Bombardier

CHALLENGER 350



SUPPLEMENTAL MATERIAL

TRAINING MANUAL

CL-350



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LIST OF EFFECTIVE PAGES

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NOTE

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CL-350



CL-350 SUPPLEMENTAL MANUAL

AIRWORK & MANEUVERS 01

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AIRWORK and MANEUVERS

I. INTRODUCTION

The Challenger 350 is a remarkable aircraft; fast, capable, and sophisticated, and mastering its full envelope of performance is one of the most rewarding pursuits in professional aviation. This chapter presents the airwork and maneuvers required to demonstrate proficiency for ATP, Type Rating, and Part 135 practical tests as defined by the FAA Airman Certification Standards (ACS). But meeting the standard is only the beginning. Our goal extends beyond the checkride to building the kind of deep, intuitive command of the aircraft that defines truly skilled aviators.

From steep turns that demand precise coordination of pitch, power, and bank, to approach-to-stall maneuvers that sharpen your recognition of the aircraft's low-speed handling characteristics, each procedure in this section is designed to develop not just competence but confidence. Whether you are new to the Challenger 350 or returning for recurrent training, the work ahead offers an opportunity to hone your skills, refine your crew coordination, and deepen your understanding of an aircraft built for professional excellence. The standards are demanding; and that is precisely what makes achieving them so satisfying.

About the ROPAT

The Recommended Operational Procedures and Techniques (ROPAT) is a comprehensive guidance document developed by Bombardier to support safe and efficient operation of the Challenger 350. While the Airplane Flight Manual (AFM) establishes mandatory limitations and procedures, the ROPAT goes further—offering practical recommendations, preferred techniques, and operational insights refined through extensive flight testing and real-world experience. It covers the full spectrum of flight operations, from normal procedures and crew coordination to instrument approaches, non-normal situations, and training maneuvers.

The Challenger 350 is a sophisticated aircraft with highly integrated systems, and there are often multiple acceptable ways to accomplish a given task. The ROPAT identifies the preferred methods while highlighting where alternatives exist. Importantly, the ROPAT is not intended to replace your company's Standard Operating Procedures, nor does it supersede the AFM—if any conflict arises, the AFM always takes precedence. What the ROPAT provides is expert guidance grounded in sound airmanship, helping crews operate this remarkable aircraft with confidence, consistency, and professionalism.

Foundation for This Training Manual

The procedures, airspeeds, power settings, and techniques presented throughout this chapter are drawn directly from the ROPAT and adapted for training purposes. When you see a recommended entry speed for a maneuver, a target N1 setting, or a specific sequence for configuring the aircraft, that guidance traces back to Bombardier's published recommendations. We have organized and presented this material in a format designed to support both initial and recurrent training, but the underlying content reflects the manufacturer's expert knowledge of how the Challenger 350 performs and how it should be flown.

By grounding our training in the ROPAT, we ensure that every pilot develops habits and techniques consistent with industry best practices and the manufacturer's intent. This alignment matters— not just for passing a checkride, but for building the kind of procedural discipline that keeps crews safe throughout their careers. As you work through the maneuvers and procedures in this chapter, know that you're learning techniques vetted by the engineers and test pilots who know this aircraft best.

Training Objectives

Our ground and flight training programs are designed to prepare you for the FAA type rating with an emphasis on four key areas: aircraft systems knowledge, crew coordination, operational utility, and overall flight safety. You will be held to ATP type rating standards throughout your training— the same standards you'll demonstrate on your checkride.

The table below summarizes the practical test standards for each phase of flight. These tolerances aren't just numbers to memorize for the exam—they represent the precision expected of professional pilots operating high-performance aircraft. As you train, you'll find that consistently flying within these standards becomes second nature, a reflection of the disciplined technique that defines competent crew operations.

For the complete and most current Airman Certification Standards, visit:
www.faa.gov/training_testing/testing/acs

ATP Practical Test Standards

Task	Airspeed	Heading / Course / Glidepath	Altitude
DEPARTURE			
Takeoffs	± 5 kts	± 5°	—
ENROUTE			
Inflight Maneuvers	± 10 kts	± 10° / Bank: ± 5°	± 100 ft
ARRIVAL & APPROACH			
Arrival Procedures	± 10 kts	± 10°	± 100 ft
Approaches Prior to FAF	± 10 kts	± 5°	± 100 ft
Final Approach Segment (Precision)	± 5 kts	CDI: ⩽ ¼ scale deflection (vertical or lateral)	—
Final Approach Segment (Non-Precision)	± 5 kts	CDI: ⩽ ¼ scale deflection	MDA +50 / –0 ft
Circling Approach	± 5 kts	± 5°	+100 / –0 ft (until descending below MDA)
GO-AROUND & LANDING			
Go-Around / Missed Approach	± 5 kts	± 5°	± 100 ft (during procedure)
Landing	± 5 kts	Touchdown with runway centerline between main gear at aiming point markings: –250 / +500 ft	

II. AIRSPEEDS AND POWER SETTINGS

Example power settings for 34,000 lb airplane in ISA conditions. Training targets only.

Flight Phase	Airspeed	N1
TAKEOFF AND CLIMB		
Takeoff/Rotate	V_R	TO detent
Flaps 0 (from Flaps 10)	V_2 + 15	CLB detent
Flaps 0 (from Flaps 20)	V_2 + 25	CLB detent
Climb (Class D)	200 KIAS	CLB detent
NORMAL CLIMB		
3,000 - 10,000 ft	250 KIAS	CLB detent
10,000 - Cruise	250/0.75 to 250/310/0.82	CLB detent
CRUISE		
Below 10,000 ft (slow)	200 KIAS	~52%
Below 10,000 ft (fast)	250 KIAS	~59%
10,000 to FL250	250 KIAS	~70%
FL410 Normal Cruise	0.80 Mach	~84%
STEEP TURNS		
15,000 ft (45° Bank)	250 KIAS	~68%
SLOW FLIGHT		
Flaps 0° - Gear Up	1.23 V_S .8 AOA	~48%
Flaps 20° - Gear Up	1.23 V_S .8 AOA	~52%
Flaps 20° - Gear Down	1.23 V_S .8 AOA	~56%
Flaps 30° - Gear Down	V_{REF}	~59%
APPROACH TO STALLS		
Clean	-1 kt per second	IDLE
Takeoff and Approach	-1 kt per second	50% - 55%
Landing	-1 kt per second	50% - 55%
HOLDING		
14,000 ft and below (1 min legs)	180 KIAS	~50%
Above 14,000 ft (1.5 min legs)	200 KIAS	~59%

Example power settings for 34,000 lb airplane in ISA conditions. Training targets only.

Flight Phase	Airspeed	N1
APPROACHES		
Flaps 0° - Gear Up	200 - 180 KIAS	~51%
Flaps 10° - Gear Up	160 KIAS	~54%
Flaps 20° - Gear Down	140 KIAS	~62%
Flaps 30° - Gear Down	V_{REF}	~59%
DESCENT TO LANDING		
On Glideslope	V_{REF}	~46%
Level Flight - MDA	V_{REF}	~59%
Level Flight - Circling	V_{REF} + 10	~60%
LANDING		
Final for Landing	V_{REF} + 1/2 Gust (max 10)	As required
50 ft above Runway	V_{REF}	Idle

III. ROPAT RECOMMENDED COCKPIT CONFIGURATION

PFD Setup	PF	PM
Format	ROSE*/PPOS	ROSE*/PPOS
Nav Source	FMS 1	FMS 2
Pointers	AS REQ'D	AS REQ'D
Traffic (TCAS)	OVERLAY SELECTED	OVERLAY SELECTED
Terrain	SELECTED	SELECTED
Weather	NOT SELECTED	NOT SELECTED
Range	10 NM OR AS REQ'D	10 NM OR AS REQ'D

MFD Setup	PF	PM
Upper Window	EICAS	SUMMARY
Lower Window	PPOS	PPOS
MFD Data Windows	VNAV	ON
Pointers	AS REQ'D	AS REQ'D
Traffic (TCAS)	OVERLAY SELECTED	OVERLAY SELECTED
Terrain	NOT SELECTED	NOT SELECTED
Weather	SELECTED	SELECTED

FMS Setup	PF	PM
FMS Page	LEGS PAGE	TUNE PAGE

* means preferred

For departures typically the speed bug is set to 200kts based on the 3-2-1 rule of controlled airspace:

- 3 = within 3000'
- 2 = maximum 200 kts
- 1 = within 10 nm of an airport

IV. CHAPTER OVERVIEW

This chapter introduces the core airwork and maneuvers that form the foundation of your training in the Bombardier Challenger 350. These maneuvers are more than training events—they are your first opportunities to experience the aircraft's performance, handling qualities, and design philosophy. Each maneuver is presented with a concise description, step-by-step execution guidance, and the standardized crew callouts and actions used in the cockpit. All procedures follow Bombardier's Recommended Operating Procedures and Techniques (ROPAT). Developing a strong understanding of the proper sequence of events and callouts will build confidence, sharpen crew coordination, and allow you to fully appreciate the precision and capability of the Challenger 350.

AIRWORK MANEUVERS

V. APPROACH TO STALL

A. INTRODUCTION

This section provides comprehensive guidance on approach to stall recognition, prevention, and recovery procedures. In addition to evaluating normal operational skills, certain training and testing maneuvers are required to pass ATP, Type Rating, and Part 135 practical tests. The following sections focus on maneuvers required by the FAA Airman Certification Standards (ACS) and industry best practices for stall awareness and recovery.

With smooth technique, the pilot can easily control the aircraft flight path and rate of change in speed during the maneuver entry and recovery from the stall warning regime. Recovery is normally initiated at the first indication of low speed or stall. Understanding the warning system indications and applying proper recovery techniques are essential skills for safe flight operations.

B. STALL WARNING INDICATIONS

The warning system provides multiple indications of an impending stall. Pilots must recognize and respond to these cues promptly. Warning indications include but are not limited to:

- Nose-high attitude
- Slow speed indication
- Rapidly decreasing speed trend vector
- Sloppiness or reduced effectiveness of flight controls
- Stick shaker activation
- Stick pusher activation
- Aural warnings

C. USE OF ANGLE OF ATTACK (AOA) INDICATORS

The AOA indicator and the “donut” displayed on the airspeed indicator are valuable tools in all phases of flight, particularly during stall recognition and recovery. An indication of 0.6 on the AOA indicator corresponds to approximately 1.3 times the stall speed reference. The stick shaker will typically activate at approximately 0.8 AOA, while a full aerodynamic stall occurs at 1.0 AOA, a condition to be avoided.

