAFM
	ENGINE BLEED ON, ENGINE AND WING A/I ON	CAFM
Go−Around (All Engines)	ENGINE BLEED OFF	CAFM
	ENGINE BLEED OFF, ENGINE A/I ON	Fig. 06−10−5 and Fig. 06−10−6
	ENGINE BLEED OFF, ENGINE AND WING A/I ON	Fig. 06−10−7 and Fig. 06−10−8
	ENGINE BLEED ON	CAFM
	ENGINE BLEED ON, ENGINE A/I ON	CAFM
	ENGINE BLEED ON, ENGINE AND WING A/I ON	CAFM

THRUST

RATING	BLEED	N1 THRUST SETTING, REFER TO
Go–Around (Single Engine)	ENGINE BLEED OFF	CAFM
	ENGINE BLEED OFF, ENGINE A/I ON	Fig. 06–10–9 and Fig. 06–10–10
	ENGINE BLEED OFF, ENGINE AND WING A/I ON	Fig. 06–10–11 and Fig. 06–10–12
	ENGINE BLEED ON	CAFM
	ENGINE BLEED ON, ENGINE A/I ON	CAFM
	ENGINE BLEED ON, ENGINE AND WING A/I ON	CAFM
CLB (Single Engine)	ENGINE BLEED ON	CAFM
	ENGINE BLEED ON, ENGINE A/I ON	CAFM
	ENGINE BLEED ON, ENGINE AND WING A/I ON	CAFM

THRUST

TAKEOFF THRUST SETTING
TO (ALL ENGINES)
ENGINE BLEED OFF, ENGINE A/I ON

THRUST SETTING – %N1									
OAT °C	ALTITUDE – FT								
	−1000	0	1000	2000	3000	4000	5000	6000	7000
10	86.6	87.8	89.1	90.4	91.7	92.8	93.4	93.4	93.4
8	86.3	87.5	88.8	90.1	91.3	92.4	93.6	93.6	93.6
6	86.0	87.2	88.5	89.7	91.0	92.1	93.2	93.7	93.7
4	85.7	86.9	88.2	89.4	90.6	91.8	92.9	93.9	93.9
2	85.4	86.6	87.8	89.1	90.3	91.4	92.6	93.8	94.0
0	85.1	86.3	87.5	88.8	89.9	91.1	92.2	93.4	94.2
−2	84.8	86.0	87.2	88.4	89.6	90.7	91.9	93.1	94.3
−4	84.5	85.7	86.9	88.1	89.3	90.4	91.5	92.8	94.0
−6	84.2	85.4	86.6	87.8	88.9	90.1	91.2	92.4	93.6
−8	83.9	85.1	86.2	87.4	88.6	89.7	90.8	92.0	93.3
−10	83.6	84.7	85.9	87.1	88.2	89.4	90.5	91.7	92.9
−12	83.3	84.4	85.6	86.8	87.9	89.0	90.1	91.3	92.6
−14	83.0	84.1	85.3	86.4	87.6	88.7	89.8	91.0	92.2
−16	82.7	83.8	85.0	86.1	87.3	88.3	89.4	90.6	91.9
−18	82.4	83.5	84.6	85.8	86.9	88.0	89.1	90.3	91.5
−20	82.0	83.2	84.3	85.5	86.6	87.7	88.8	89.9	91.2
−22	81.7	82.8	84.0	85.2	86.2	87.3	88.4	89.6	90.8
−24	81.3	82.5	83.7	84.8	85.9	87.0	88.0	89.2	90.4
−26	80.9	82.1	83.3	84.5	85.6	86.6	87.7	88.9	90.1
−28	80.6	81.7	82.9	84.1	85.2	86.3	87.3	88.5	89.7
−30	80.2	81.4	82.6	83.8	84.9	85.9	87.0	88.2	89.4
−32	79.8	81.0	82.2	83.4	84.6	85.6	86.6	87.8	89.0
−34	79.5	80.6	81.8	83.1	84.2	85.2	86.2	87.4	88.7
−36	79.1	80.3	81.5	82.8	83.9	84.9	85.9	87.0	88.3
−38	78.8	79.9	81.1	82.4	83.5	84.5	85.5	86.7	87.9
−40	78.4	79.6	80.8	82.1	83.2	84.2	85.1	86.3	87.5
−42									

N1TABLES_TO_010_1_M184_25APR14

bfm0610_imp_001

Figure 06–10–1

THRUST

TAKEOFF THRUST SETTING
TO (ALL ENGINES)
ENGINE BLEED OFF, ENGINE A/I ON

THRUST SETTING – %N1 – (Continued)								
OAT °C	ALTITUDE – FT							
	8000	9000	10000	11000	12000	13000	14000	15000
10	93.4	93.4	93.4	93.2	93.1	93.0	92.8	92.7
8	93.6	93.6	93.6	93.5	93.3	93.2	93.1	92.9
6	93.7	93.7	93.8	93.6	93.6	93.4	93.3	93.2
4	93.9	93.9	93.9	93.8	93.7	93.6	93.4	93.4
2	94.0	94.1	94.1	93.9	93.7	93.7	93.6	93.4
0	94.2	94.2	94.2	94.1	93.9	93.8	93.7	93.6
−2	94.4	94.4	94.4	94.3	94.2	94.0	93.9	93.8
−4	94.6	94.6	94.6	94.5	94.4	94.3	94.2	94.0
−6	94.8	94.8	94.8	94.8	94.7	94.6	94.5	94.3
−8	94.5	94.8	94.8	94.8	94.8	94.8	94.8	94.7
−10	94.2	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−12	93.8	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−14	93.4	94.7	94.8	94.8	94.8	94.8	94.8	94.8
−16	93.1	94.3	94.8	94.8	94.8	94.8	94.8	94.8
−18	92.7	94.0	94.8	94.8	94.8	94.8	94.8	94.8
−20	92.4	93.6	94.8	94.8	94.8	94.8	94.8	94.8
−22	92.0	93.3	94.5	94.6	94.7	94.7	94.8	94.8
−24	91.7	92.9	94.2	94.3	94.4	94.3	94.4	94.6
−26	91.3	92.6	93.8	93.9	94.0	93.9	94.0	94.2
−28	91.0	92.2	93.4	93.6	93.7	93.6	93.6	93.9
−30	90.6	91.8	93.1	93.2	93.3	93.3	93.4	93.6
−32	90.2	91.5	92.7	92.8	92.9	93.0	93.1	93.2
−34	89.9	91.1	92.3	92.5	92.6	92.7	92.8	92.8
−36	89.5	90.8	92.0	92.1	92.2	92.3	92.4	92.5
−38	89.1	90.4	91.6	91.8	91.9	92.0	92.0	92.1
−40	88.8	90.0	91.3	91.4	91.5	91.6	91.7	91.8
−42								91.4

N1TABLES_TO_010_2_M184_25APR14

bfm0610_imp_002

Figure 06−10−2

THRUST

TAKEOFF THRUST SETTING
TO (ALL ENGINES)
ENGINE BLEED OFF, ENGINE AND WING A/I ON

THRUST SETTING – %N1									
OAT °C	ALTITUDE – FT								
	−1000	0	1000	2000	3000	4000	5000	6000	7000
10	86.6	87.8	89.1	90.4	90.8	90.6	90.4	90.2	90.0
8	86.3	87.5	88.8	90.1	91.1	90.9	90.8	90.5	90.3
6	86.0	87.2	88.5	89.7	91.0	91.2	91.1	90.8	90.6
4	85.7	86.9	88.2	89.4	90.6	91.5	91.3	91.1	90.9
2	85.4	86.6	87.8	89.1	90.3	91.4	91.6	91.4	91.2
0	85.1	86.3	87.5	88.8	89.9	91.1	91.8	91.6	91.4
−2	84.8	86.0	87.2	88.4	89.6	90.7	91.9	91.8	91.6
−4	84.5	85.7	86.9	88.1	89.3	90.4	91.5	92.0	91.8
−6	84.2	85.4	86.6	87.8	88.9	90.1	91.2	92.3	92.1
−8	83.9	85.1	86.2	87.4	88.6	89.7	90.8	92.0	92.3
−10	83.6	84.7	85.9	87.1	88.2	89.4	90.5	91.7	92.6
−12	83.3	84.4	85.6	86.8	87.9	89.0	90.1	91.3	92.6
−14	83.0	84.1	85.3	86.4	87.6	88.7	89.8	91.0	92.2
−16	82.7	83.8	85.0	86.1	87.3	88.3	89.4	90.6	91.9
−18	82.4	83.5	84.6	85.8	86.9	88.0	89.1	90.3	91.5
−20	82.0	83.2	84.3	85.5	86.6	87.7	88.8	89.9	91.2
−22	81.7	82.8	84.0	85.2	86.2	87.3	88.4	89.6	90.8
−24	81.3	82.5	83.7	84.8	85.9	87.0	88.0	89.2	90.4
−26	80.9	82.1	83.3	84.5	85.6	86.6	87.7	88.9	90.1
−28	80.6	81.7	82.9	84.1	85.2	86.3	87.3	88.5	89.7
−30	80.2	81.4	82.6	83.8	84.9	85.9	87.0	88.2	89.4
−32	79.8	81.0	82.2	83.4	84.6	85.6	86.6	87.8	89.0
−34	79.5	80.6	81.8	83.1	84.2	85.2	86.2	87.4	88.7
−36	79.1	80.3	81.5	82.8	83.9	84.9	85.9	87.0	88.3
−38	78.8	79.9	81.1	82.4	83.5	84.5	85.5	86.7	87.9
−40	78.4	79.6	80.8	82.1	83.2	84.2	85.1	86.3	87.5
−42									

N1TABLES_TO_011_1_M184_25APR14

bfm0610_imp_003

Figure 06–10–3

THRUST

TAKEOFF THRUST SETTING
TO (ALL ENGINES)
ENGINE BLEED OFF, ENGINE AND WING A/I ON

THRUST SETTING – %N1 – (Continued)								
OAT °C	ALTITUDE – FT							
	8000	9000	10000	11000	12000	13000	14000	15000
10	89.8	89.5	89.3	88.9	88.5	88.1	87.7	87.2
8	90.1	89.9	89.7	89.4	89.0	88.6	88.2	87.7
6	90.4	90.2	90.0	89.7	89.4	89.0	88.7	88.3
4	90.7	90.5	90.3	90.0	89.7	89.4	89.0	88.7
2	91.0	90.8	90.6	90.3	90.0	89.7	89.4	89.0
0	91.2	91.0	90.8	90.6	90.3	90.1	89.7	89.4
−2	91.4	91.3	91.1	90.8	90.5	90.3	90.1	89.7
−4	91.6	91.5	91.4	91.1	90.8	90.5	90.3	90.1
−6	91.8	91.6	91.5	91.3	91.0	90.7	90.5	90.3
−8	92.1	91.8	91.6	91.4	91.2	90.9	90.7	90.5
−10	92.4	92.1	91.8	91.6	91.4	91.2	90.9	90.6
−12	92.7	92.5	92.2	91.8	91.6	91.4	91.1	90.8
−14	93.0	92.8	92.6	92.2	91.8	91.6	91.3	90.9
−16	93.1	93.2	92.9	92.6	92.3	91.9	91.6	91.3
−18	92.7	93.5	93.3	93.1	92.7	92.4	91.9	91.6
−20	92.4	93.6	93.7	93.5	93.2	92.9	92.5	92.0
−22	92.0	93.3	94.3	93.9	93.7	93.4	93.1	92.5
−24	91.7	92.9	94.2	94.3	94.2	94.0	93.6	93.0
−26	91.3	92.6	93.8	93.9	94.0	93.9	94.0	93.6
−28	91.0	92.2	93.4	93.6	93.7	93.6	93.6	93.9
−30	90.6	91.8	93.1	93.2	93.3	93.3	93.4	93.6
−32	90.2	91.5	92.7	92.8	92.9	93.0	93.1	93.2
−34	89.9	91.1	92.3	92.5	92.6	92.7	92.8	92.8
−36	89.5	90.8	92.0	92.1	92.2	92.3	92.4	92.5
−38	89.1	90.4	91.6	91.8	91.9	92.0	92.0	92.1
−40	88.8	90.0	91.3	91.4	91.5	91.6	91.7	91.8
−42								91.4

N1TABLES_TO_011_2_M184_25APR14

bfm0610_imp_004

Figure 06−10−4

THRUST

GO–AROUND THRUST SETTING
TO (ALL ENGINES)
ENGINE BLEED OFF, ENGINE A/I ON

THRUST SETTING – %N1									
SAT °C	ALTITUDE – FT								
	−1000	0	1000	2000	3000	4000	5000	6000	7000
10	86.1	87.4	88.8	90.1	91.3	92.4	93.1	93.1	93.1
8	85.8	87.1	88.4	89.8	91.0	92.1	93.2	93.3	93.2
6	85.5	86.8	88.1	89.4	90.7	91.8	92.8	93.5	93.4
4	85.2	86.5	87.8	89.1	90.3	91.4	92.5	93.7	93.6
2	84.9	86.2	87.5	88.8	90.0	91.1	92.2	93.3	93.8
0	84.6	85.9	87.2	88.5	89.7	90.7	91.8	93.0	93.9
−2	84.3	85.6	86.8	88.1	89.3	90.4	91.5	92.6	93.8
−4	84.0	85.3	86.5	87.8	89.0	90.1	91.2	92.3	93.5
−6	83.7	84.9	86.2	87.5	88.7	89.7	90.8	91.9	93.1
−8	83.4	84.6	85.9	87.2	88.3	89.4	90.4	91.6	92.8
−10	83.1	84.3	85.6	86.8	88.0	89.0	90.1	91.2	92.4
−12	82.8	84.0	85.2	86.5	87.7	88.7	89.8	90.9	92.1
−14	82.5	83.7	84.9	86.2	87.3	88.4	89.4	90.5	91.7
−16	82.2	83.4	84.6	85.8	87.0	88.0	89.1	90.2	91.3
−18	81.9	83.1	84.3	85.5	86.7	87.7	88.8	89.9	91.0
−20	81.6	82.8	84.0	85.2	86.3	87.4	88.4	89.5	90.7
−22	81.2	82.4	83.7	84.9	86.0	87.0	88.1	89.2	90.3
−24	80.9	82.1	83.3	84.6	85.7	86.7	87.7	88.8	90.0
−26	80.5	81.7	83.0	84.2	85.3	86.4	87.4	88.5	89.6
−28	80.2	81.4	82.6	83.9	85.0	86.0	87.1	88.1	89.3
−30	79.8	81.0	82.2	83.5	84.7	85.7	86.7	87.8	88.9
−32	79.5	80.7	81.9	83.2	84.3	85.3	86.3	87.5	88.6
−34	79.1	80.3	81.6	82.8	84.0	85.0	86.0	87.1	88.2
−36	78.8	79.9	81.2	82.5	83.6	84.6	85.6	86.7	87.8
−38	78.4	79.6	80.8	82.1	83.3	84.3	85.3	86.3	87.5
−40	78.1	79.2	80.5	81.8	82.9	83.9	84.9	86.0	87.1
−42									

N1TABLES_GA_AEO_010_1_M184_24APR14

bfm0610_imp_005

Figure 06−10−5

THRUST

GO–AROUND THRUST SETTING
TO (ALL ENGINES)
ENGINE BLEED OFF, ENGINE A/I ON

THRUST SETTING – %N1 – (Continued)

SAT °C	ALTITUDE – FT								
	8000	9000	10000	11000	12000	13000	14000	15000	16000
10	93.1	93.0	93.0	92.8	92.6	92.4	92.0	91.8	91.5
8	93.3	93.3	93.2	93.1	92.9	92.8	92.5	92.2	91.9
6	93.4	93.5	93.5	93.3	93.2	93.1	92.9	92.7	92.3
4	93.6	93.6	93.7	93.6	93.4	93.3	93.1	93.0	92.7
2	93.7	93.7	93.8	93.7	93.6	93.5	93.4	93.2	93.0
0	93.9	93.8	93.9	93.9	93.8	93.6	93.5	93.4	93.2
−2	94.1	93.9	93.9	94.0	93.9	93.8	93.6	93.5	93.4
−4	94.2	94.2	94.1	94.1	94.1	94.0	93.8	93.6	93.5
−6	94.3	94.5	94.4	94.3	94.3	94.2	94.1	93.8	93.7
−8	93.9	94.7	94.7	94.6	94.5	94.4	94.3	94.1	93.9
−10	93.6	94.8	94.8	94.8	94.8	94.7	94.6	94.4	94.2
−12	93.2	94.4	94.8	94.8	94.8	94.8	94.8	94.7	94.6
−14	92.9	94.1	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−16	92.5	93.7	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−18	92.2	93.4	94.6	94.7	94.7	94.7	94.7	94.8	94.8
−20	91.8	93.0	94.2	94.3	94.4	94.3	94.3	94.4	94.4
−22	91.5	92.7	93.9	93.9	94.0	93.9	93.9	94.1	94.1
−24	91.1	92.3	93.5	93.6	93.7	93.6	93.5	93.7	93.7
−26	90.8	92.0	93.1	93.2	93.3	93.2	93.1	93.4	93.4
−28	90.4	91.6	92.8	92.8	92.9	92.9	92.8	93.0	93.0
−30	90.1	91.2	92.4	92.5	92.6	92.5	92.5	92.6	92.7
−32	89.7	90.9	92.1	92.1	92.2	92.2	92.2	92.3	92.3
−34	89.4	90.6	91.7	91.8	91.8	91.9	91.9	92.0	91.9
−36	89.0	90.2	91.3	91.4	91.5	91.5	91.5	91.6	91.6
−38	88.7	89.8	91.0	91.1	91.2	91.2	91.2	91.3	91.2
−40	88.2	89.5	90.7	90.7	90.8	90.8	90.8	90.9	90.8
−42								90.6	90.4

N1TABLES_GA_AEO_010_2_M184_24APR14

bfm0610_imp_006

Figure 06–10–6

THRUST

GO–AROUND THRUST SETTING
TO (ALL ENGINES)
ENGINE BLEED OFF, ENGINE AND WING A/I ON

THRUST SETTING – %N1									
SAT °C	ALTITUDE – FT								
	−1000	0	1000	2000	3000	4000	5000	6000	7000
10	86.1	87.4	88.8	90.1	90.5	90.3	90.2	89.9	89.7
8	85.8	87.1	88.4	89.8	90.8	90.7	90.5	90.3	90.0
6	85.5	86.8	88.1	89.4	90.7	90.9	90.9	90.6	90.4
4	85.2	86.5	87.8	89.1	90.3	91.2	91.1	90.9	90.7
2	84.9	86.2	87.5	88.8	90.0	91.1	91.4	91.2	91.0
0	84.6	85.9	87.2	88.5	89.7	90.7	91.6	91.4	91.2
−2	84.3	85.6	86.8	88.1	89.3	90.4	91.5	91.6	91.4
−4	84.0	85.3	86.5	87.8	89.0	90.1	91.2	91.8	91.7
−6	83.7	84.9	86.2	87.5	88.7	89.7	90.8	91.9	91.8
−8	83.4	84.6	85.9	87.2	88.3	89.4	90.4	91.6	92.0
−10	83.1	84.3	85.6	86.8	88.0	89.0	90.1	91.2	92.2
−12	82.8	84.0	85.2	86.5	87.7	88.7	89.8	90.9	92.1
−14	82.5	83.7	84.9	86.2	87.3	88.4	89.4	90.5	91.7
−16	82.2	83.4	84.6	85.8	87.0	88.0	89.1	90.2	91.3
−18	81.9	83.1	84.3	85.5	86.7	87.7	88.8	89.9	91.0
−20	81.6	82.8	84.0	85.2	86.3	87.4	88.4	89.5	90.7
−22	81.2	82.4	83.7	84.9	86.0	87.0	88.1	89.2	90.3
−24	80.9	82.1	83.3	84.6	85.7	86.7	87.7	88.8	90.0
−26	80.5	81.7	83.0	84.2	85.3	86.4	87.4	88.5	89.6
−28	80.2	81.4	82.6	83.9	85.0	86.0	87.1	88.1	89.3
−30	79.8	81.0	82.2	83.5	84.7	85.7	86.7	87.8	88.9
−32	79.5	80.7	81.9	83.2	84.3	85.3	86.3	87.5	88.6
−34	79.1	80.3	81.6	82.8	84.0	85.0	86.0	87.1	88.2
−36	78.8	79.9	81.2	82.5	83.6	84.6	85.6	86.7	87.8
−38	78.4	79.6	80.8	82.1	83.3	84.3	85.3	86.3	87.5
−40	78.1	79.2	80.5	81.8	82.9	83.9	84.9	86.0	87.1
−42									

N1TABLES_GA_AEO_011_1_M184_24APR14

bfm0610_imp_007

Figure 06–10–7

THRUST

GO–AROUND THRUST SETTING
TO (ALL ENGINES)
ENGINE BLEED OFF, ENGINE AND WING A/I ON

THRUST SETTING – %N1 – (Continued)

SAT °C	ALTITUDE – FT								
	8000	9000	10000	11000	12000	13000	14000	15000	16000
10	89.5	89.2	88.9	88.6	88.2	87.7	87.3	86.8	85.7
8	89.8	89.6	89.3	89.0	88.7	88.2	87.8	87.3	86.3
6	90.1	90.0	89.7	89.4	89.1	88.7	88.3	87.9	86.9
4	90.5	90.3	90.1	89.8	89.4	89.2	88.7	88.3	87.4
2	90.8	90.6	90.4	90.1	89.8	89.5	89.2	88.8	87.9
0	91.1	90.9	90.7	90.3	90.1	89.8	89.4	89.2	88.3
−2	91.3	91.2	90.9	90.6	90.3	90.1	89.8	89.5	88.8
−4	91.5	91.3	91.2	90.9	90.6	90.3	90.0	89.8	89.1
−6	91.7	91.5	91.4	91.2	90.8	90.6	90.3	90.0	89.4
−8	91.9	91.7	91.5	91.3	91.1	90.8	90.5	90.2	89.7
−10	92.1	91.9	91.7	91.4	91.2	91.0	90.8	90.5	89.9
−12	92.4	92.2	92.0	91.6	91.4	91.2	91.0	90.7	90.1
−14	92.6	92.5	92.3	92.0	91.6	91.3	91.2	90.9	90.4
−16	92.5	92.8	92.6	92.3	91.9	91.5	91.3	91.1	90.6
−18	92.2	93.1	92.9	92.7	92.3	92.0	91.5	91.3	90.8
−20	91.8	93.0	93.2	93.0	92.7	92.4	92.0	91.6	91.0
−22	91.5	92.7	93.7	93.4	93.1	92.9	92.5	92.0	91.2
−24	91.1	92.3	93.5	93.6	93.6	93.4	93.1	92.5	91.7
−26	90.8	92.0	93.1	93.2	93.3	93.2	93.1	93.1	92.2
−28	90.4	91.6	92.8	92.8	92.9	92.9	92.8	93.0	92.8
−30	90.1	91.2	92.4	92.5	92.6	92.5	92.5	92.6	92.7
−32	89.7	90.9	92.1	92.1	92.2	92.2	92.2	92.3	92.3
−34	89.4	90.6	91.7	91.8	91.8	91.9	91.9	92.0	91.9
−36	89.0	90.2	91.3	91.4	91.5	91.5	91.5	91.6	91.6
−38	88.7	89.8	91.0	91.1	91.2	91.2	91.2	91.3	91.2
−40	88.2	89.5	90.7	90.7	90.8	90.8	90.8	90.9	90.8
−42								90.6	90.4

N1TABLES_GA_AEO_011_2_M184_24APR14

bfm0610_imp_008

Figure 06–10–8

THRUST

GO–AROUND THRUST SETTING
APR (SINGLE ENGINE)
ENGINE BLEED OFF, ENGINE A/I ON

THRUST SETTING – %N1									
SAT °C	ALTITUDE – FT								
	−1000	0	1000	2000	3000	4000	5000	6000	7000
10	86.1	87.4	88.8	90.1	91.3	92.4	93.5	94.2	94.2
8	85.8	87.1	88.4	89.8	91.0	92.1	93.2	94.3	94.4
6	85.5	86.8	88.1	89.4	90.7	91.8	92.9	94.0	94.5
4	85.2	86.5	87.8	89.1	90.3	91.4	92.5	93.7	94.7
2	84.9	86.2	87.5	88.8	90.0	91.1	92.2	93.3	94.5
0	84.6	85.9	87.2	88.5	89.7	90.8	91.9	93.0	94.2
−2	84.3	85.6	86.8	88.1	89.3	90.4	91.5	92.6	93.8
−4	84.0	85.3	86.5	87.8	89.0	90.1	91.2	92.3	93.5
−6	83.7	84.9	86.2	87.5	88.7	89.7	90.8	91.9	93.1
−8	83.4	84.6	85.9	87.2	88.3	89.4	90.5	91.6	92.8
−10	83.1	84.3	85.6	86.8	88.0	89.1	90.1	91.3	92.4
−12	82.8	84.0	85.2	86.5	87.7	88.7	89.8	90.9	92.1
−14	82.5	83.7	84.9	86.2	87.3	88.4	89.4	90.6	91.7
−16	82.2	83.4	84.6	85.8	87.0	88.1	89.1	90.2	91.4
−18	81.9	83.1	84.3	85.5	86.7	87.7	88.8	89.9	91.0
−20	81.6	82.8	84.0	85.2	86.3	87.4	88.4	89.5	90.7
−22	81.2	82.4	83.7	84.9	86.0	87.1	88.1	89.2	90.3
−24	80.9	82.1	83.3	84.6	85.7	86.7	87.8	88.8	90.0
−26	80.5	81.7	83.0	84.2	85.3	86.4	87.4	88.5	89.6
−28	80.2	81.4	82.6	83.9	85.0	86.0	87.1	88.2	89.3
−30	79.8	81.0	82.3	83.5	84.7	85.7	86.7	87.8	88.9
−32	79.5	80.7	81.9	83.2	84.3	85.3	86.4	87.5	88.6
−34	79.1	80.3	81.6	82.8	84.0	85.0	86.0	87.1	88.2
−36	78.8	79.9	81.2	82.5	83.6	84.6	85.7	86.7	87.9
−38	78.4	79.6	80.8	82.2	83.3	84.3	85.3	86.3	87.5
−40	78.1	79.2	80.5	81.8	83.0	83.9	84.9	86.0	87.1
−42									