For training purposes, stall recognition is considered initiated at stick shaker activation. However, good airmanship requires pilots to maintain an active watch on aircraft performance to recognize the warning signs well before stick shaker activation. A stick shaker event indicates an impending stall, not an actual stall, but should still prompt immediate stall recovery procedures.

D. RECOVERY PHILOSOPHY

The AFM recovery procedures must be used in all stall recovery situations. Recovery should be maintained until the aircraft is above the minimum safe speed for the current configuration. Normally, the aircraft is recovered to 180 KIAS at the same altitude where the maneuver began.

IMPORTANT: While altitude loss is a consideration, it is not the primary focus during stall recovery. Reducing the angle of attack by reducing pitch attitude should be the pilot’s main goal, not maintaining an arbitrary cleared altitude. The emphasis must be on recovering the airplane from the stall, regardless of altitude loss. Maintaining a cleared altitude is irrelevant in stall recovery. However, this is not a license to lose an unreasonable amount of altitude, and principles of good airmanship always apply.

E. LOW ALTITUDE CONSIDERATIONS

At low altitude (past the FAF on approach), terrain proximity is a significant factor that must be considered. A proper balance between altitude loss and stall recovery technique must be exercised with sound judgment. A trade-off must occur between what is required versus what is acceptable and pilots should use all available margin when circumstances demand it.

F. TRAINING ENVIRONMENT AND CONDITIONS

Because training is conducted in a flight simulator, altitude and cloud clearance requirements do not apply. Your instructor will determine the maneuver conditions based on training needs. For example, landing configuration stall demonstrations may be conducted at the MDA, and departure configuration stalls may be conducted immediately after takeoff.

G. AIRMAN CERTIFICATION STANDARDS (ACS) REQUIREMENTS

Per AC 120-109A and current ACS guidance, the following requirements apply to stall prevention training:

- One stall must be induced while in a turn with a bank angle of 15-30 degrees
- One stall should be induced with the autopilot engaged
- An impending stall means the same as the first indication of a stall, occurring when angle of attack causes a stall warning from inherent aerodynamics (buffet) or an acceptable stall warning device (stick shaker)
- Evaluation criteria must not mandate a predetermined value for altitude loss and must not mandate maintaining altitude during recovery
- When accomplished in an FSTD, entries should be consistent with the expected operational environment with no minimum entry altitude defined

H. USE OF AUTOMATION

The autopilot and/or flight director/flight path vector (FPV) may be used on any of the approach-tostall maneuvers. If the autopilot is used, a distraction scenario may be employed to make the stall warning activation and aircraft recovery more realistic. The use of the flight director, FPV and autopilot remains at the discretion of the instructor or examiner based on the training objective.

A stall recovery maneuver used to demonstrate aircraft low-speed handling characteristics may be flown without the use of the flight director, FPV or autopilot. However, when demonstrating a stall recovery, allowing the autopilot to trim to the stall warning can be beneficial for understanding aircraft behavior. Throughout training, a pilot will experience stall recovery maneuvers both with and without aircraft automation.

I. PRE-MANEUVER SPEED CALCULATIONS

When training in a flight simulator or training device, stall warning speeds do not need to be calculated in advance. If conducting a departure-based stall recovery, V2 and flap retract speed should be posted on the airspeed tape. If conducting an approach-based stall recovery, VREF and VGA should be posted.

The following approach-to-stall profiles and recovery procedures are covered:

- Approach to Stall — Clean Configuration (Flaps 0)
- Approach to Stall — Takeoff or Approach Configuration (10°/20°)
- Approach to Stall — Landing Configuration

- Demonstration of the Stick Pusher
- High Altitude Stalls

These profiles are examples, and strict adherence to their choreography is not required as long as all three baseline profiles (clean, approach/takeoff, and landing) are performed. Proper recoveries per AFM procedures must be followed in all cases.

VI. AFM STALL RECOVERY PROCEDURE

The following procedure represents the AFM-approved stall recovery technique. This procedure must be executed at the first indication of an impending stall (stick shaker activation).

A. IMMEDIATE ACTION ITEMS

1. **Autopilot** — DISCONNECT
2. **Lower Pitch Attitude** — REDUCE AOA
3. **Thrust Levers** — APR (Automatic Power Reserve)
4. **Spoilers** — RETRACT
5. **Roll** — WINGS LEVEL (or reduce bank if necessary)

B. RECOVERY COMPLETION

After AOA Recovery:

- Verify stall warning cessation
- Return to desired flight path
- Adjust thrust as required
- Reconfigure aircraft as appropriate

C. KEY RECOVERY PRINCIPLES

STALL RECOVERY PRINCIPLES

Principle	Application
Reduce AOA	Primary recovery action — always first priority
Apply Max Thrust	APR for energy recovery and acceleration
Level Wings	Reduces load factor and aids recovery
Accept Altitude Loss	Recovery from stall takes priority over altitude
Avoid Secondary Stalls	Do not pull up prematurely

VII. APPROACH TO STALL — CLEAN (FLAPS 0°)

A. ENTRY PROCEDURE

Initial Setup:

- Establish level flight at entry altitude
- Stabilize at 180 KIAS / 65% N_1
- No V-speeds selected on airspeed tape

Maneuver Entry:

- Reduce thrust to idle
- Increase pitch to approximately 5° above horizon
- Maintain altitude until stall warning
- Allow aircraft to decelerate smoothly

B. RECOVERY PROCEDURE

1. **Autopilot** — DISCONNECT
2. **Lower Pitch Attitude** — REDUCE AOA
3. **Thrust Levers** — APR
4. **Roll** — WINGS LEVEL
5. **Recover to Level Flight** — 180 KIAS
6. **Reduce Thrust** — MAINTAIN 180 KIAS

C. CREW COORDINATION

APPROACH TO STALL - CLEAN CONFIGURATION

Entry: 180 KIAS, Flaps 0°, Gear UP. Reduce thrust to IDLE, maintain altitude until stick shaker.

PF (Pilot Flying)	PM (Pilot Monitoring)
At first indication of impending stall **Call:** "STALL, STALL, STALL"	**Call:** "STALL, STALL, STALL"
Action: Disconnect A/P, reduce AOA, set APR thrust, wings level	**Action:** Monitor recovery, airspeed trend **Call:** "Confirm APR THRUST" **Call:** "Airspeed increasing"
Recovery **Action:** Recover to 180 KIAS **Call:** "Recovered"	**Action:** Confirm normal flight parameters

VIII. APPROACH TO STALL — TAKEOFF/APPROACH (FLAPS 10°/20°)

A. ENTRY PROCEDURE

Initial Setup:

- Establish level flight at entry altitude
- Set V_2 on airspeed tape
- Configure flaps to 10° or 20°
- Landing gear UP

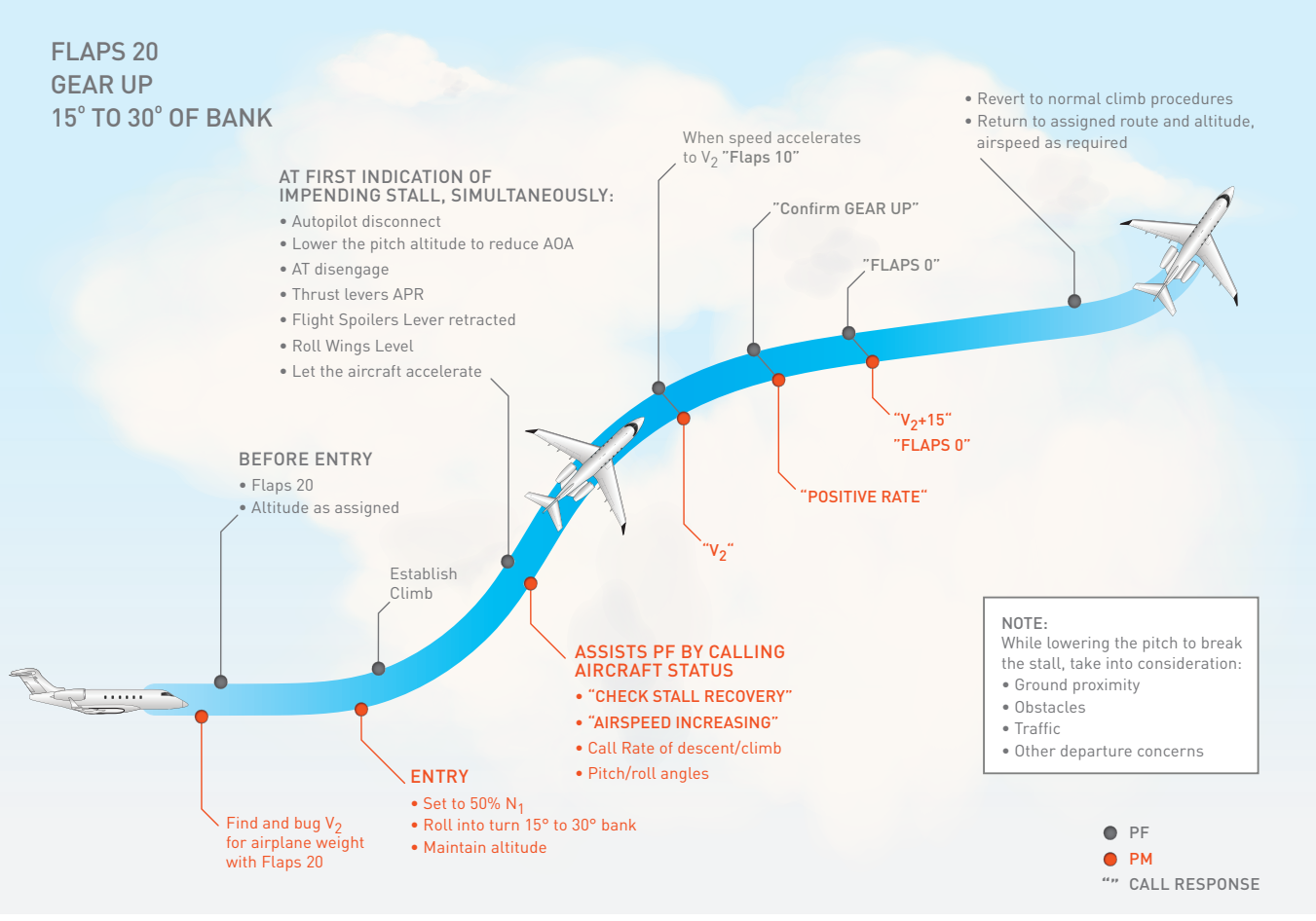
Maneuver Entry:

- Establish 15-30° bank turn (ACS requirement)
- Reduce thrust to idle
- Pitch to maintain altitude
- Allow deceleration to stall warning

B. RECOVERY PROCEDURE

1. **Autopilot** — DISCONNECT
2. **Lower Pitch Attitude** — REDUCE AOA
3. **Thrust Levers** — APR
4. **Roll** — WINGS LEVEL
5. **Flaps (above V_2)** — RETRACT TO 0°
6. **Recover to Level Flight** — 180 KIAS
7. **Reduce Thrust** — MAINTAIN 180 KIAS

APPROACH TO STALL - TAKEOFF CONFIGURATION



C. CREW COORDINATION

APPROACH TO STALL — TAKEOFF/APPROACH CONFIGURATION (FLAPS 10°/20°)

Entry: Establish level flight, V_2 on tape, Flaps 10° or 20°, Gear UP. 15-30° bank, 50-55% N1, maintain altitude, decelerate to stick shaker.

PF (Pilot Flying)	PM (Pilot Monitoring)
At First Indication of Impending Stall	
Call: "STALL, STALL, STALL"	**Call:** "STALL, STALL, STALL"
Action: Sets APR Thrust	**Action:** Assists PF by calling aircraft status: **Call:** "Confirm APR THRUST" **Call:** "CHECK STALL RECOVERY" **Call:** "AIRSPEED INCREASING" • Calls rate of climb or descent • Advises pitch/roll angles
	When Speed Accelerates to V2 **Call:** "V2"
Call: "Flaps 10"	
	Positive Rate of Climb **Call:** "POSITIVE RATE"
Call: "Confirm GEAR UP"	
	V2 + 15 **Call:** "V2 + 15"
Call: "Flaps 0"	
	Call: "Flaps 0" **Call:** "Indicating 0"
Recovery **Action:** Recover to 180 KIAS **Call:** "Recovered"	**Action:** Confirm normal flight parameters

CAUTION: Do not change A/C configuration below V_2. Flap retraction should only occur once accelerating above V_2 to prevent secondary stall.

IX. APPROACH TO STALL — LANDING CONFIGURATION

A. ENTRY PROCEDURE

Initial Setup:

- Establish level flight at entry altitude
- Set VREF and VGA on airspeed tape
- Configure flaps to FULL
- Landing gear DOWN

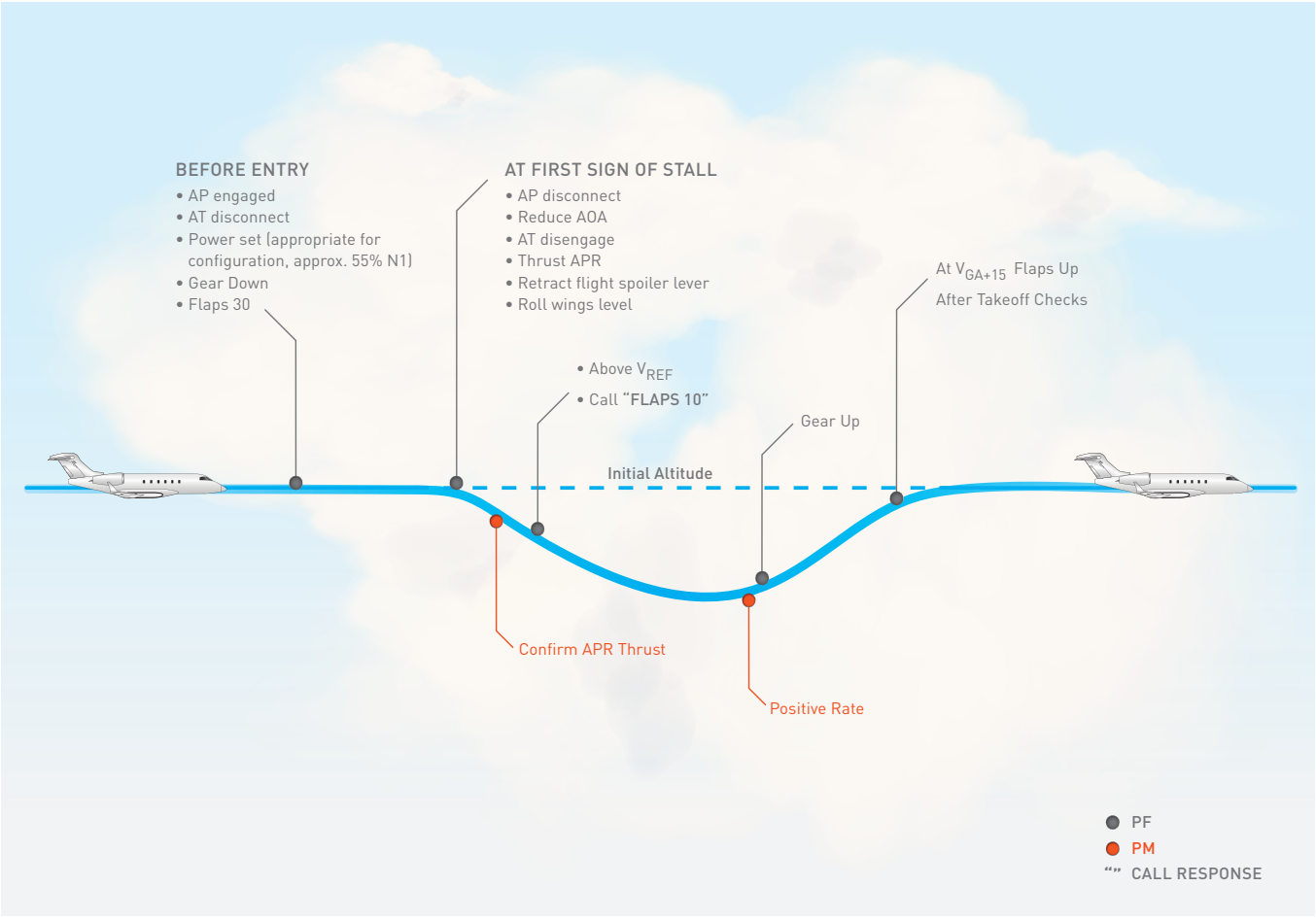
Maneuver Entry:

- Reduce thrust to idle
- Maintain altitude with increasing pitch
- Allow deceleration to stall warning

B. RECOVERY PROCEDURE

1. **Autopilot** — DISCONNECT
2. **Lower Pitch Attitude** — REDUCE AOA (on or below horizon)
3. **Thrust Levers** — APR
4. **Flaps** — 20° (at positive rate of climb)
5. **Landing Gear** — UP
6. **Complete Go-Around** — PER CHECKLIST

APPROACH TO STALL - LANDING CONFIGURATION



C. CREW COORDINATION

APPROACH TO STALL — LANDING CONFIGURATION

Before Entry: AP engage, Power set (appropriate for configuration, approx. 55% N1), Gear Down, Flaps 30

PF (Pilot Flying)	PM (Pilot Monitoring)
At First Indication of Impending Stall	
Call: "STALL, STALL, STALL"	Call: "STALL, STALL, STALL"
Action: A/P disconnect, Reduce AOA, AT disconnect, Thrust APR, Flight Spoiler Lever Retract, Roll Wings Level	**Action:** Monitor recovery
Above V_{REF}	Call: "Confirm APR Thrust"
Call: "Flaps 10"	Call: "Flaps 10"
	Call: "Indicating 10"
Call: "Gear up"	Call: "Positive rate"
	Call: "Gear up"
	Call: "Gear indicating up"
At V_{GA} + 15	
Call: "Flaps up, After Takeoff Checks"	Call: "Flaps up"
	Call: "Indicating up"
	Call: "After Takeoff Checks"
Recovery	
Action: Recover to 180 KIAS	
Call: "Recovered"	**Action:** Confirm normal flight parameters

NOTE: Think "Go-Around" procedure. This recovery mirrors a missed approach with stall recovery as the initial action. DO NOT use TO/GA.

X. DEMONSTRATION OF THE STICK PUSHER

WARNING: This maneuver is conducted in a flight simulator or training device ONLY. Stalls to pusher in the actual airplane are NOT authorized and are prohibited by AFM limitation.

A. PURPOSE

- Demonstrate operation of stick pusher system
- Familiarize pilot with pusher activation characteristics
- Teach proper technique for recovery from full pusher event

B. PUSHER ACTIVATION SEQUENCE

1. **Aircraft slows** — through low-speed warning cue
2. **Stick shaker** — activates
3. **Autopilot** — disconnects automatically
4. **Hand-fly** — while continuing to reduce speed
5. **Stick pusher** — activates
6. **Allow pusher** — to take yoke
7. **Pusher releases** — at normal AOA

C. CRITICAL RECOVERY TECHNIQUE

CRITICAL TECHNIQUE: Forward pressure MUST be maintained during initial stall recovery. The aircraft will tend to pitch nose-up and may cause secondary shaker and/or pusher activation. Then complete AFM stall recovery procedure as normal.

Key Points:

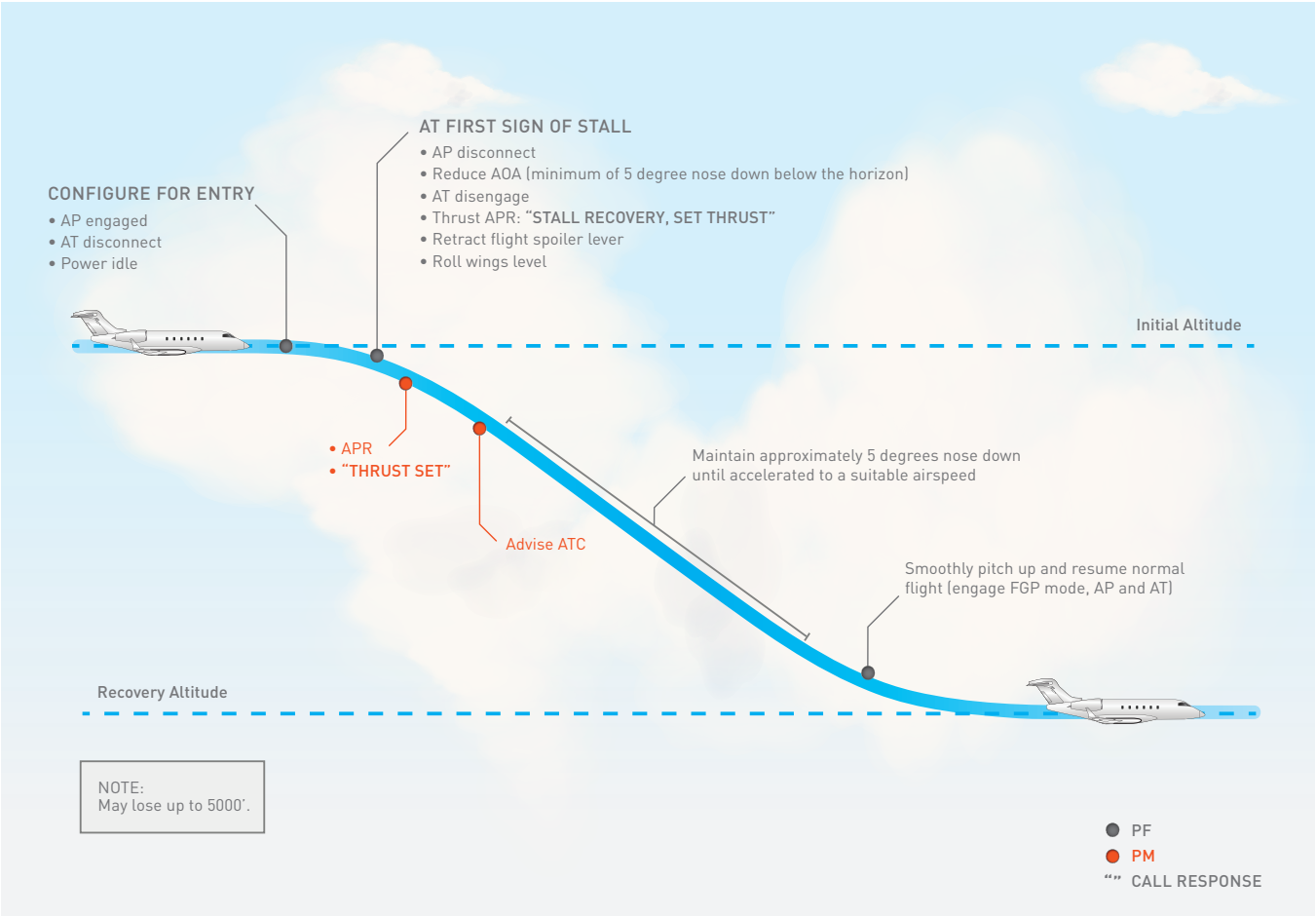
- Allow pusher to take yoke out of your hands
- Maintain forward pressure after pusher releases
- Exit low energy regime completely before resuming normal flight
- Do not attempt to arrest altitude loss prematurely

XI. HIGH ALTITUDE STALLS

A. RECOVERY PROCEDURE

1. **Autothrottle (if installed)** — DISENGAGE
2. **Autopilot** — DISCONNECT
3. **Lower Pitch Attitude** — TARGET -5° BELOW HORIZON
4. **Thrust Levers** — APR
5. **Spoilers** — RETRACT
6. **Roll** — WINGS LEVEL

APPROACH TO STALL - HIGH ALTITUDE



C. RECOVERY TARGETS

HIGH ALTITUDE STALL RECOVERY TARGETS

Parameter	Target
Pitch Attitude	-5° below horizon
Minimum Recovery Speed	0.72 Mach
Expected Altitude Loss	Up to 5,000 feet or more

CAUTION: Any recovery to level flight BEFORE 0.72M is attained can leave you on the wrong side of the power curve and may lead to secondary stalls. ATC and crew communications cannot be over-emphasized.

D. CREW COORDINATION

HIGH ALTITUDE STALLS

Setup: FL450, Cruise Flight, AP Engaged, Idle Thrust, allow deceleration to stick shaker

Key Differences: Less power available from engines at altitude. Exchange of altitude for speed required. Engine spool-up time and speed increase can be very slow from idle. Target pitch: -5° below horizon. Minimum recovery speed: 0.72 Mach. Expected altitude loss: Up to 5,000 feet or more.

PF (Pilot Flying)	PM (Pilot Monitoring)
Stall Recognition **Call:** "STALL RECOVERY, SET THRUST"	**Call:** "APR THRUST SET"
Action: Pitch to -5° below horizon	PM Responsibilities • Advise ATC of situation • Monitor performance parameters • Voice energy (speed) returning • Report altitude losses progressively until recovered

CAUTION: Any recovery to level flight BEFORE 0.72M is attained can leave you on the wrong side of the power curve and may lead to secondary stalls. ATC and crew communications cannot be over-emphasized.

STALL SUMMARY

STALL SUMMARY

Configuration	Key Points
Clean (Flaps 0°)	No V-speeds selected; simulates cruise/maneuvering stall; pitch to ~5° above horizon
Takeoff/Approach	Set V2; 15-30° bank required; do not change config below V2
Landing	Set VREF/VGA; think Go-Around procedure; pitch on or below horizon
Stick Pusher	Maintain forward pressure after release; avoid secondary activation
High Altitude	Pitch -5° below horizon; recover to 0.72M; expect ~5,000 ft loss

Universal Recovery Principles

- **Reduce AOA** — Always the primary recovery action
- **Apply Maximum Thrust** — APR for energy recovery
- **Level the Wings** — Reduces load factor
- **Accept Altitude Loss** — Stall recovery takes priority
- **Avoid Secondary Stalls** — Do not pull up prematurely

XII. STEEP TURNS

A. INTRODUCTION

The steep turn is a fundamental instrument maneuver that demonstrates precise aircraft control and coordination of pitch, power, and bank. This exercise tests the pilot's ability to maintain altitude, airspeed, and bank angle while executing a coordinated turn at high bank angles. The maneuver develops skills essential for maneuvering flight and enhances situational awareness of the aircraft's energy state and performance characteristics.

For this maneuver, the flight director and Flight Path Vector can be ON or OFF. Altitude and speed selection is at the discretion of the instructor/examiner. The normal maneuvering speed for this exercise is 250 KIAS at 15,000 feet. The maneuver is accomplished at 45° of bank, turning in both directions with heading changes of 180°. A constant speed and altitude is maintained throughout the maneuver.

B. SETUP

Initial Configuration:

- Altitude: 14,000 – 15,000 feet (or as assigned)
- Airspeed: Stabilize at 250 KIAS
- Configuration: Clean (Flaps 0°, Gear Up)
- Flight Director: OFF
- Autopilot: OFF
- Power: Approximately 66% N_1

C. ENTRY PROCEDURE

1. **Stabilize** — at assigned speed and altitude
2. **Note heading** — for rollout reference
3. **Begin roll** — smoothly into 45° bank
4. **Increase power** — approximately 2-4% N_1 as bank increases
5. **Increase back pressure** — to maintain altitude
6. **Trim** — as desired to reduce yoke pressure

D. MANEUVER EXECUTION

During the Turn:

- Maintain 45° bank angle (sky pointer on 45° triangle)
- Maintain entry altitude ±100 feet
- Maintain entry airspeed ±10 knots
- Keep the ball centered (coordinated flight)
- Cross-check instruments continuously

E. COURSE REVERSAL

At the 180° point, execute immediate reversal to the opposite direction:

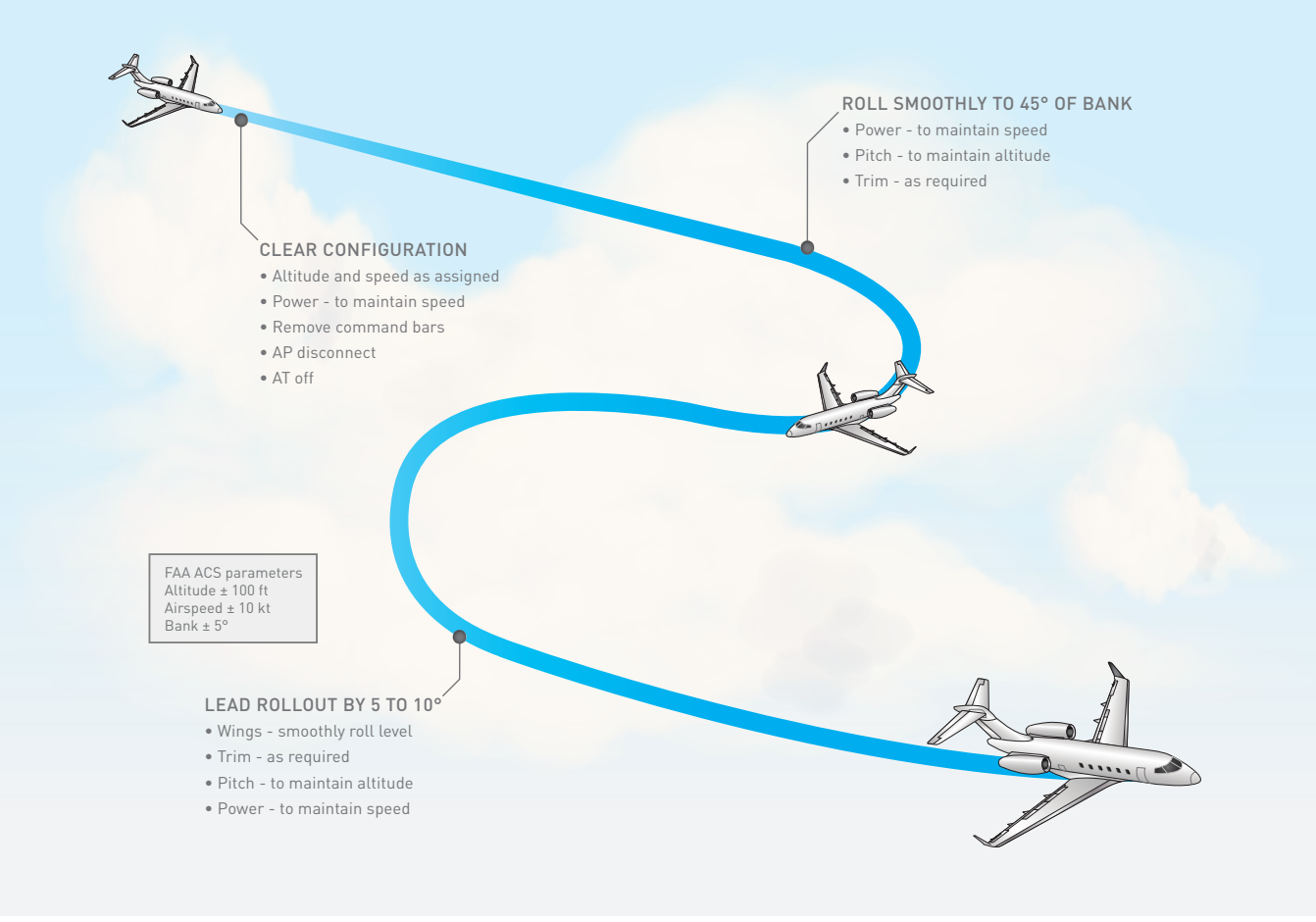
1. **Lead rollout** — approximately 10° prior to desired heading
2. **Roll through wings level** — immediately into opposite direction turn
3. **Adjust pitch down slightly** — to avoid ballooning during transition
4. **Bank to 45° AOB** — opposite direction (sky pointer on 45° triangle)
5. **Maintain altitude and airspeed** — throughout reversal

No pause is necessary or desired when changing the direction of turn. Very little trim correction is required when transitioning quickly from one direction to the other.