N1TABLES_GA_OEI_010_1_M184_24APR14

bfm0610_imp_009

Figure 06–10–9

THRUST

GO–AROUND THRUST SETTING
APR (SINGLE ENGINE)
ENGINE BLEED OFF, ENGINE A/I ON

THRUST SETTING – %N1 – (Continued)									
SAT °C	ALTITUDE – FT								
	8000	9000	10000	11000	12000	13000	14000	15000	16000
10	94.2	94.2	94.2	94.0	93.9	93.8	93.6	93.5	92.9
8	94.4	94.3	94.3	94.3	94.1	94.0	93.9	93.7	93.2
6	94.5	94.5	94.5	94.4	94.3	94.2	94.1	94.0	93.5
4	94.7	94.7	94.7	94.5	94.4	94.4	94.2	94.1	93.7
2	94.8	94.8	94.8	94.7	94.5	94.4	94.3	94.2	93.9
0	94.8	94.8	94.8	94.8	94.7	94.5	94.5	94.3	93.9
−2	94.8	94.8	94.8	94.8	94.8	94.7	94.6	94.5	94.1
−4	94.7	94.8	94.8	94.8	94.8	94.8	94.8	94.8	94.3
−6	94.3	94.8	94.8	94.8	94.8	94.8	94.8	94.8	94.6
−8	93.9	94.8	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−10	93.6	94.8	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−12	93.3	94.5	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−14	92.9	94.1	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−16	92.6	93.8	94.8	94.8	94.8	94.8	94.8	94.8	94.8
−18	92.2	93.4	94.6	94.8	94.8	94.8	94.8	94.8	94.8
−20	91.9	93.1	94.2	94.5	94.7	94.8	94.8	94.8	94.8
−22	91.5	92.7	93.9	94.1	94.3	94.4	94.6	94.8	94.8
−24	91.2	92.3	93.5	93.8	94.0	94.1	94.2	94.6	94.5
−26	90.8	92.0	93.2	93.4	93.6	93.7	93.8	94.3	94.1
−28	90.4	91.6	92.8	93.0	93.3	93.3	93.4	93.9	93.8
−30	90.1	91.3	92.4	92.7	92.9	93.0	93.2	93.5	93.4
−32	89.8	90.9	92.1	92.3	92.6	92.7	92.9	93.2	93.0
−34	89.4	90.6	91.7	92.0	92.2	92.4	92.6	92.8	92.6
−36	89.1	90.2	91.4	91.6	91.8	92.0	92.2	92.5	92.3
−38	88.7	89.9	91.0	91.2	91.5	91.7	91.9	92.1	91.9
−40	88.3	89.5	90.7	90.9	91.1	91.3	91.5	91.8	91.5
−42								91.4	91.1

1TABLES_GA_OEI_010_2_M184_24APR14

bfm0610_imp_010

Figure 06–10–10

THRUST

GO−AROUND THRUST SETTING
APR (SINGLE ENGINE)
ENGINE BLEED OFF, ENGINE AND WING A/I ON

THRUST SETTING − %N1									
SAT °C	ALTITUDE − FT								
	−1000	0	1000	2000	3000	4000	5000	6000	7000
10	86.1	87.4	88.8	90.1	90.5	90.3	90.2	89.9	89.7
8	85.8	87.1	88.4	89.8	90.8	90.7	90.5	90.3	90.0
6	85.5	86.8	88.1	89.4	90.7	90.9	90.9	90.6	90.4
4	85.2	86.5	87.8	89.1	90.3	91.2	91.1	90.9	90.7
2	84.9	86.2	87.5	88.8	90.0	91.1	91.4	91.2	91.0
0	84.6	85.9	87.2	88.5	89.7	90.8	91.6	91.4	91.2
−2	84.3	85.6	86.8	88.1	89.3	90.4	91.5	91.6	91.4
−4	84.0	85.3	86.5	87.8	89.0	90.1	91.2	91.8	91.7
−6	83.7	84.9	86.2	87.5	88.7	89.7	90.8	91.9	91.8
−8	83.4	84.6	85.9	87.2	88.3	89.4	90.5	91.6	92.0
−10	83.1	84.3	85.6	86.8	88.0	89.1	90.1	91.3	92.2
−12	82.8	84.0	85.2	86.5	87.7	88.7	89.8	90.9	92.1
−14	82.5	83.7	84.9	86.2	87.3	88.4	89.4	90.6	91.7
−16	82.2	83.4	84.6	85.8	87.0	88.1	89.1	90.2	91.4
−18	81.9	83.1	84.3	85.5	86.7	87.7	88.8	89.9	91.0
−20	81.6	82.8	84.0	85.2	86.3	87.4	88.4	89.5	90.7
−22	81.2	82.4	83.7	84.9	86.0	87.1	88.1	89.2	90.3
−24	80.9	82.1	83.3	84.6	85.7	86.7	87.8	88.8	90.0
−26	80.5	81.7	83.0	84.2	85.3	86.4	87.4	88.5	89.6
−28	80.2	81.4	82.6	83.9	85.0	86.0	87.1	88.2	89.3
−30	79.8	81.0	82.3	83.5	84.7	85.7	86.7	87.8	88.9
−32	79.5	80.7	81.9	83.2	84.3	85.3	86.4	87.5	88.6
−34	79.1	80.3	81.6	82.8	84.0	85.0	86.0	87.1	88.2
−36	78.8	79.9	81.2	82.5	83.6	84.6	85.7	86.7	87.9
−38	78.4	79.6	80.8	82.2	83.3	84.3	85.3	86.3	87.5
−40	78.1	79.2	80.5	81.8	83.0	83.9	84.9	86.0	87.1
−42									

N1TABLES_GA_OEI_012_1_M184_24APR14

bfm0610_imp_011

Figure 06−10−11

THRUST

GO–AROUND THRUST SETTING

APR (SINGLE ENGINE)

ENGINE BLEED OFF, ENGINE AND WING A/I ON

THRUST SETTING – %N1 – (Continued)									
SAT °C	ALTITUDE – FT								
	8000	9000	10000	11000	12000	13000	14000	15000	16000
10	89.5	89.2	88.9	88.6	88.2	87.7	87.3	86.8	85.7
8	89.8	89.6	89.3	89.0	88.7	88.2	87.8	87.3	86.3
6	90.1	90.0	89.7	89.4	89.1	88.7	88.3	87.9	86.9
4	90.5	90.3	90.1	89.8	89.4	89.2	88.7	88.3	87.4
2	90.8	90.6	90.4	90.1	89.8	89.5	89.2	88.8	87.9
0	91.1	90.9	90.7	90.3	90.1	89.8	89.4	89.2	88.3
−2	91.3	91.2	90.9	90.6	90.3	90.1	89.8	89.5	88.8
−4	91.5	91.3	91.2	90.9	90.6	90.3	90.0	89.8	89.1
−6	91.7	91.5	91.4	91.2	90.8	90.6	90.3	90.0	89.4
−8	91.9	91.7	91.5	91.3	91.1	90.8	90.5	90.2	89.7
−10	92.1	91.9	91.7	91.4	91.2	91.0	90.8	90.5	89.9
−12	92.4	92.2	92.0	91.6	91.4	91.2	91.0	90.7	90.1
−14	92.6	92.5	92.3	92.0	91.6	91.3	91.2	90.9	90.4
−16	92.6	92.8	92.6	92.3	91.9	91.5	91.3	91.1	90.6
−18	92.2	93.1	92.9	92.7	92.3	92.0	91.5	91.3	90.8
−20	91.9	93.1	93.2	93.0	92.7	92.4	92.0	91.6	91.0
−22	91.5	92.7	93.7	93.4	93.1	92.9	92.5	92.0	91.2
−24	91.2	92.3	93.5	93.8	93.6	93.4	93.1	92.5	91.7
−26	90.8	92.0	93.2	93.4	93.6	93.7	93.7	93.1	92.2
−28	90.4	91.6	92.8	93.0	93.3	93.3	93.4	93.6	92.8
−30	90.1	91.3	92.4	92.7	92.9	93.0	93.2	93.5	93.4
−32	89.8	90.9	92.1	92.3	92.6	92.7	92.9	93.2	93.0
−34	89.4	90.6	91.7	92.0	92.2	92.4	92.6	92.8	92.6
−36	89.1	90.2	91.4	91.6	91.8	92.0	92.2	92.5	92.3
−38	88.7	89.9	91.0	91.2	91.5	91.7	91.9	92.1	91.9
−40	88.3	89.5	90.7	90.9	91.1	91.3	91.5	91.8	91.5
−42								91.4	91.1

N1TABLES_GA_OEI_012_2_M184_24APR14

bfm0610_imp_012

Figure 06–10–12

THIS PAGE INTENTIONALLY LEFT BLANK

TAKEOFF

GENERAL

The Takeoff Performance Module in the CAFM calculates all items in the takeoff segment, including the various takeoff distances, takeoff speeds, maximum tire speed, brake energy and climb limitations, in varying conditions of temperature, airport pressure altitude and airplane weight for the specified takeoff configurations.

DETERMINATION OF THE TAKEOFF WEIGHT LIMIT

Fig. 06–20–3 provides a schematic of the takeoff weight determination procedure. The takeoff weight is the lowest weight based on the most restrictive limitation:

1. Field Length Weight Limitation (takeoff distance or takeoff run)
2. Climb Weight Limitation
3. Maximum Brake Energy Limitation (V_{1MBE} limit on V_1)
4. Takeoff Weight Limited by maximum tire speed
5. Takeoff Flight Path Weight Limitation (Obstacle Clearance)
6. Maximum Structural Takeoff Weight

Once the scheduled takeoff weight is determined, the corresponding takeoff speeds (V_1, V_R and V_2) can be calculated taking into consideration applicable speed limitations. The following paragraphs provide more information on each takeoff weight limitation.

NOTE: 1. All takeoff performance data presented in this section is based on the APR ARMED configuration.

2. The CAFM applies the maximum brake energy limitation as a V_1 upper limit instead of a takeoff weight limitation. The decision speed V_1 cannot exceed V_{1MBE} for the specified aircraft, runway and atmospheric conditions. If V_1 exceeds V_{1MBE} for the specified conditions, the input V_1 speed may be reduced or the aircraft configuration can be changed to increase V_{1MBE} (weight reduction, increase flap setting). It is noted that the Full Takeoff calculator automatically sets V_1 equal to V_{1MBE} when V_{1MBE} is limiting.

TAKEOFF

TAKEOFF PERFORMANCE CALCULATIONS

The Takeoff Performance Module in the CAFM includes the following calculation scenarios:

- **One Engine Inoperative Takeoff:** This calculator determines the OEI takeoff run and OEI takeoff distance. It also calculates the V_1, V_R, V_2 and V_{FTO} takeoff speeds for the specified Aircraft, Runway and Atmospheric data inputs. The V_1/V_R and V_2/V_S speed ratios and the V_{1MCG} speed limit are presented for information purposes.
- **All Engines Operating Takeoff:** This calculator determines the factored AEO takeoff run and takeoff distance. It also calculates the V_R, V_2 and V_{FTO} takeoff speeds for the specified Aircraft, Runway and Atmospheric data inputs. The V_2/V_S speed ratio is presented for information purposes.
- **Accelerate−Stop:** This calculator determines the Accelerate−Stop distance and the V_1 and V_R takeoff speeds for the specified Aircraft, Runway and Atmospheric data inputs. The V_1/V_R speed ratio and the V_{1MCG} speed limit are presented for information purposes.
- **V_1 Limited by Brake Energy (V_{1MBE}):** This calculator determines the V_{1MBE} speed limit for the specified Aircraft, Runway and Atmospheric data inputs.
- **V_1 Limited by Control on the Ground (V_{1MCG}):** This calculator determines the V_{1MCG} speed limit for the specified Aircraft, Runway and Atmospheric data inputs.
- **Full Takeoff:** This calculator groups together all the takeoff calculators described above. It determines the following takeoff data for the specified Aircraft, Runway and Atmospheric data inputs.
  - OEI takeoff run and takeoff distance
  - Factored AEO takeoff run and takeoff distance
  - Accelerate−Stop distance
  - V_1, V_R, V_2 and V_{FTO} takeoff speeds.

  This calculator also presents the following information:
  - V_1/V_R and V_2/V_S speed ratios
  - V_{1MBE} and V_{1MCG} speed limits.
- **Takeoff Weight Limited by Tire Speed:** This calculator determines the takeoff weight limited by tire speed for the specified Aircraft, Runway and Atmospheric data inputs.
- **Takeoff Weight Limited by Climb Requirements:** This calculator determines the takeoff weight limited by climb requirements for the specified Aircraft and Atmospheric data inputs. For information, it also provides the limiting segment (1: first segment, 2: second segment, 3: final segment, 4: approach climb, and 5: landing climb).

TAKEOFF

NOTE: 1. Dry and wet runway performance is provided by the takeoff performance calculators. Contaminated runways performance is also presented however this is covered in the Supplements section of this AFM.

2. The Full Takeoff scenario is recommended to determine the required takeoff distance or takeoff run. This scenario presents all the distances required for this evaluation, and also includes the V_{1MBE} and V_{1MCG} speed limits on V_1. Best takeoff distance performance is obtained by selecting the balanced V_1 option in the V_1 Type button. The CAFM will then optimize V_1 to obtain the balanced V_1 condition, unless takeoff speed limitations prevent a balanced V_1. A balanced takeoff distance results when the OEI Takeoff distance and the Accelerate–Stop distance are equal. An unbalanced distance occurs when this is not achieved. It is noted that unbalanced distances may be useful to optimize obstacle clearance (see the TAKEOFF FLIGHT PATH section, this chapter).

3. The CAFM gives different options to enter the V_1 speed with the V_1 Type button (Aircraft Data pane). The V_1 speed may be entered directly in knots (IAS), or the V_1/V_R speed ratio may be specified (default value is 1.0). The V_1/V_R ratio must lie between 0.8 and 1.0 (V_1 cannot exceed V_R). Generally, the V_1/V_R ratio is more convenient for takeoff calculations than the IAS input. A low V_1/V_R ratio will reduce the accelerate–stop distance but increase the OEI takeoff distance. A high V_1/V_R reduces the OEI takeoff distance but increases the accelerate–stop distance. The optimal V_1/V_R will be the ratio that optimizes the most limiting criteria on takeoff (runway length, obstacle clearance, etc.).

The takeoff weight limited by takeoff field length is based on the greater of the following distances:

1) OEI and AEO takeoff distance,

2) OEI and AEO takeoff run, and

3) Accelerate–stop distance.