F. EXIT PROCEDURE

1. **Lead rollout** — 10-20° depending on roll rate
2. **Begin pitch reduction** — as you roll through ~30° AOB
3. **Reduce pitch** — approximately 2° (to ~0.5° nose up)
4. **Reduce power** — approximately 3% N1
5. **Level wings** — on original heading
6. **Select FD modes** — as appropriate
7. **Autopilot** — ON when stable

STEEP BANK TURNS



G. CREW COORDINATION

STEEP TURNS

Setup: Altitude: 15,000 feet. Airspeed: 250 KIAS. Configuration: Clean. FD: ON/OFF. FPV ON/OFF. Autopilot: OFF. Power: ~66% N1. Execute 45° bank turns, 180° in each direction with immediate reversal

PF (Pilot Flying)	PM (Pilot Monitoring)
Setup **Action:** Configure Flaps 0, Gear UP, 250 KIAS, note heading **Call:** "Steep turn left/right"	Silent — no callouts during maneuver
Entry **Action:** Roll smoothly to 45° bank, add back pressure and 2% power	—
Maintain **Action:** Trim as needed, scan attitude/altitude/bank	—
Rollout **Action:** Lead ~15° before heading, reduce back pressure/power, level wings	—

NOTE: PM remains silent during steep turn maneuvers. This is a single-pilot demonstration of aircraft control per the ACS.

H. COMPLETION STANDARDS

- Altitude: ±100 feet
- Airspeed: ±10 knots
- Bank angle: ±5° of 45°
- Heading: ±10° on rollout
- Coordinated flight throughout (ball centered)
- Smooth, continuous turn with immediate reversal

XIII. UNUSUAL ATTITUDE RECOVERY

A. INTRODUCTION

It is critical to maintain positive control of the aircraft by recognizing the airplane flight condition. During a sudden or unknown change to an unusual attitude, verify the aircraft attitude using all available indicators. Use these references to make the proper recovery.

Aircraft upsets and unusual attitudes can be caused by a number of factors including failure of attitude information, clear air turbulence, windshear, wake turbulence, engine failure, flight control problems, aircraft mishandling, or pilot inattention.

The first step in any upset recovery is to centralize the controls to avoid exacerbating the situation. Then conduct an expeditious analysis of the aircraft pitch attitude, angle of bank, current airspeed, airspeed trend, rate of descent, and altitude. Make use of primary flight and performance instruments (PFD) when analyzing the situation; however, should their reliability be in doubt, immediate reference must be made to the standby instruments.

B. RECOGNITION AND CONFIRMATION

Before conducting an unusual attitude recovery, confirm that an unusual attitude exists:

- Does the opposite PFD indicate an unusual attitude?
- Do airspeed and altitude changes confirm an unusual attitude?
- Are the standby instruments consistent with the PFD indications?

C. PFD UNUSUAL ATTITUDE INDICATIONS

Excessive Pitch Attitude Chevrons:

- Red chevrons appear at +23 degrees nose up
- Red chevrons appear at -13 degrees nose down
- Full chevrons visible at +27 degrees and -18 degrees

Display Declutter Mode Activation:

- Triggers at pitch >30° up or >20° down
- Triggers at roll angle >65 degrees
- Removes non-essential information
- Returns to normal at pitch ⩽25° up or ⩽15° down
- Returns to normal at roll angle ⩽60 degrees

D. NOSE HIGH RECOVERY

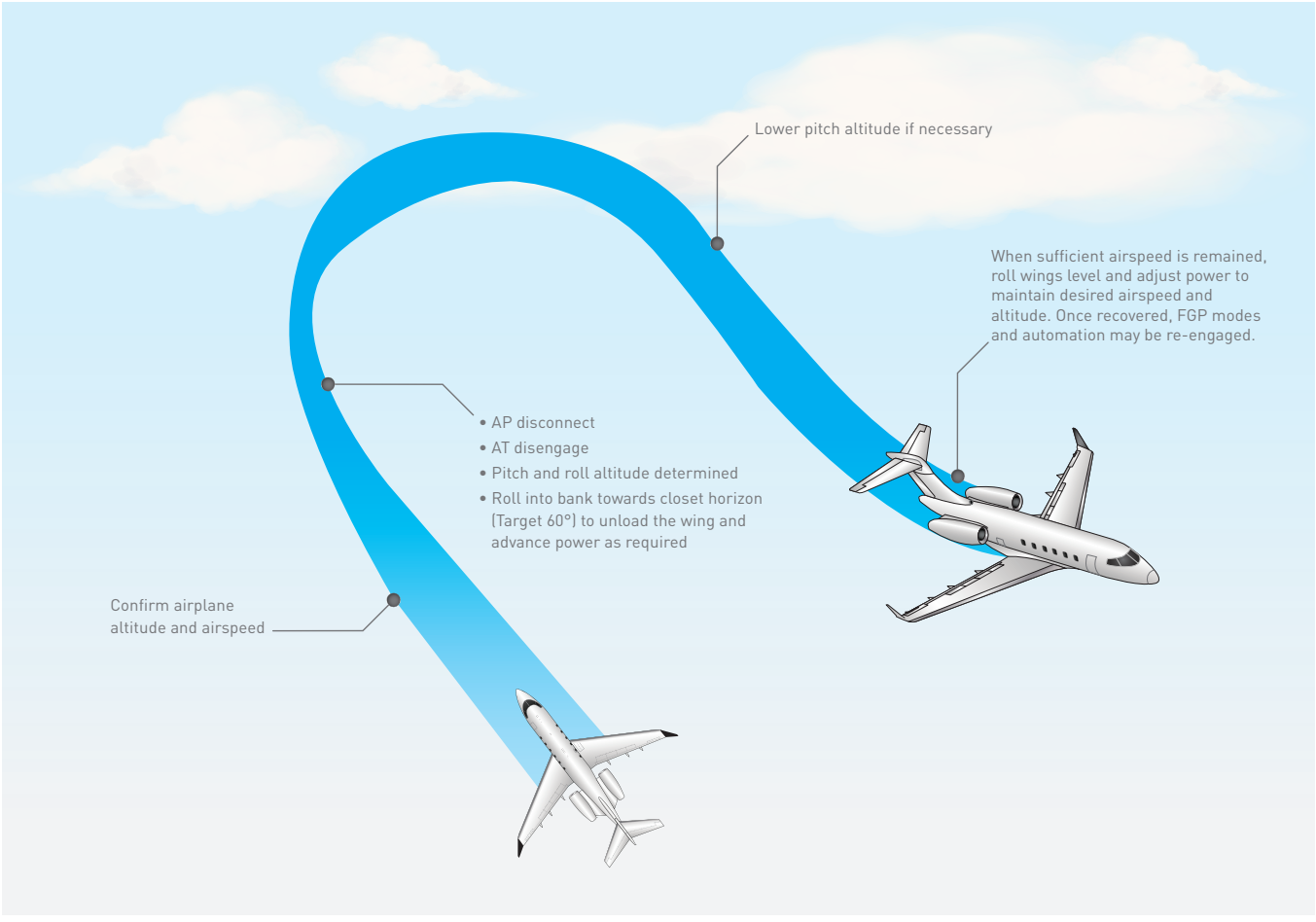
1. **Recognition Cues:**
    - Pitch attitude unusually high (above horizon)
    - Airspeed decreasing rapidly
    - Altitude increasing initially, then potentially decreasing
    - VSI showing climb, then descent
    - Red nose-up chevrons on PFD

2. **Recovery Procedure:**
    1. **Autopilot** — Disconnect
    2. **Throttles** — APR
    3. **Pitch Attitude** — Reduce

        Roll in the shortest direction towards the horizon. This aids in allowing the nose to come down. It is preferable not to exceed 60° bank.
    4. **Return to previous altitude** — As the nose approaches the horizon, level off while leveling the wings
    5. **Reduce power** — When a safe airspeed is attained

CAUTION: If normal pitch control and roll control is ineffective, careful rudder input in the direction of the desired roll may be required to induce a rolling maneuver for recovery. Only a small amount of rudder is needed. Too much rudder applied too quickly or held too long may result in loss of lateral and directional control. Because of the low energy condition, pilots should exercise caution when applying rudder.