NOTE: The takeoff run distances are applicable in the presence of a clearway, as defined in the applicable regulations.

The following takeoff speeds are required for takeoff and they are determined at the limiting takeoff weight condition:

– V_1 = Takeoff Decision Speed

– V_R = Takeoff Rotation Speed

– V_2 = Takeoff Safety Speed

– V_{FTO} = Final Takeoff Speed.

TAKEOFF

The weight limitation due to brake energy is effectively applied as a limitation in V_1 speed (V_{1MBE}).

NOTE: – CAFM Takeoff calculators present the V_2/V_S ratio applicable for the specified conditions. The minimum V_2/V_S ratio (1.19 for Flap 10 and 1.155 for Flap 20) is increased when V_2 is limited by minimum speed considerations. The V_2/V_S ratio is presented for information only.

– Takeoff speeds provided by the CAFM may be rounded−up to the nearest unit (0.5 and above) for cockpit use.

STABILIZER TRIM SETTING FOR TAKEOFF

Determine the required stabilizer trim setting for takeoff using the appropriate Stabilizer Trim Setting chart (Flap 10° or flap 20°), as a function of aircraft weight and CG position.

TAKEOFF FROM WET RUNWAYS

A runway is considered to be wet when it has a shiny appearance due to a thin layer of water on it, but without significant areas of standing water.

NOTE: A runway with greater than 0.125 inch (3 mm) of standing water would be a contaminated runway.

There are two wet runway selections given in the drop−down menu of the Runway Surface Condition under the Runway Data window. For wet smooth runways, Wet Runway must be selected. For wet runways that have been grooved or treated with porous friction course material, select Wet Grooved Runway.

NOTE: Supplement 9 OPERATION ON WET GROOVED RUNWAYS provides detailed information and applicable limitations for operation on wet grooved runways.

When a Wet Runway or a Wet Grooved Runway is selected as the runway surface condition, the CAFM calculator presents the `Thrust Reversers` drop−down menu (when applicable). The CAFM user can then select the number of thrust reversers available at dispatch, as permitted by the applicable MEL (Minimum Equipment List).

NOTE: If the takeoff weight obtained from the CAFM calculation for a wet runway is higher than the takeoff weight for a dry runway, use the takeoff weight for a dry runway. In this situation, the V_1 speed must be determined for the wet runway condition at the limiting weight.

When operating on wet runways, ground handling characteristics will not be as good as can be achieved on dry runways. The variability of surface conditions and crosswinds should be taken into consideration.

TAKEOFF

STANDARD PERFORMANCE CONDITIONS

All wet runway takeoff performance in this section is based on the following performance conditions:

- Braking – Maximum until full stop
- Automatic Ground Lift Dumping – ARMED
- Thrust Reversers – Maximum Reverse until 40 KIAS then set to Reverse Idle until full stop.

TAKEOFF FROM CONTAMINATED RUNWAYS

Refer to OPERATION ON CONTAMINATED RUNWAYS supplement.

TAKEOFF FLIGHT PATH

The gross and net takeoff paths are determined through the Takeoff Path Module of the CAFM. This module provides for the calculation of the takeoff path in either the fixed level–off height or the maximum level–off height scenario.

The takeoff flight path is divided into segments defined by changes in the airplane configuration. The terms used in flight path plotting are defined as follows and are illustrated on the TAKEOFF PROFILE Fig. 06–20–4. Different takeoff profiles are required according to the gross level–off height above the runway. If the gross level–off height is lower than 1,500 feet (400 feet minimum), then a final segment climb is required. The gross flight path represents the actual climb and acceleration performance of the airplane. The net flight path is obtained by reducing the gross climb performance by a climb gradient of 0.8% and by reducing the gross acceleration, during the level flight acceleration segment, by 0.008 g. The net takeoff flight path must clear all obstacles by a minimum of 35 feet.

Reference Zero	A point 35 feet above the runway surface at the final point of the takeoff run (takeoff distance).
First Segment	Segment extending from 35 feet height at the end of the takeoff run (Reference Zero) to the height at the end of gear retraction. It is flown at V_2 speed with the operating engine at APR thrust.
Second Segment	Segment beginning at the end of gear retraction (end of first segment) and continuing to level–off height at V_2 speed. For obstacle clearance, maintain second segment climb (gear up, flaps at takeoff setting, operating engine at APR thrust, and V_2) until reaching obstacle clearance altitude. This procedure will produce the performance provided by the Takeoff Path calculators of the CAFM.

TAKEOFF

Transition (Level Acceleration) Segment	Segment beginning at the end of second segment and representing the acceleration at level–off height. It includes the acceleration from V_2 to transition speed (V_2 + 15 KIAS for flaps 10° and V_2 + 25 for flaps 20°), flap retraction, and continued acceleration to V_{FTO} (final segment climb speed). The operating engine is at APR thrust during this segment. **NOTE:** In some conditions, flap retraction speed (V_2 +15 KIAS for Flaps 10 and V_2 +25 KIAS for Flaps 20) can exceed the V_{FTO} speed. In this case, the flap retraction speed can be set equal to V_{FTO}. In this situation, flap retraction will begin when V_{FTO} is reached during the level acceleration segment.
Final Segment (if required)	This segment begins at the end of the transition segment and ends at 1,500 feet above the runway. Final segment climb is based on gear UP, flaps UP, operating engine at Maximum Continuous thrust (CLB setting) and V_{FTO} final segment speed. **NOTE:** The CAFM allows the user to select a gross final height well above 1,500 ft if required for far obstacles clearance during the final segment climb.

The gross level–off height is selected before takeoff. It must not be less than 400 feet and not greater than the maximum gross level–off height. The maximum gross level–off height is attained when the takeoff thrust time limit (10 minutes) expires at the end of the acceleration segment (Fig. 06–20–4). In addition, the pressure altitude corresponding to the gross level–off height must not exceed the maximum altitude with flaps extended (18,000 ft).

The following configurations are used in the CAFM calculators for the different phases of flight:

TAKEOFF

Configuration	Engines Operating	Thrust Setting	Flap Setting	Gear
1st Segment Takeoff Climb	1	APR	10° or 20°	Down
2nd Segment Takeoff Climb	1	APR	10° or 20°	Up
Transition (Level Acceleration)	1	APR	10° or 20° to 0°	Up
Final Segment Climb	1	CLB	0°	Up
En Route Climb	1	CLB	0°	Up
Approach Climb	1	APR	10°	Up
Landing Climb	2	TO	30°	Down

DETERMINATION OF TAKEOFF PATH FOR OBSTACLE CLEARANCE

The weight used to determine the takeoff path is defined as the airplane weight at the beginning of takeoff roll. Using this weight for each climb segment will result in some small conservatism, since the gradients are presented in terms of instantaneous gross weight rather than the weight at the beginning of takeoff roll.

When takeoff path planning for obstacle clearance is desired, the following procedure may be used:

1. From the CAFM Calculation Module Takeoff Weight Limited by Climb Requirements, determine the highest weight at which a takeoff may be made for the ambient temperature and pressure altitude.
2. From the CAFM Calculation Module Takeoff Weight Limited by Tire Speed, determine the highest weight at which a takeoff may be made not to be limited by the maximum lift–off speed (maximum tire speed).

TAKEOFF

3. From the applicable CAFM Takeoff Performance Modules, determine the highest weight at which a takeoff may be made using the available runway length, number of operable thrust reversers (if applicable), runway gradient, reported wind, airport pressure altitude and ambient temperature. The lower of this weight and the weights from Steps 1 and 2 is the first trial takeoff weight.
4. The full takeoff module may be used to optimize the V_1 speed (Balanced V_1 option) if desired for best runway performance. The resulting V_1 / V_R ratio can then be used in the Takeoff Path calculator.

   NOTE: In some situations, better obstacle clearance performance is obtained by selecting a higher V_1 / V_R ratio while still meeting runway performance considerations.
5. Determine the horizontal distance of the obstacle from reference zero or from brake release as appropriate.
6. From the applicable CAFM Takeoff Path Calculation Module, determine the net trajectory of the takeoff path. Compare the actual position of the obstacles with the Net Takeoff Path trajectory. All obstacles must be cleared by a minimum of 35 ft.
7. The gross level−off height is also determined at this stage. For most obstacle clearance cases, best performance is obtained by selecting a gross level−off height that ensures that all obstacles are cleared by the net flight path during the first or second segments.

   NOTE: It is noted at this point that a headwind serves to increase climb gradient performance, whereas a tailwind decreases climb gradient performance.
8. The CAFM output also provides the pressure altitude at gross level−off height, correcting the level−off geometric height for non−standard temperature conditions. This pressure altitude at level−off height is used by the pilot for the transition segment (Level−off Acceleration).
9. If the obstacles cannot be cleared by the 35 ft minimum, the other takeoff flap setting may be used, or the takeoff weight must be reduced. Takeoff distance will be reduced with reducing weight, and in−flight climb gradient will improve. Both effects contribute to improve obstacle clearance.

TAKEOFF

GRADIENT LOSS IN A STEADY TURN

The gradient loss in a steady turn is tabulated below for a 15° bank angle.

For bank angles less than 15°, the gradient loss may be considered proportional to bank angle.

FLAP	GRADIENT LOSS (%)
0°	0.28
10°	0.34
20°	0.38

TAKEOFF

TAKEOFF PERFORMANCE EXAMPLE

The following example provides the recommended work flow to determine the maximum allowable takeoff weight and the corresponding takeoff speeds for a typical runway condition. The sequence used follows the takeoff weight determination procedure shown on Fig. 06–20–3.

CAFM INPUT CONDITIONS

The following data will be used as CAFM inputs:

Aircraft Data:

- Weight: calculator dependent (see below)
- Flaps: 20
- V_1 Type: calculator dependent (see below)
- Engine Bleed: Engine Bleed On
- Rolling Takeoff: No
- Gross Level–off Height (LOH): 1500 ft
- Gross Final Height: 2000 ft.

Runway Data:

- Runway Slope: 1.0% (Positive Uphill)
- Runway Surface Condition: Dry Runway.

Atmospheric Data:

- Airport Pressure Altitude: 4300 ft
- Reported Wind: 5 kts (Positive for Headwind)
- Airport Temperature (OAT): 30 °C

MMEL/CDL:

- CDL Index: Zero
- No MMEL item selected for calculation.

AIRPORT INFORMATION (DESIRED CAFM PERFORMANCE)

The following airport information will be used to determine the maximum allowable takeoff weight. This information cannot be entered in CAFM. Instead, the CAFM outputs will be used to verify if the desired performance is obtained or not.

- The available runway length is 6770 ft.
- A 400 ft clearway is available at the end of the runway.
- The most critical obstacle is located 49210 ft from the beginning of the runway and is 1128 ft high above the runway surface (lift–off end).

TAKEOFF

CASE 1: DETERMINE THE MAXIMUM ALLOWABLE TAKEOFF WEIGHT (NO CREDIT FOR CLEARWAY)

The maximum allowable takeoff weight is the lowest of the different takeoff weight limitations, including the MTOW structural limit (40600 lb). Each weight limitation will be evaluated in turn using the appropriate CAFM calculator. With no credit for clearway, a lower (conservative) takeoff weight will be obtained but this is acceptable for operation.

A. TAKEOFF WEIGHT LIMITED BY CLIMB REQUIREMENTS MODULE

Open this CAFM module to determine the takeoff weight limited by climb requirements (no weight input required). For the specified CAFM input conditions, the weight limit calculated by the CAFM is 43215 lb and this is above MTOW. The limiting segment is the second segment as shown by a (2) in the right hand column. It can therefore be concluded that climb requirements are not limiting.

B. TAKEOFF WEIGHT LIMITED BY TIRE SPEED MODULE

Open this CAFM module to determine the takeoff weight limited by the maximum tire speed (no weight input required). For the specified CAFM input conditions, the weight limit calculated by the CAFM is 51156 lb and this is above MTOW. It can therefore be concluded that maximum tire speed is not limiting.

Notes on warning (Messages View):

- CAFM output data remains valid when warning messages are issued (yellow coding). These messages provide useful information on the CAFM output.
- CAFM will issue a warning when the tire speed weight limit exceeds 126% of the MTOW. The exact weight limit is extremely high and CAFM reduces the weight limit to a more practical value. Therefore, the weight limit is set to 126% of the MTOW (51156 lb) for the specified conditions.

C. FULL TAKEOFF MODULE

This calculator will be used to determine the various takeoff distances and speeds. In this case, there is no credit for clearway therefore the Takeoff Field Length (TOFL) is the greatest of the OEI Takeoff Distance (TOD), the AEO TOD and the Accelerate−Stop Distance (ASD). OEI and AEO Takeoff Runs (TOR) are never limiting when there is no clearway credit.

TAKEOFF

Therefore, the user must determine at what optimal takeoff weight is the TOFL limited by the available runway length (6770 ft). This is done by requesting a multiple run on weight: activate the multiple run window to generate an input weight array. The certified weight range will be used: 27400 lb as the start weight, 40600 lb as the last weight and a 1000 lb interval. The multiple run array is generated automatically by clicking on the magic stick button. Balanced V1 is selected as the V1 type since it provides the best runway performance.

Output analysis shows that 38400 lb is the optimal weight in order to meet the runway length limitation. At 38400 lb, the OEI TOD is the most limiting distance as it matches the available runway length (6770 ft).