UNUSUAL ATTITUDE RECOVERY - NOSE HIGH



3. **Crew Coordination:**

UNUSUAL ATTITUDE RECOVERY — NOSE HIGH

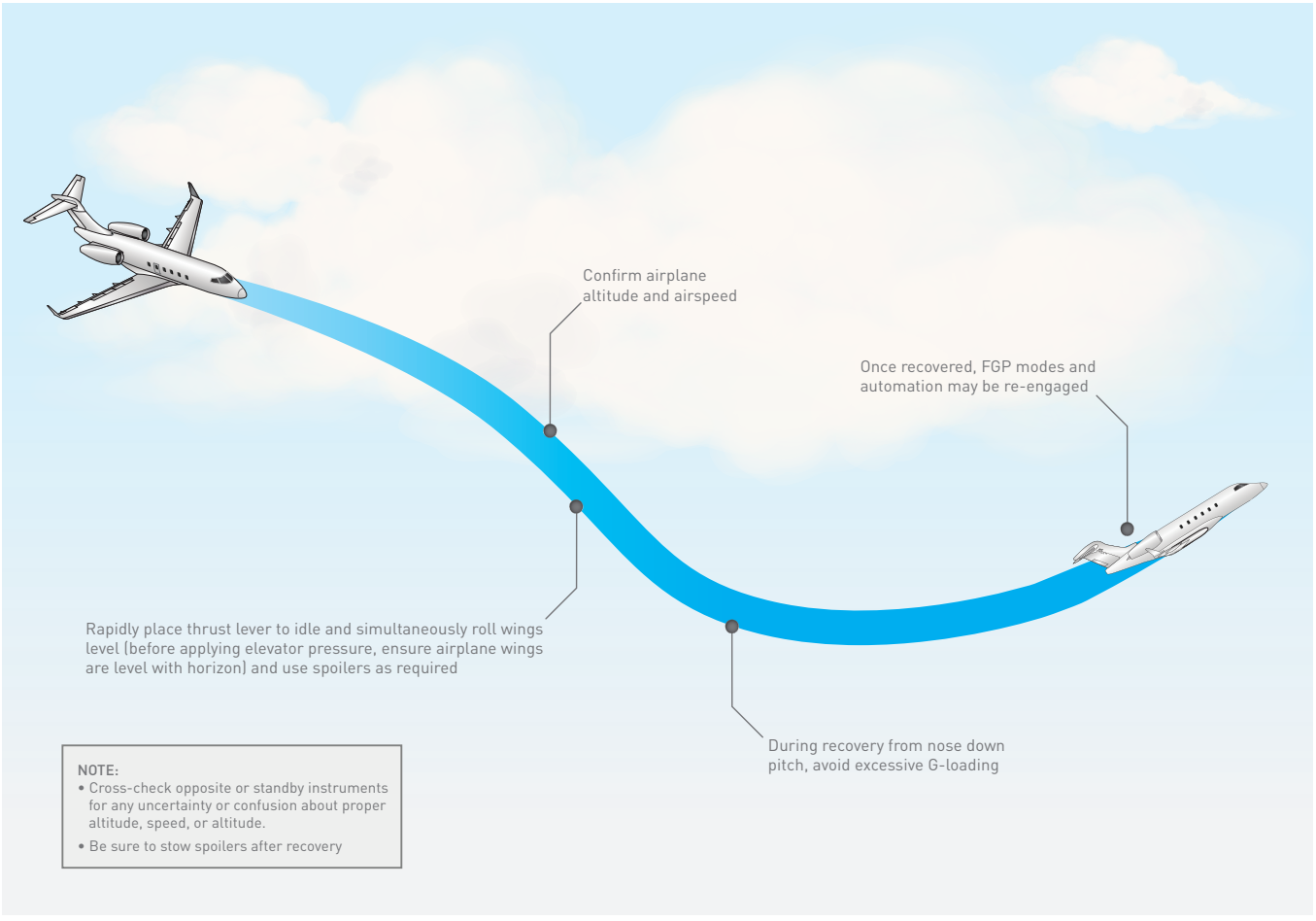
Recognition: Confirm unusual attitude exists by cross-checking both PFDs, verifying airspeed and altitude changes are consistent with the unusual attitude indication, and referencing standby instruments if reliability is in doubt.

PF (Pilot Flying)	PM (Pilot Monitoring)
Recognition	
Call: "UNUSUAL ATTITUDE "	**Call:** "UNUSUAL ATTITUDE"
Action: Takes control if not already flying	
Recovery	
Call: "Autopilot disconnect, setting thrust, reducing pitch"	**Action:** Confirms autopilot disconnect
Action: Roll into bank towards closest horizon (Target 60°) to unload wing and advance power as required.	**Action:** Monitors attitude, airspeed, altitude
	Call: Airspeed trend and altitude
Recovery Complete	
Call: "Recovered, level flight"	**Action:** Confirms normal parameters

E. NOSE LOW RECOVERY

1. **Recognition Cues:**
    - Pitch attitude unusually low (below horizon)
    - Airspeed increasing rapidly
    - Altitude decreasing
    - VSI showing high rate of descent
    - Red nose-down chevrons on PFD
2. **Recovery Procedure:**
    1. **Autopilot** — Disconnect
    2. **Throttles** — Idle
    3. **Roll** — Wings Level
    4. **Pitch Attitude** — Risse the nose to stop the descent and climb
    5. **Spoilers** — Extend as necessary to control airspeed
    6. **Return to previous altitude** — Add power and retract spoilers to maintain safe airspeed

UNUSUAL ATTITUDE RECOVERY - NOSE LOW



F. CREW COORDINATION

UNUSUAL ATTITUDE RECOVERY — NOSE LOW

Recognition: Confirm unusual attitude exists by cross-checking both PFDs, verifying airspeed and altitude changes are consistent with the unusual attitude indication, and referencing standby instruments if reliability is in doubt.

PF (Pilot Flying)	PM (Pilot Monitoring)
Recognition **Call:** "UNUSUAL ATTITUDE" **Action:** Takes control if not already flying	**Call:** "UNUSUAL ATTITUDE"
Recovery **Call:** "Autopilot disconnect, idle, rolling wings level" **Action:** Roll wings level FIRST, then raise nose	**Action:** Confirms autopilot disconnect **Action:** Monitors attitude, airspeed, altitude **Call:** Airspeed and descent rate
Recovery Complete **Call:** "Recovered, level flight"	**Action:** Confirms normal parameters

CAUTION: Level wings BEFORE raising the nose to prevent asymmetric G-loading.

G. COMPLETION STANDARDS

- Correct recognition of unusual attitude type
- Proper recovery technique applied
- Aircraft returned to controlled, level flight
- No excessive airspeed or G-loading during recovery
- Altitude and heading stabilized

XIV. NORMAL TAKEOFF

A. INTRODUCTION

The normal takeoff demonstrates the pilot's ability to safely transition the aircraft from the ground to initial climb while maintaining precise directional control, proper rotation technique, and appropriate climb profile. This procedure establishes the foundation for all departure operations and must be executed with consistency and precision.

B. TAKEOFF BRIEFING

A thorough takeoff briefing should be accomplished before requesting the Starting Engines checklist to avoid interfering with last-minute takeoff preparations. The briefing should include:

- Takeoff runway and SID
- SID details: altitude/speed restrictions, gradients
- Calculated takeoff distance vs. runway available
- Taxi plan and hotspots
- V-speeds: V1, VR, V2
- Engine failure procedures (before and after V1)
- Abort criteria
- Initial altitude and heading

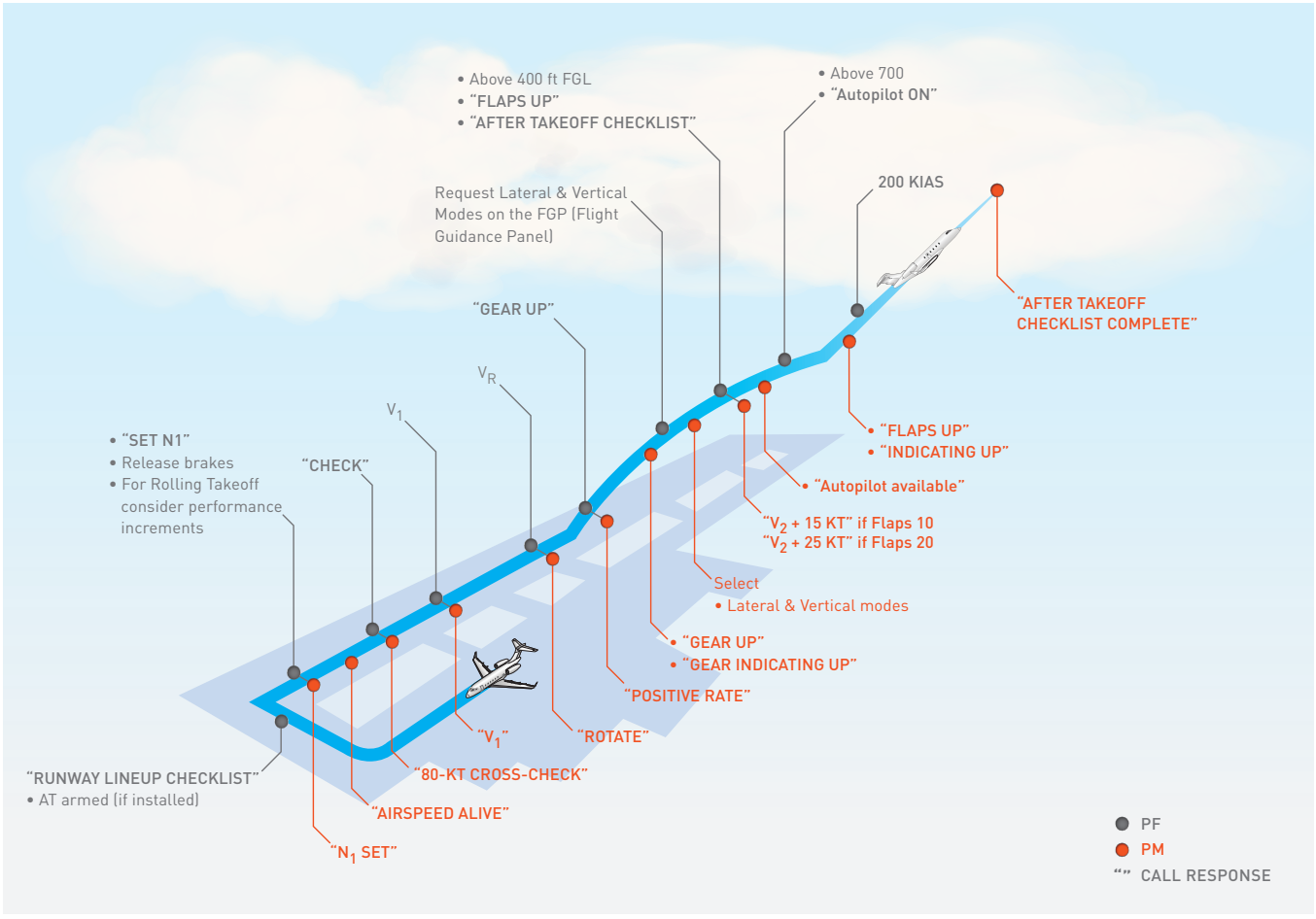
C. SETUP AND CONFIGURATION

- Before Takeoff checklist: COMPLETE
- Flaps: SET for takeoff (10° or 20° as briefed)
- Trim: SET
- V-speeds: POSTED on PFD
- Flight director: ON, takeoff mode
- Transponder: ON/ALT
- Lights: AS REQUIRED

D. TAKEOFF PROCEDURE

1. **Line up on centerline** — and verify heading
2. **Hold brakes** — and advance throttles to approximately 60% N1
3. **Verify engine instruments** — normal
4. **Release brakes** — and advance throttles to TAKEOFF detent
5. **Maintain centerline** — with rudder
6. **At VR** — smoothly rotate to approximately 10° pitch
7. **At positive rate** — call "GEAR UP"
8. **Maintain V2 + 15** — until acceleration altitude
9. **At V2 + 15** — call "FLAPS 0"
10. **Accelerate to climb speed** — 200 KIAS (Class D)
11. **Complete After Takeoff checklist**

NORMAL TAKEOFF



E. CREW COORDINATION

NORMAL TAKEOFF

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Runway Lineup checklist"	
	Action: Complete Runway Lineup checklist
	Call: "Runway Lineup checklist complete"
Action: Place hand on thrust levers. Move up two clicks to the TO detent.	
Call: "Set N1"	
Action: Verify Thrust levers in the TO detent	
	Call: "N1 set"

NORMAL TAKEOFF

PF (Pilot Flying)	PM (Pilot Monitoring)
	Action: At first sign of airspeed **Call:** "Airspeed alive"
Call: "Check"	**Action:** At 80 KIAS **Call:** "80 knots...crosscheck"
Action: Move hand from thrust levers to control wheel	**Call:** "V1" **Call:** "Rotate"
Action: Rotate to takeoff attitude	**Action:** When the VSI is showing positive climb and the indicated altitude is increasing **Call:** "Positive rate"
Call: "Gear up"	**Call:** "Gear up" **Action:** When all gear lights extinguished: **Call:** "Gear indicating up"
	Call: "V2+15 (Flaps 10) or V2+25 (Flaps 20)"
Action: Above 400 ft AGL and clear of obstacles: **Call:** "Flaps up"	**Call:** "Flaps up" **Action:** Verify flap position indication up **Call:** "Indicating up"
Call: "Autopilot On"	Above 700 ft **Call:** "Autopilot is available"
Call: "After Takeoff checklist"	**Action:** After contacting departure control or the next radar center, do the After Takeoff checklist. **Call:** "After Takeoff checklist complete"
Call: "CLIMB Check"	**Action:** Pressurization check every 10,000 ft **Call:** "Climb Check complete"

F. COMPLETION STANDARDS

- Smooth, coordinated takeoff roll on centerline
- Rotation at VR with proper pitch attitude
- Airspeed: ±5 knots of target
- Heading/Track: ±5°
- Proper configuration sequence
- Appropriate crew coordination and callouts

XV. REJECTED TAKEOFF

A. INTRODUCTION

A rejected takeoff (RTO) is a profile initiated during a takeoff roll to expeditiously stop the airplane on the runway. As the airplane accelerates, energy increases rapidly. At low speeds, up to approximately 80 KIAS, the energy developed is not sufficient to cause difficulty in stopping the airplane. As the speed approaches V1, on a balanced field, the effort to stop the airplane in the event of a rejected takeoff approaches maximum.

IMPORTANT: The decision to reject the takeoff must be made so that the RTO can be initiated no later than V1. During the takeoff run, making a decision to reject takeoff after V1 may result in the airplane not being able to stop safely on the remaining runway.

B. DECISION CRITERIA

Below 80 Knots:

Takeoff will be rejected prior to 80 knots for any abnormality.

Between 80 Knots and V1:

Reject only for the following:

- Master warnings
- Directional control problems
- Safety of flight issues

C. RTO PROCEDURE

When triggered by circumstances warranting a discontinuance of the takeoff, an RTO is to be initiated immediately and without reference to a checklist procedure. When the decision is made to reject a takeoff, either pilot may announce:

- "ABORT, ABORT, ABORT"
- "REJECT, REJECT, REJECT"
- "STOP, STOP, STOP"

Immediate Actions:

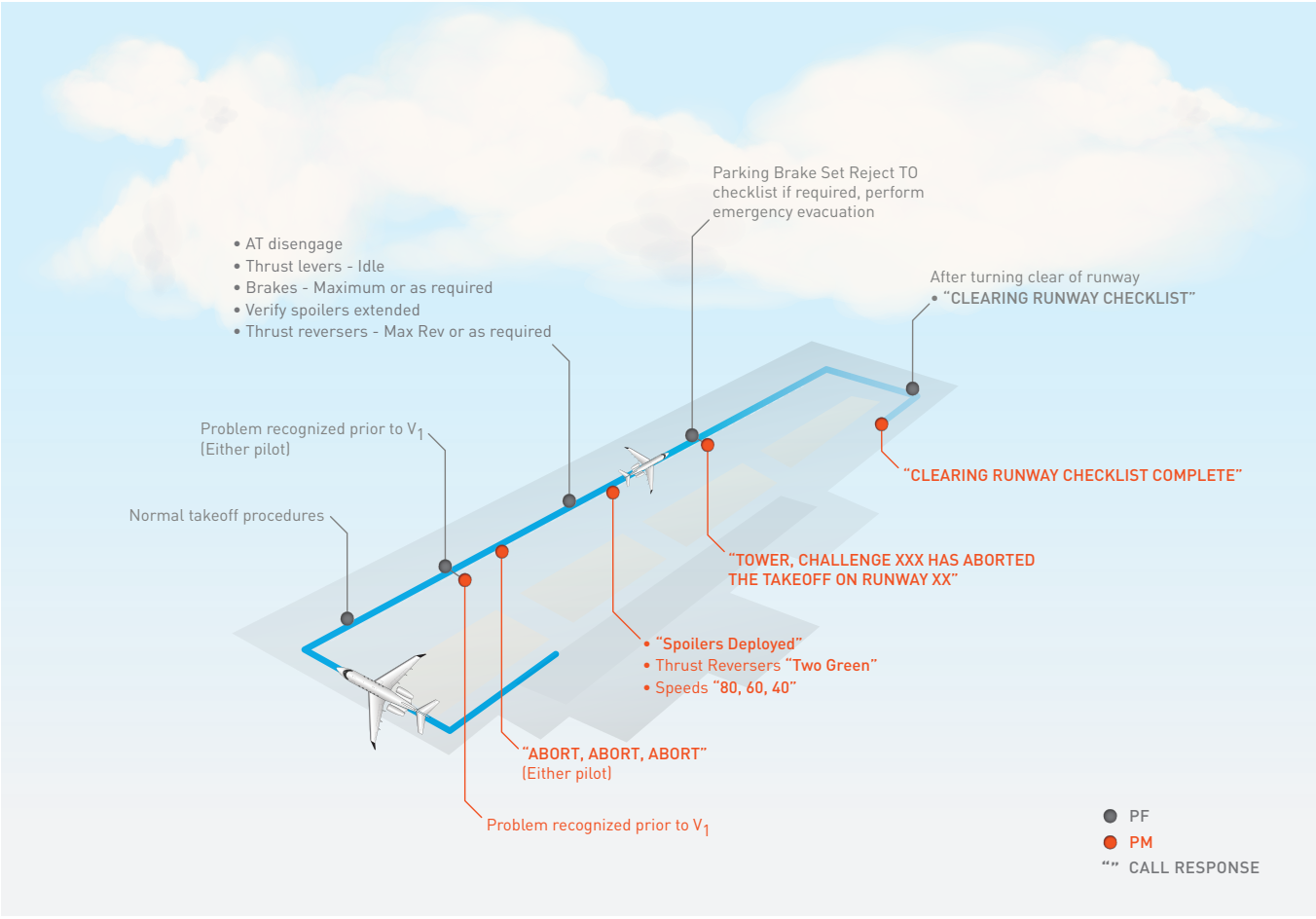
1. **Thrust levers** — Idle
2. **Brakes** — Maximum or as required
3. **Thrust reverser(s)** — Max Reverse or as required

D. POST-RTO ACTIONS

When the airplane has rolled to a full stop and the park brake is ON:

- Assess the situation
- Perform additional emergency procedures if required
- Clear runway or request emergency evacuation if required
- Communicate with passengers
- PM commences Rejected Takeoff checklist as commanded by the PF

ABORTED OR REJECTED TAKEOFF BELOW



E. CREW COORDINATION

REJECTED TAKEOFF

Below 80 kts: Reject for any abnormality. **80 kts to V1:** Reject only for master warnings, loss of directional control, or safety of flight issues.

PF (Pilot Flying)	PM (Pilot Monitoring)
Decision Made to Abort	
Call: "ABORT, ABORT, ABORT" (or "REJECT" / "STOP")	**Call:** "ABORT, ABORT, ABORT" (or "REJECT" / "STOP")
RTO Execution	
Action: Throttles IDLE, MAX braking	**Call:** "Spoilers extended"
Action: Deploys thrust reversers	**Call:** "TRs deployed"
	Call: "80, 60, 40" (speed calls)
Aircraft Stopped	
Action: Sets park brake	**Action:** Notifies Tower / Requests assistance
Action: Assesses situation	
After Stopping	
Call: "Rejected Takeoff checklist"	**Action:** Completes Rejected Takeoff checklist
Action: Communicates with passengers	**Call:** "Rejected Takeoff checklist complete"

NOTE: Any of these terms (ABORT, REJECT, STOP) are acceptable as long as all crew members are clear on the call, its meaning, and consistent with the SOPs. The word STOP is becoming more widely used, especially for international procedures.

NOTE: It may take a few seconds to deploy the thrust reversers. Do not delay braking while thrust reverser deployment takes place.

CAUTION: Consider brake energy prior to subsequent operation of the aircraft. Refer to AFM brake cooling performance section for additional guidance.

F. COMPLETION STANDARDS

- Prompt recognition of reject criteria
- Proper reject callout
- Immediate and coordinated RTO procedure
- Aircraft stopped on runway
- Appropriate post-RTO actions completed