Output data for the 38400 lb line:

- OEI TOR: 5654 ft (not limiting)
- OEI TOD: 6770 ft = **Most Limiting Distance**
- AEO TOR: 5588 ft (not limiting)
- AEO TOD: 6168 ft < 6770 ft
- ASD: 6535 ft < 6770 ft
- V_1 127.1 KIAS
- V_R: 127.1 KIAS
- V_1/V_R: 1.0 (used in the Takeoff Path calculator)
- V_2: 129.7 KIAS
- V_2/V_S: 1.155 (for information)
- V_{FTO}: 158.3 KIAS
- V_{1MCG}: 116.1 KIAS (not limiting V_1)
- V_{1MBE}: 165.2 KIAS (not limiting V_1).

Notes on warnings (Messages View):

- CAFM output data remains valid when warning messages are issued (yellow coding). These messages provide useful information on the CAFM output.
- For the 38400 lb output line, a warning message mentions that the CAFM was unable to balance V_1. The CAFM sets V_1 equal to V_R as V_1 cannot exceed V_R. A balanced V_1 would result in equal OEI TOD and ASD.
- The Full Takeoff calculator ensures that V_1 lies in–between the minimum V_1 (greater of V_{1MCG} and 80% of V_R) and the maximum V_1 (lower of V_{1MBE} and V_R). At light weights in the multiple run, V_1 was limited by V_{1MCG} and a warning message was issued.

TAKEOFF

- CAFM will issue a warning when V_{1MBE} has been reduced from the exact V_{1MBE} value. In some situations, the exact V_{1MBE} will be extremely high and CAFM reduces V_{1MBE} to a more practical value. For some of the weights in the multiple run, CAFM reduced V_{1MBE} to a lower value which is not limiting V_1.

D. TAKEOFF PATH – FIXED LEVEL–OFF HEIGHT MODULE

This calculator will be used to verify the critical obstacle clearance. The takeoff path calculators can only use one weight at the time. The field length limited weight (38400 lb) is used with the corresponding V_1/V_R ratio of 1.0 as a first trial weight. The default gross LOH of 1500 ft is kept as a first trial LOH. The output columns Net Distance and Net Height are used to verify the obstacle clearance. Per regulations, the net flight path trajectory must clear all obstacles by a minimum of 35 ft.

For the specified conditions, the net trajectory clears the critical obstacle by more than 35 ft and the obstacle is therefore not limiting at this takeoff weight condition. At the obstacle 49210 ft net distance, the net height is 1184 ft (horizontal LOH segment) giving an obstacle clearance of 1184 – 1128 = 56 ft. The assumed 1500 ft gross LOH is acceptable in this case. The required pressure altitude at LOH is of 5683 ft (available at the bottom of the output Conditions View). Since there are no obstacles to clear in the final segment, the gross final height of 2000 ft is optional in this example.

NOTE:

- In some situations, the selected gross LOH may result in a net LOH which does not clear all the obstacles. The input gross LOH is then increased such that the net LOH clears all obstacles by 35 ft. The gross LOH must be at least 400 ft but cannot exceed the Maximum LOH determined from the Maximum LOH calculator.
- If the net trajectory cannot clear an obstacle by 35 ft during the second segment, then the takeoff weight input must be reduced. When the allowable runway length is not limiting takeoff weight, the V_1/V_R ratio may also be increased to improve obstacle clearance.
- The CAFM Graphical Result View is useful to visualize the net flight path trajectory and to verify obstacle clearance. The CAFM Graphical Result View is activated through the View menu on the main menu bar.

E. RESULT TAKEOFF WEIGHT AND SPEEDS

The takeoff weight is limited to 38400 lb by the 6770 ft runway length (OEI Takeoff distance is limiting).

Takeoff Weight: 38400 lb

Takeoff speeds (KIAS rounded–up): V_1 127, V_R 127, V_2 130, V_{FTO} 158

Level–off at 5683 ft pressure altitude.

TAKEOFF

CASE 2: DETERMINE THE MAXIMUM ALLOWABLE TAKEOFF WEIGHT (CLEARWAY CREDIT)

In this case, the maximum allowable takeoff weight is still the lowest of the different takeoff weight limitations. However, clearway credit will now be accounted for in the Full Takeoff Module calculation.

A. TAKEOFF WEIGHT LIMITED BY CLIMB REQUIREMENTS MODULE

Clearway credit does not change the result obtained in Case 1. The weight limit is 43215 lb and is above MTOW (not limiting).

B. TAKEOFF WEIGHT LIMITED BY TIRE SPEED MODULE

Clearway credit does not change the result obtained in Case 1. The weight limit is still 51156 lb and is above MTOW (not limiting).

C. FULL TAKEOFF MODULE

Clearway credit will now be accounted for as follows:

- The TOFL is now the greatest of the OEI TOR, the AEO TOR and the ASD.
- The TOD must be less than the available runway length (6770 ft) plus clearway (400 ft) = 7170 ft.
- The ASD cannot exceed the runway length (clearways do not apply for ASD).

As for case 1, the optimal takeoff weight is found with a multiple run on weight. Balanced V_1 is selected as the V_1 type since it provides the best runway performance. By refinement of the weight inputs, it is found that the optimal weight is now 39104 lb. The ASD is the most limiting distance and matches the available runway length (6770 ft). A clearway analysis of the OEI and AEO takeoff distances is required and is provided below.

Output data:

– OEI TOR: 5911 ft < 6770 ft

– OEI TOD: 7087 ft < 7170 ft

– AEO TOR: 5821 ft < 6770 ft

– AEO TOD: 6417 ft < 7170 ft

– ASD: 6770 ft = **Most Limiting Distance**

– V_1: 128.4 KIAS

– V_R: 128.4 KIAS

– V_1/V_R: 1.0 (used in the Takeoff Path calculator)

– V_2: 130.8 KIAS

– V_2/V_S: 1.155 (for information)

– V_{FTO}: 159.7 KIAS

– V_{1MCG}: 116.0 KIAS (not limiting V_1)

– V_{1MBE}: 162.8 KIAS (not limiting V_1).

Notes on warnings (Messages View):

See Case 1 for an explanation of the warning messages.

D. TAKEOFF PATH – FIXED LEVEL–OFF HEIGHT MODULE

This calculator is then used to verify the critical obstacle clearance for the new field length limited weight. The input takeoff weight is now 39104 lb with a corresponding V_1/V_R ratio of 1.0. Again, the output columns Net Distance and Net Height are used to verify that the critical obstacle is cleared by a minimum of 35 ft. The net flight path trajectory shows that the obstacle will be cleared by exactly 35 ft at the beginning of the LOH horizontal segment. At the obstacle 49210 ft net distance, the net height is 1163 ft giving an obstacle clearance of 1163 – 1128 = 35 ft. Therefore, obstacle clearance is limiting takeoff weight in this example. The required pressure altitude at LOH is unchanged at 5683 ft.

E. RESULT TAKEOFF WEIGHT AND SPEEDS

The clearway credit gives an increase in takeoff weight from 38400 lb to 39104 lb. The additional clearway analysis required provides a takeoff weight benefit. The takeoff weight is limited by both the runway length of 6770 ft (Accelerate–Stop distance) and by the critical obstacle minimum clearance of 35 ft (net flight path).

Takeoff Weight: 39104 lb

Takeoff speeds (KIAS rounded–up): V_1 128, V_R 128, V_2 131, V_{FTO} 160

Level–off at 5683 ft pressure altitude.

TAKEOFF

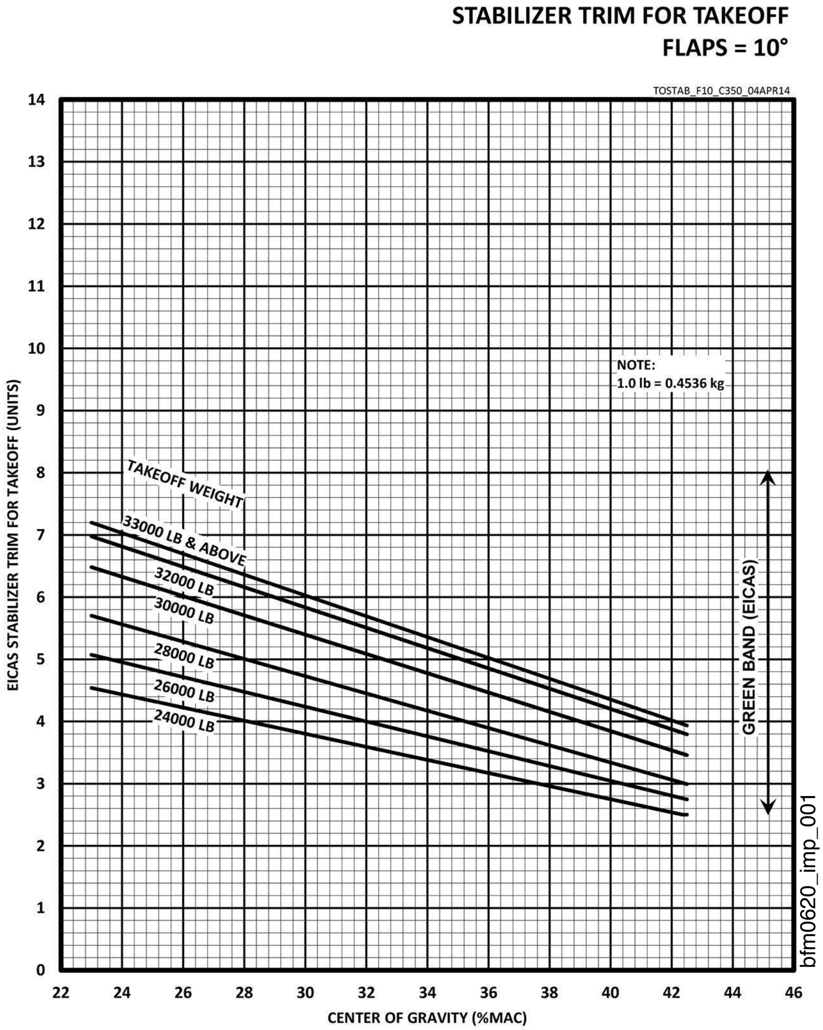


Figure 06–20–1

TAKEOFF

STABILIZER TRIM FOR TAKEOFF
FLAPS = 20°

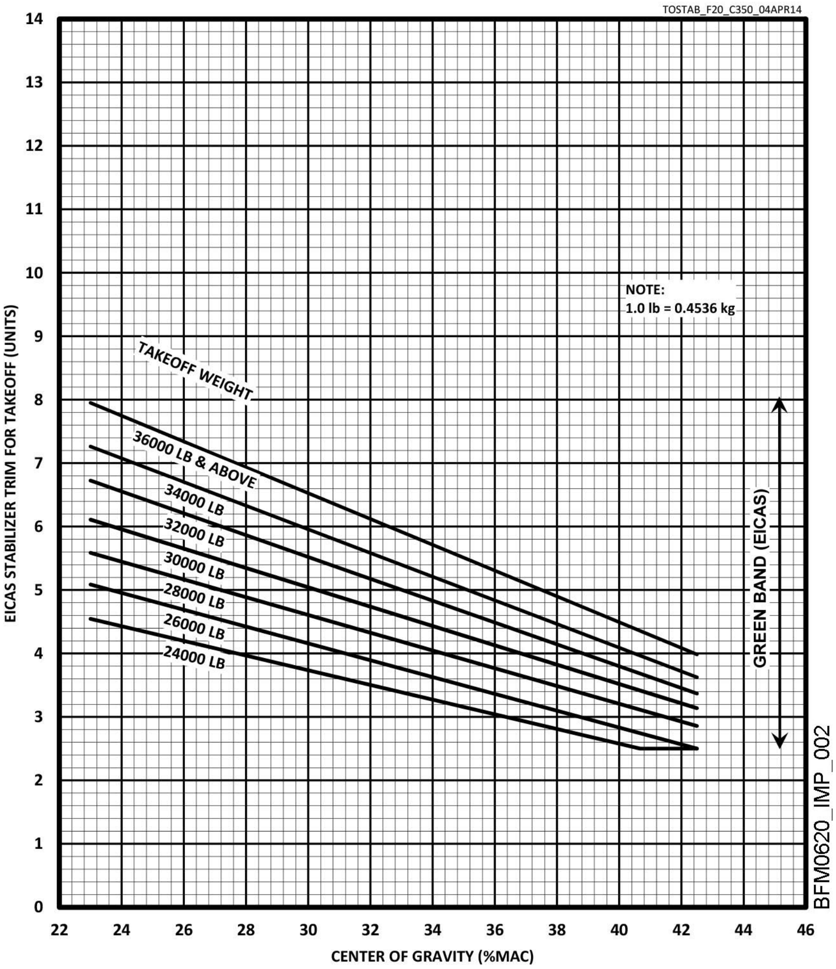


Figure 06–20–2

TAKEOFF

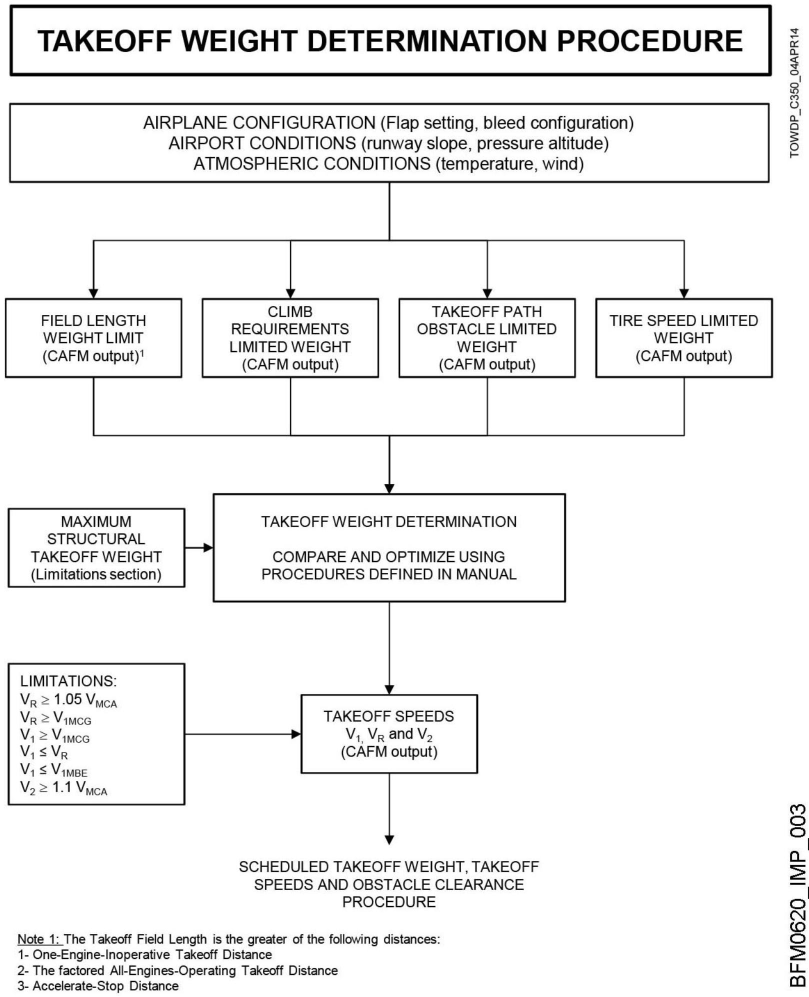


Figure 06–20–3

THIS PAGE INTENTIONALLY LEFT BLANK

TAKEOFF

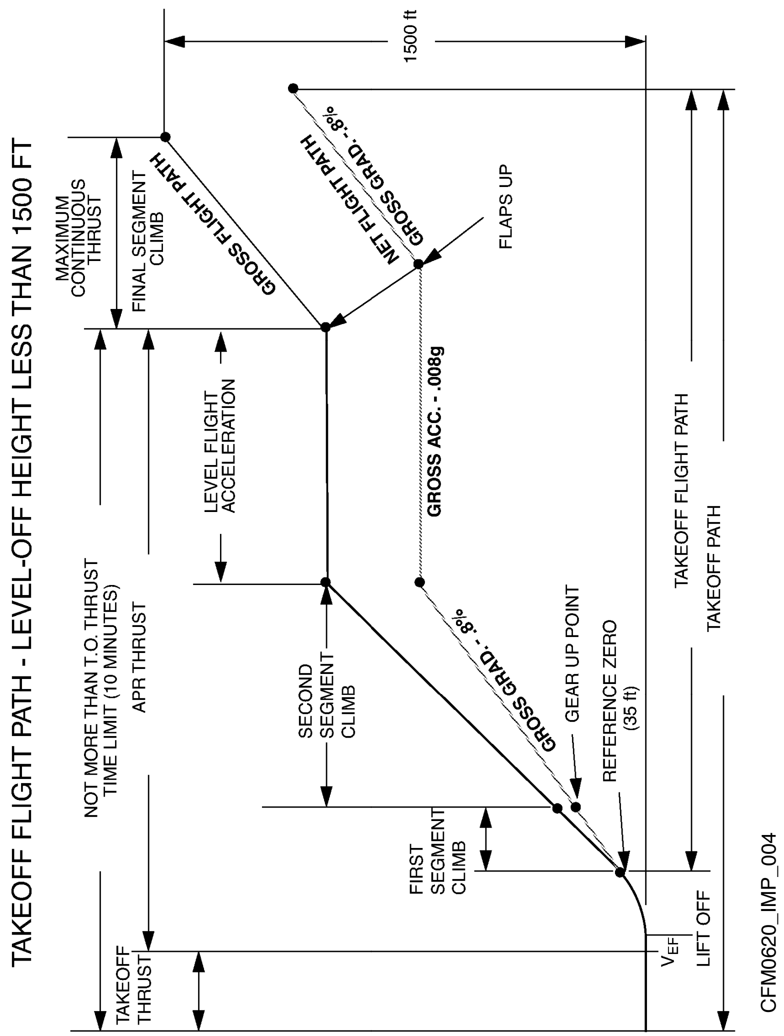


Figure 06–20–4 (Sheet 1 of 2)

TAKEOFF

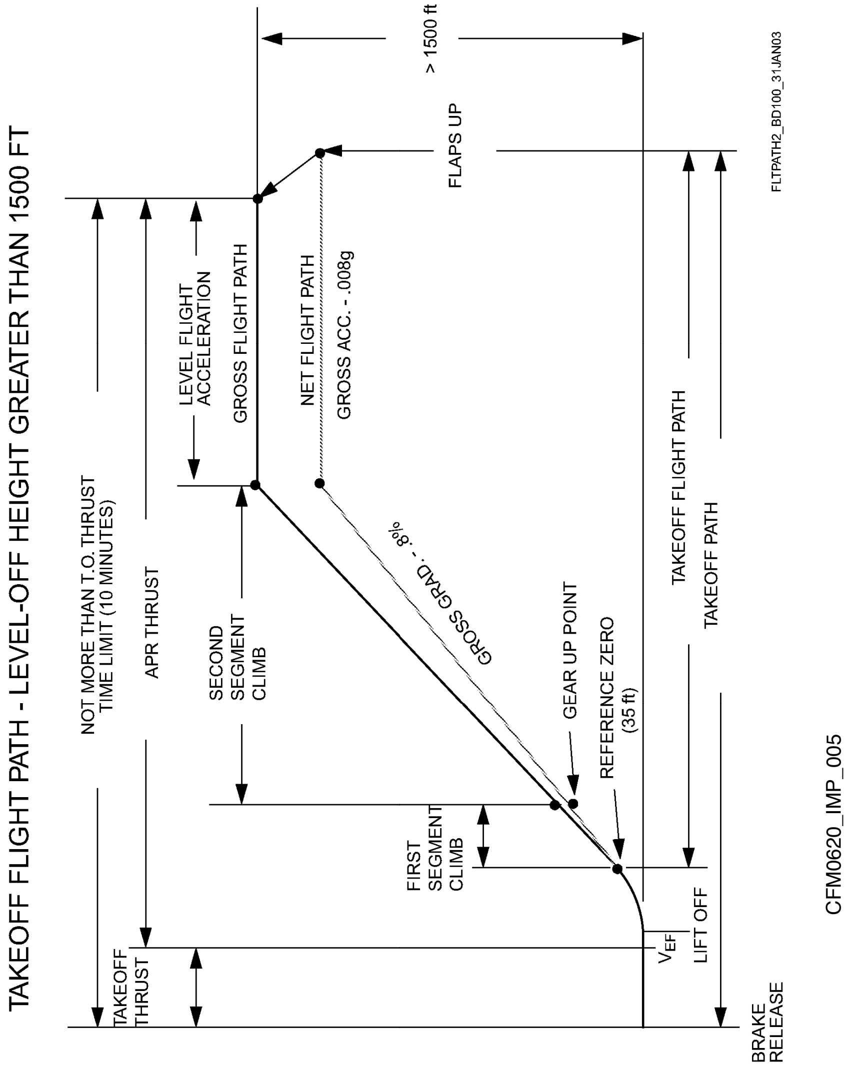


Figure 06–20–4 (Sheet 2 of 2)

THIS PAGE INTENTIONALLY LEFT BLANK

EN ROUTE

USE OF EN ROUTE DATA

The CAFM En Route Performance Module is used to determine the single–engine net En Route climb gradient and net ceiling versus weight, as well as En Route climb speeds, at FLAPS 0, with the operating engine at maximum continuous thrust rating.

The net En Route climb gradients are based on the following assumptions:

1. One engine at maximum continuous thrust (CLB setting).
2. Flaps retracted and landing gear UP.
3. En Route climb speed schedule.

ENROUTE CLIMB GRADIENT AND NET CEILING

The net enroute climb gradient is calculated by reducing the gross enroute climb gradient by 1.1%. The CAFM calculator allows for the determination of wind effect (headwind or tailwind) on the climb gradient.

The net ceiling is determined for the specified weight input(s) by calculating the altitude at which a net enroute climb gradient of 0% is achieved. Wind is not accounted for in the calculations of the net ceiling.

ICE ACCRETION ON UNPROTECTED SURFACES

The CAFM provides correction of the climb gradient if ice accretion is suspected on unprotected surfaces. In this condition, the CAFM user shall set the Ice Accumul. toggle to Yes (Aircraft Data pane).

EN ROUTE

THIS PAGE INTENTIONALLY LEFT BLANK

APPROACH/LANDING

APPROACH AND LANDING

The Approach and Landing Performance Module of the CAFM provides for the following scenarios:

- Approach climb performance,
- Landing climb performance,
- Landing weight limited by climb requirements,
- Landing distance and speed.

The maximum allowable landing weight is limited by the most restrictive of the following:

- Maximum approved landing weight (structural limit for landing),
- Runway length available,
- Climb requirements,
- Brake energy (Quick Turnaround).

ICE ACCRETION ON UNPROTECTED SURFACES

The CAFM provides correction of the climb gradient if ice accretion is suspected on unprotected surfaces. In this condition, the CAFM user shall set the Ice Accumul. toggle to Yes (Aircraft Data pane).

APPROACH CLIMB PERFORMANCE

This scenario calculates the gross approach climb gradient and the approach climb speed (V_{2GA} [IAS]) for a specified airport pressure altitude and other associated conditions.

LANDING CLIMB PERFORMANCE

This scenario calculates the gross landing climb gradient and the landing climb speed (V_{REF} [IAS]) for a specified airport pressure altitude and other relevant conditions.

LANDING WEIGHT LIMITED BY CLIMB REQUIREMENTS

This scenario calculates the landing weight limited by climb requirements and the limiting segment (approach or landing).

LANDING DISTANCE AND SPEED

This scenario calculates the landing distance and V_{REF} speed. The landing distance is calculated for ISA temperature only and assumes no runway slope. The landing distance is calculated considering the following segments:

- Airborne distance from 50 ft height point to touchdown,
- Delay distance from touchdown to full braking configuration including de–rotation,
- Braking distance.

APPROACH/LANDING

LANDING WEIGHT LIMIT – BRAKE ENERGY

The weight limit based on brake energy is also referred to as the maximum permissible quick turn–around landing weight. It is the landing weight that will cause the brakes to reach maximum fusible plug energy levels.

NOTE: After landing at a weight exceeding the quick turn–around landing weight, a minimum waiting time of 40 minutes must be observed, followed by an inspection of the wheels, brakes, tires, and landing gear in accordance with the Airplane Maintenance Manual. After landing at a weight equal to or less than the quick turn–around landing weight, a brake cooling time, determined in accordance with the method described in TURN–AROUND TIME – COOLING OF WHEELS, BRAKES, AND TIRES in this chapter must be observed before takeoff.

The brake energy (quick turn–around) landing weight limit is determined using Figure 06–43–1, for the specified airport pressure altitude, ambient temperature, reported wind and runway gradient conditions.

ACTUAL LANDING DISTANCE

The Actual Landing Distances (ALD) presented in the CAFM are based on **minimum** landing distances determined in accordance with the Airworthiness requirements. The actual landing distance is measured from a point 50 feet above the end of the runway, with an airspeed of V_{REF} and Flaps 30°, until full stop on a smooth, dry, hard–surfaced runway. Actual landing distances are based on ISA temperature conditions and assume zero runway gradient.

The effect of reported wind (positive for headwind, negative for tailwind) is considered in the Atmospheric Data pane of the CAFM calculator.

FACTORED LANDING DISTANCE

The Factored Landing Distance (FLD) is also presented in the CAFM. The factored landing distance includes factors for operational rules which require use of 60% of the available runway on dry runway. It is provided as a function of airport pressure altitude and weight. Factored landing distance is used when required by applicable regulations.

The effect of reported wind (positive for headwind, negative for tailwind) is considered in the Atmospheric Data pane of the CAFM calculator.

LANDING ON WET RUNWAY

The Factored Landing Distance (FLD) is presented in the CAFM for landing on wet runways. Operational rules may require that for wet runway surfaces, the runway length available be at least 115% of the factored landing distance on dry runway.

LANDING ON CONTAMINATED RUNWAY

Refer to the CONTAMINATED RUNWAY DATA supplement.

APPROACH/LANDING DATA

LANDING PERFORMANCE EXAMPLE

The following example provides the recommended work flow to determine the maximum allowable landing weight and the corresponding landing speeds for typical runway conditions. The sequence used follows the landing weight determination procedure explained in the Approach and Landing section, this chapter.

CAFM INPUT CONDITIONS

The following data will be used as CAFM inputs:

Aircraft Data:

- Weight: calculator dependent (see below)
- Category II: No
- Engine Bleed: Engine Bleed On
- Ice Accumulation on Unprotected Surfaces: No

Runway Data:

- Runway Surface Condition: Dry and Wet
- Runway Slope: –1.5% (Negative for Downhill).

Atmospheric Data:

- Airport Pressure Altitude: 3600 ft
- Reported Wind: –10 kts (Negative for Tailwind)
- Airport Temperature (OAT): 30 °C.

MMEL/CDL

- CDL Index: Zero
- No MMEL item selected for calculation.

AIRPORT INFORMATION (DESIRED CAFM PERFORMANCE)

The following airport information will be used to determine the maximum allowable landing weight. This information cannot be entered in CAFM. Instead, the CAFM outputs will be used to verify if the desired performance is obtained or not.

- The available runway length is 7000 ft.

Question: Determine if a MLW landing is possible on the specified runway for both Dry and Wet runway conditions

APPROACH/LANDING DATA

1– LANDING DISTANCE AND SPEED MODULE

This module is used twice. First, a dry runway is selected and then, the runway condition is changed to wet. In both cases, the landing weight is set to the MLW condition (single weight input of 34150 lb). For both a dry and a wet runway, the outputs show that the Factored Landing Distances (FLD) are less than the available runway length of 7000 ft. It is therefore concluded that runway length is not limiting landing weight. It is noted that the dry Actual Landing Distance (ALD) cannot be used for this evaluation.

Output data:

- Dry ALD: 3480 ft (not applicable)
- Dry FLD: 5800 ft
- Wet FLD: 6670 ft
- V_{REF}: 125.4 KIAS.

NOTE: When available runway is less than the FLD, the landing weight must be reduced. The multiple run window may be used to generate a set of landing weight inputs, and the FLD output may then be used to determine at what weight is the runway length limiting.

2– LANDING WEIGHT LIMITED BY CLIMB REQUIREMENTS MODULE

Open this CAFM module to determine the landing weight limited by climb requirements (no weight input in this module). For the specified conditions, the weight limit is of 50329 lb and is above MLW. The limiting segment is the approach climb segment (segment 4, shown by a (4) in the second output column).

3– BRAKE ENERGY LANDING WEIGHT LIMIT (QUICK TURN–AROUND)

In this case, Fig. 06–43–1 must be used. For the specified conditions of altitude, temperature, reported wind and runway slope, the quick turn–around landing weight limit is 36800 lb and is not considered limiting.

NOTE: In this case, the altitude/temperature point is outside of the chart. Conservatively, a weight limit of 42000 lb must be used before applying the tailwind and downhill runway gradient corrections.

4– APPROACH CLIMB PERFORMANCE MODULE

Open this CAFM module to determine the approach climb gradient. At MLW and for the specified conditions, the approach climb gradient is of 7.2% with an approach climb speed (V_{2GA}) of 131.2 KIAS. This is determined for information only as there are no specific approach climb gradient requirements in this example.

APPROACH/LANDING DATA

5– LANDING CLIMB PERFORMANCE MODULE

Open this CAFM module to determine the landing climb gradient. At MLW and for the specified conditions, a landing climb gradient of 17.1% is achieved at a landing climb speed (V_{LC}) of 125.4 KIAS. This is determined for information only as there are no specific landing climb gradient requirements in this example.

NOTE: The landing climb speed V_{LC} is identical to V_{REF} on the Challenger 350.

6– RESULT LANDING WEIGHT AND SPEED

The MLW condition is allowed for both dry and wet runway conditions as runway length is not limiting. The structural MLW limits the landing weight in this example.

Landing Weight: 34150 lb (MLW)

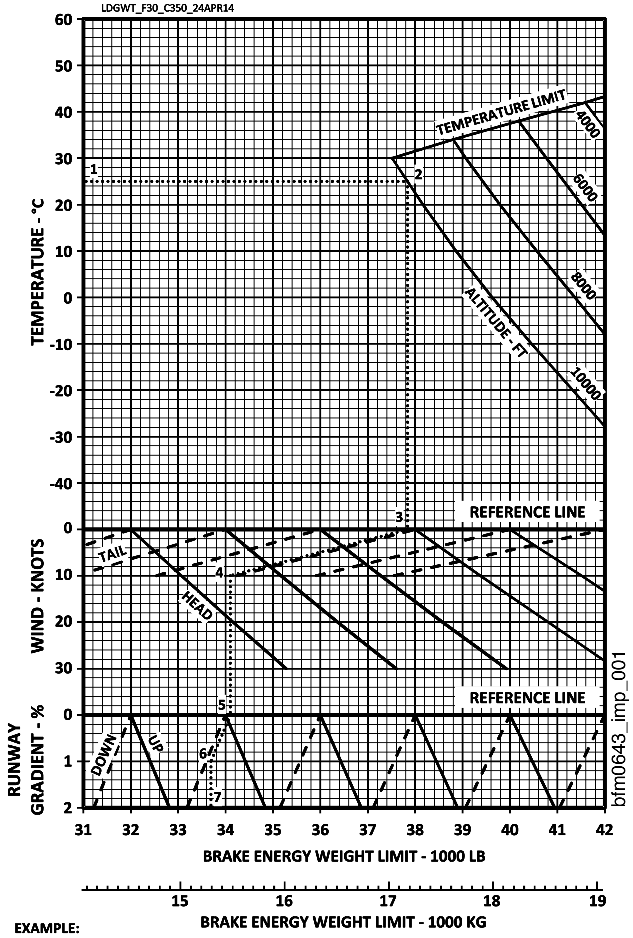
Landing speeds (KIAS rounded–up): V_{REF} 125, V_{2GA} 131.

Challenger 350

PERFORMANCE

APPROACH/LANDING DATA

MAXIMUM PERMISSIBLE QUICK TURN–AROUND LANDING WEIGHT



EXAMPLE:
1. Temperature..25°C
2. Altitude...10 000 ft
3. Wind Reference Line
4. Tailwind..10 kt
5. Gradient Reference Line
6. Runway Gradient.......................................1.0% DN
7. Brake Energy Weight Limit .... 33 692 lb (15 283 kg)

Figure 06–43–1

RUNWAY OVERRUN ALERTING AND AWARENESS SYSTEM (ROAAS)

If installed, ROAAS landing performance modelling applies RCC 6 and RCC 5, using cockpit switch selection, based on the following table.

RUNWAY CONDITION CODE (RCC)	RUNWAY SURFACE DESCRIPTION CONDITION	PILOT–REPORTED BRAKING ACTION
6	DRY	–
5	• Frost • Wet (includes damp and 1/8in (3mm) depth or less of water) 1/8in (3mm) depth or less of: • Slush • Dry snow • Wet snow	Good

THIS PAGE INTENTIONALLY LEFT BLANK

TURN–AROUND TIME

COOLING OF WHEELS, BRAKES, AND TIRES CHARTS

The charts on the following pages present performance data that allows determination of the brake cooling time. Landing Brake Energy, Rejected Takeoff (RTO) Brake Energy (Flaps 10° and Flaps 20°), and Main Wheel Brake Cooling Time Charts are provided.

Landing and RTO Brake Energy Charts present brake energies for a range of weight and braking speeds or V_1 speeds, with corrections for altitude, temperature, runway gradient, and wind.

Main Wheel Brake Cooling Time Charts present Brake Cooling Times to be observed between a landing or a low energy RTO and a subsequent takeoff.

DETERMINATION OF MAIN WHEEL BRAKE COOLING TIME

Brake Cooling Times are obtained from the applicable Main Wheel Brake Cooling Time Charts, using the landing or RTO brake energy and the required RTO brake energy for the subsequent takeoff.

Brake Cooling Times derived from the Main Wheel Brake Cooling Time Charts must be observed to ensure that brake energy limits are not exceeded during the next takeoff or in the event that the next takeoff is rejected.

The brake cooling times provided in the Main Wheel Brake Cooling Time Charts apply only to single landing/takeoff turn–around.

It is assumed that the airplane is operated in the approved takeoff or landing configuration.

When brake cooling time is desired, the following procedure may be used:

1. Determine the brake energy for specified airplane associated conditions from the Landing or RTO Brake Energy Charts. The brake application indicated airspeed (KIAS) should be used.
2. Using the RTO (Flaps 10° and Flaps 20°) Brake Energy Chart, determine the required RTO brake energy for specified airplane associated conditions. The V_1 speed appropriate for the takeoff conditions should be used.
3. Determine the Brake Cooling Time, using the resulting brake energies from step 1 and 2 in the appropriate Main Wheel Brake Cooling Time Chart.

REPEATED TURN–AROUND OPERATIONS

For repeated turn–around operations, such as multi–segment flights or crew training, additional in–flight cooling may be required to avoid progressive temperature build–up of heat in the wheels, brakes, and tires.

NOTE: In–flight cooling of the brakes is required during crew training with multiple takeoff and landings if braking is used on the ground segments of the flight. For multi–segment flights with intermediate flight times of less than one hour, in–flight cooling of the brakes is also required.

TURN–AROUND TIME

A ten minute in–flight cooling period with the landing gear extended prior to landing on the second and subsequent turn–around, will allow the turn–around times to be used on a repeated basis.

NOTE: In–flight cooling does not replace the ground cooling requirements specified in the Main Wheel Brake Cooling Time Chart, but is additional cooling required for multiple turn–around operations.

SYSTEM MALFUNCTION

If a brake malfunction occurs during landing or RTO, or a landing is conducted at reduced flap angles, the brake energy expended derived from the Brake Energy Charts (as appropriate) may be increased significantly.

A minimum brake cooling time of 45 minutes must be observed to ensure that the fuse plug limit has not been exceeded. The system's defect must be rectified prior to the next flight, and the gear assembly, wheels, brakes and tires visually inspected for damage.

FUSE PLUG RELEASE

If a fuse plug releases, the affected landing gear, wheels, brakes, tires, and the wheel speed sensors must be inspected in accordance with the procedures outlined in the Airplane Maintenance Manual, CH350 AMM, and any damage rectified before the next flight.

LANDING BRAKE ENERGY EXAMPLE

This section presents an example of how the Landing Brake Energy Chart is used in determining Landing Brake Energy. The braking speed equal to the indicated airspeed (KIAS) at the time the wheel brakes were first applied must be used.

Associated Conditions:

Aircraft weight	=	33,250 lb (15,082 kg)
Braking speed	=	121 KIAS
Airport altitude	=	4,000 ft
Ambient temperature	=	10 °C
Runway gradient	=	+2%
Reported wind	=	10 knots (headwind)

The Landing Brake Energy chart (Fig. Fig. 06–50–3) shows a brake energy of 19.6 X 10^6 ft.lb.

RTO BRAKE ENERGY EXAMPLE

This section presents an example of how the RTO Brake Energy Charts are used in determining Rejected Takeoff Brake Energy.

The required RTO Brake Energy for the subsequent takeoff is determined from the applicable Brake Energy RTO Chart (Flaps 10° or Flaps 20°), using the V_1 speed appropriate for the takeoff conditions.

TURN–AROUND TIME

The applicable Brake Energy RTO Chart (Flaps 10° or Flaps 20°) can also be used to determine the brake energy absorbed during a previous RTO. In this case, the indicated airspeed (KIAS) at the time the wheel brakes were first applied must be used instead of the V_1 speed.

Associated conditions:

Aircraft weight	=	33,250 lb (15,082 kg)
Flaps	=	20°
V_1 Speed	=	116 KIAS
Airport Altitude	=	4,000 ft
Ambient temperature	=	10 °C
Runway gradient	=	+2%
Reported Wind	=	10 knots (headwind)

The RTO Flaps 20° Brake Energy Chart (Fig. Fig. 06–50–2) shows a required RTO brake energy of 21.9 X 10^6 ft.lb.

MAIN WHEEL BRAKE COOLING TIME EXAMPLE

This section presents an example of how the Brake Cooling Time Charts are used in determining Brake Cooling Time.

Associated Conditions:

Landing Brake Energy	=	19.6 X 10^6 ft.lb
Required RTO Brake Energy	=	21.9 X 10^6 ft.lb

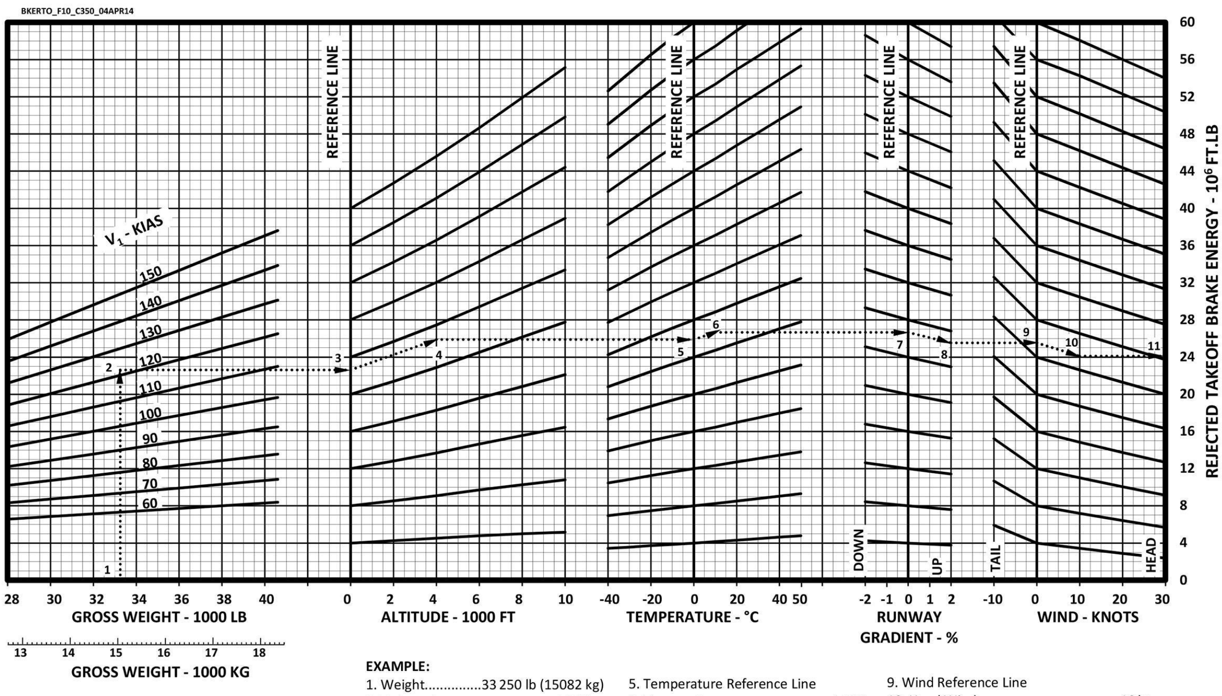
The Main Wheel Brake Cooling Time Chart (following a landing) (Fig. 06–50–4) shows a brake cooling time of four minutes.

TURN–AROUND TIME

THIS PAGE INTENTIONALLY LEFT BLANK

TURN–AROUND TIME

REJECTED TAKEOFF BRAKE ENERGY
FLAPS 10°



EXAMPLE:

1. Weight..............33 250 lb (15082 kg)
2. V_1 Speed...............................122 kias
3. Altitude Reference Line
4. Altitude................................4000 ft
5. Temperature Reference Line
6. Temperature............................10 °C
7. Runway Gradient Reference Line
8. Runway Gradient...................2% UP
9. Wind Reference Line
10. Head Wind.....................................10 kt
11. RTO Brake Energy...........24.1 X 10^6 ft.lb

BFM0650_IMP_001

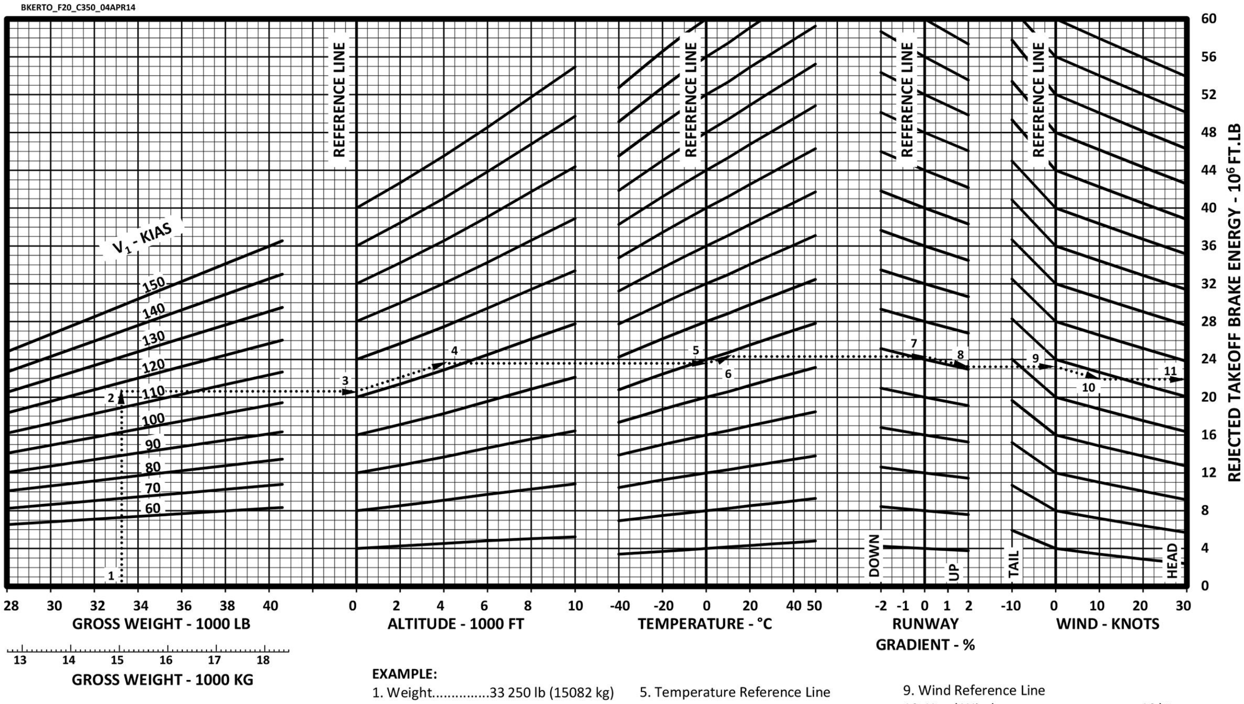
Figure 06–50–1

TURN–AROUND TIME

THIS PAGE INTENTIONALLY LEFT BLANK

TURN–AROUND TIME

REJECTED TAKEOFF BRAKE ENERGY
FLAPS 20°



EXAMPLE:

1. Weight...............33 250 lb (15082 kg)
2. V_1 Speed................................116 kias
3. Altitude Reference Line
4. Altitude................................4000 ft
5. Temperature Reference Line
6. Temperature............................10 °C
7. Runway Gradient Reference Line
8. Runway Gradient....................2% UP
9. Wind Reference Line
10. Head Wind......................................10 kt
11. RTO Brake Energy............21.9 X 10^6 ft.lb

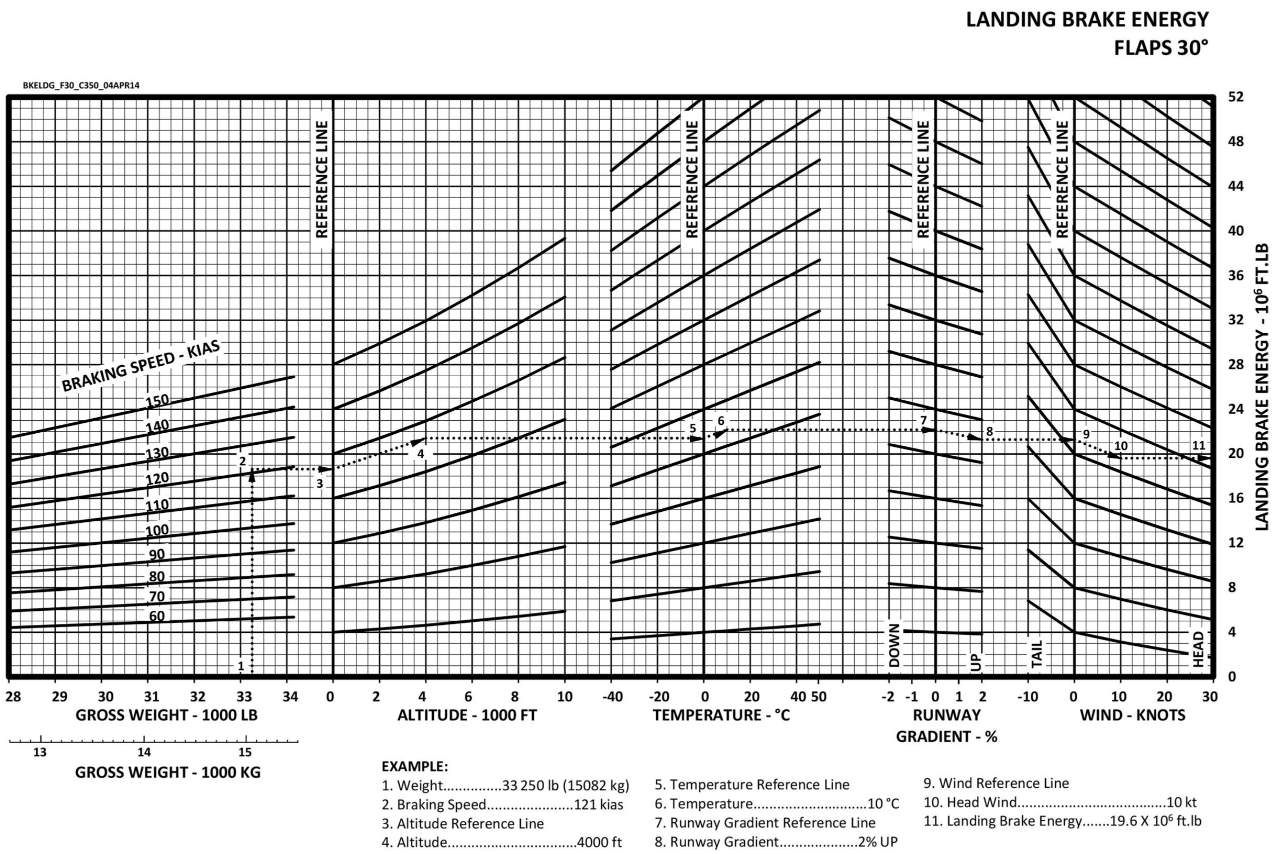
BFM0650_IMP_002

Figure 06–50–2

TURN–AROUND TIME

THIS PAGE INTENTIONALLY LEFT BLANK

TURN–AROUND TIME



BFM0650_IMP_003

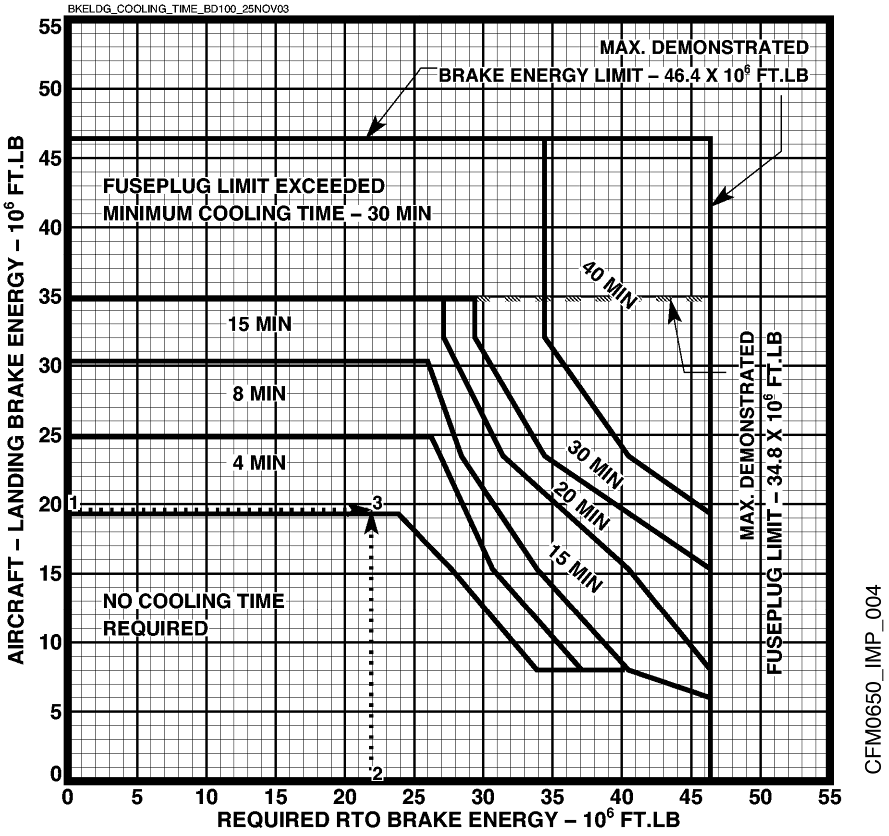
Figure 06–50–3

TURN–AROUND TIME

THIS PAGE INTENTIONALLY LEFT BLANK

TURN–AROUND TIME

MAIN WHEEL BRAKE COOLING TIME FOLLOWING A LANDING



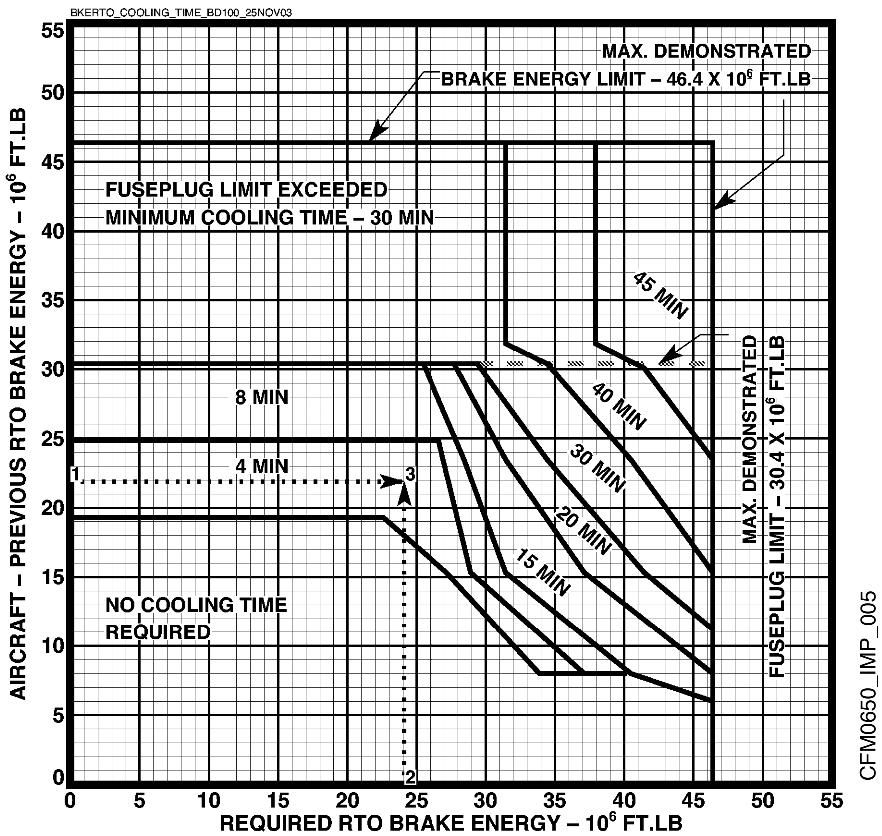
EXAMPLE:

1. Landing Brake Energy................ 19.6 X 10^6ft.lb
2. Required RTO Brake Energy...... 21.9 X 10^6ft.lb
3. Main Wheel Brake Cooling Time.............. 4 min.

Figure 06–50–4

TURN–AROUND TIME

MAIN WHEEL BRAKE COOLING TIME FOLLOWING AN RTO



EXAMPLE:

1. Previous RTO Brake Energy.......... 21.9 X 10^{6}ft.lb
2. Required RTO Brake Energy.......... 24.1 X 10^{6}ft.lb
3. Main Wheel Brake Cooling Time.................. 4 min.

Figure 06–50–5

This page intentionally left blank

This page intentionally left blank