XVI. ENGINE FAILURE ABOVE V1

A. INTRODUCTION

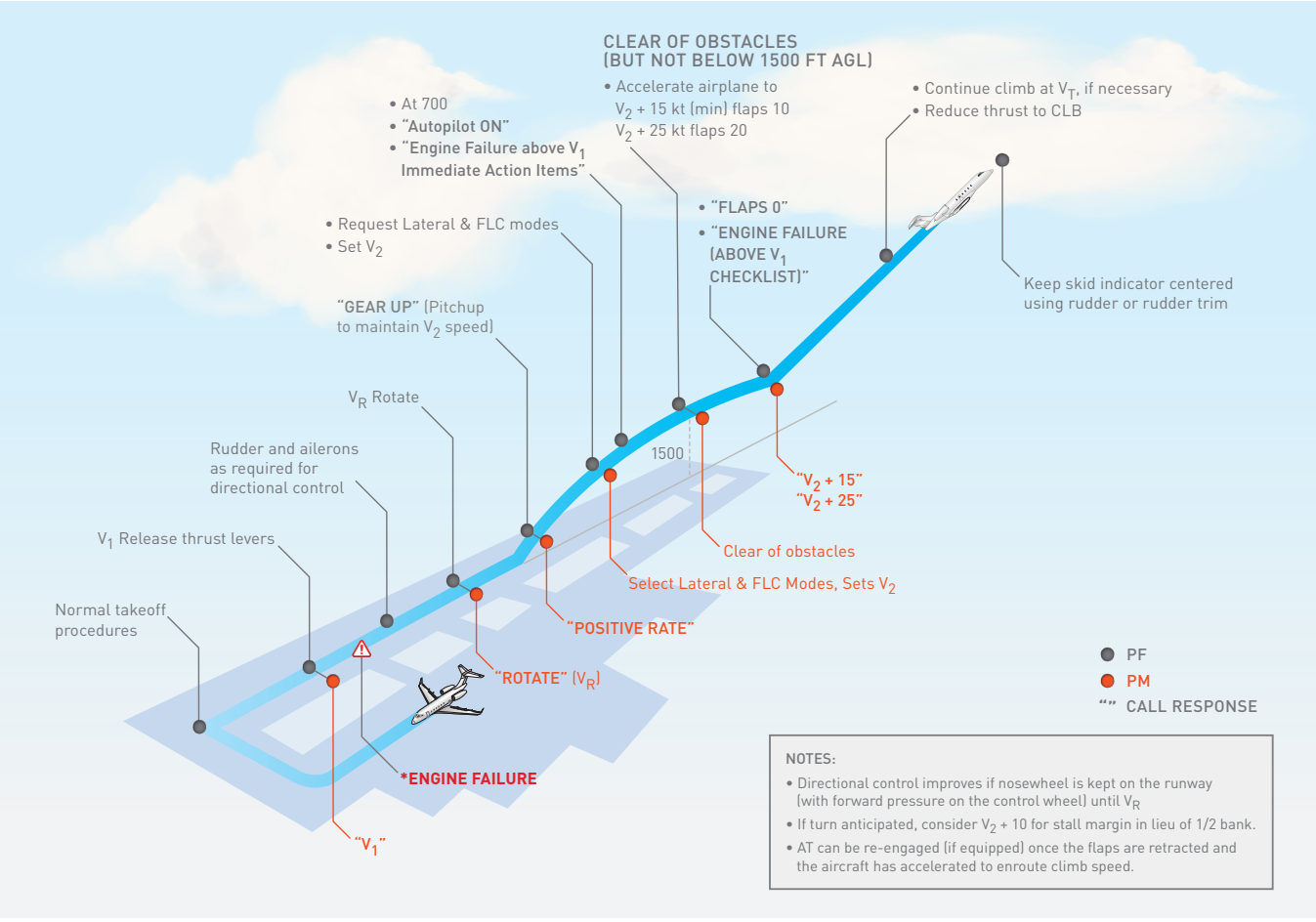
Engine failure at or above V1 requires continuation of the takeoff. The aircraft is designed and certificated to safely take off and climb with one engine inoperative when proper technique is applied. This maneuver, often called a "V1 cut," demonstrates the pilot's ability to maintain directional control, complete a safe departure, and properly configure the aircraft for singleengine flight.

B. RECOGNITION

Engine failure indications may include:

- Yaw toward the failed engine
- Asymmetric thrust sensation
- EICAS warnings/cautions
- Engine instrument anomalies
- Aural warnings

ENGINE FAILURE ABOVE V1



C. V1 CUT PROCEDURE

If an engine fails at or above V1 and the TLA is in the TO Detent, APR thrust will be commanded by the FADEC.

1. **Maintain directional control** — with rudder
2. **Keep nosewheel on runway** — until VR
3. **Track centerline** — using rudder
4. **At VR** — rotate and continue to apply rudder to maintain track
5. **Bank into good engine** — approximately 5° to maintain coordinated flight
6. **Verify slip/skid indicator** — centered
7. **Climb at V2** — until safe altitude
8. **At positive rate** — GEAR UP
9. **Complete engine failure procedures** — per QRH

D. INITIAL CLIMB AND CONFIGURATION

At V2 + 15 (Flaps 10°) or V2 + 25 (Flaps 20°) (Clear of Obstacles (but NOT below 1500 ft AGL)):

- Flaps: RETRACT to 0°
- Accelerate to VENR (single-engine enroute climb speed)
- Complete appropriate checklists

E. CREW COORDINATION

ENGINE FAILURE ABOVE V_1 SPEED

Takeoff Continued: Engine failure at or above V_1 — continue the takeoff

PF (Pilot Flying)	PM (Pilot Monitoring)
Engine Failure Recognition	Call: "V_1"
Action: Maintains directional control with rudder	[Engine Fails]
Action: Keeps nosewheel on runway until V_R	Call: "ENGINE FAILURE" (if PF doesn't recognize)
Rotation and Liftoff	Call: "Rotate"
Action: Rotate at V_R, Pitch to maintain V_2	
Action: Rudder and ailerons as required for directional control	Call: "Positive rate"
Call: "Gear up"	
Action: Request Lateral & FLC Modes	Call: "Gear up"
Call: "Set V_2"	Call: "Gear indicating up"
	Action: Selects requested Lateral & FLC modes, Sets V_2

ENGINE FAILURE ABOVE V_1 SPEED

Takeoff Continued: Engine failure at or above V_1 — continue the takeoff

PF (Pilot Flying)	PM (Pilot Monitoring)
	At 700 ft AGL **Call:** "Autopilot available"
Call: "Autopilot ON" **Call:** "Engine Failure above V_1 Immediate Action Items"	**Action:** Completes Engine Failure above V_1 Immediate Action Items QRC
Clear of Obstacles (but not below 1500 ft AGL) **Action:** Accelerate airplane to V_2 + 15 kt (min) Flaps 10 or V_2 + 25 kt Flaps 20	**Call:** "V_2 + 15" or **Call:** "V_2 + 25"
Call: "Flaps 0, Engine Failure above V_1 checklist" **Action:** Maintain V_T	**Call:** "Flaps 0" **Call:** "Indicating 0" **Action:** Completes Engine Failure Above V_1 checklist
Climb **Action:** Continue climb at V_T (if necessary) **Action:** Reduce Thrust to CLB **Action:** Keep skid indicator centered using rudder or rudder trim	

NOTES:

- Directional control improves if nosewheel is kept on the runway (with forward pressure on the control wheel) until VR.
- If turns anticipated, consider V_2 + 10 for stall margin in lieu of ½ bank.
- AT can be re-engaged (if equipped) once the flaps are retracted and the aircraft has accelerated to enroute climb speed.

F. COMPLETION STANDARDS

- Directional control maintained throughout
- Proper rotation at VR
- V2 maintained ±5 knots
- Proper bank angle into operating engine
- Slip/skid indicator centered
- Proper configuration sequence
- Appropriate checklist completion

XVII. VISUAL APPROACH AND LANDING

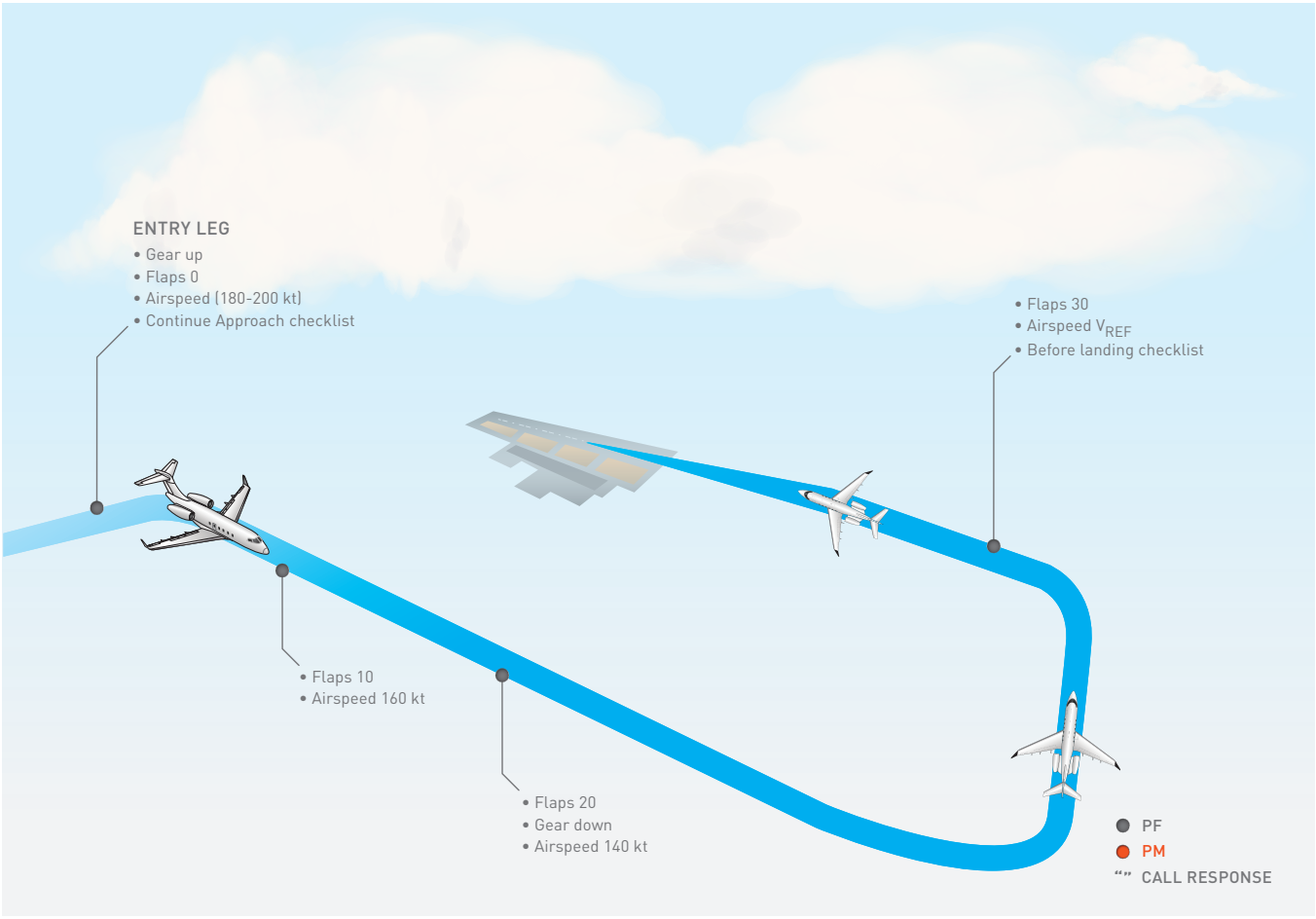
A. INTRODUCTION

A visual approach is an approach conducted under IFR when the pilot has the airport or preceding aircraft in sight and ATC has authorized the approach. While less structured than an instrument approach, the visual approach requires precise airmanship, proper traffic pattern procedures, and consistent technique to ensure a stabilized approach to landing.

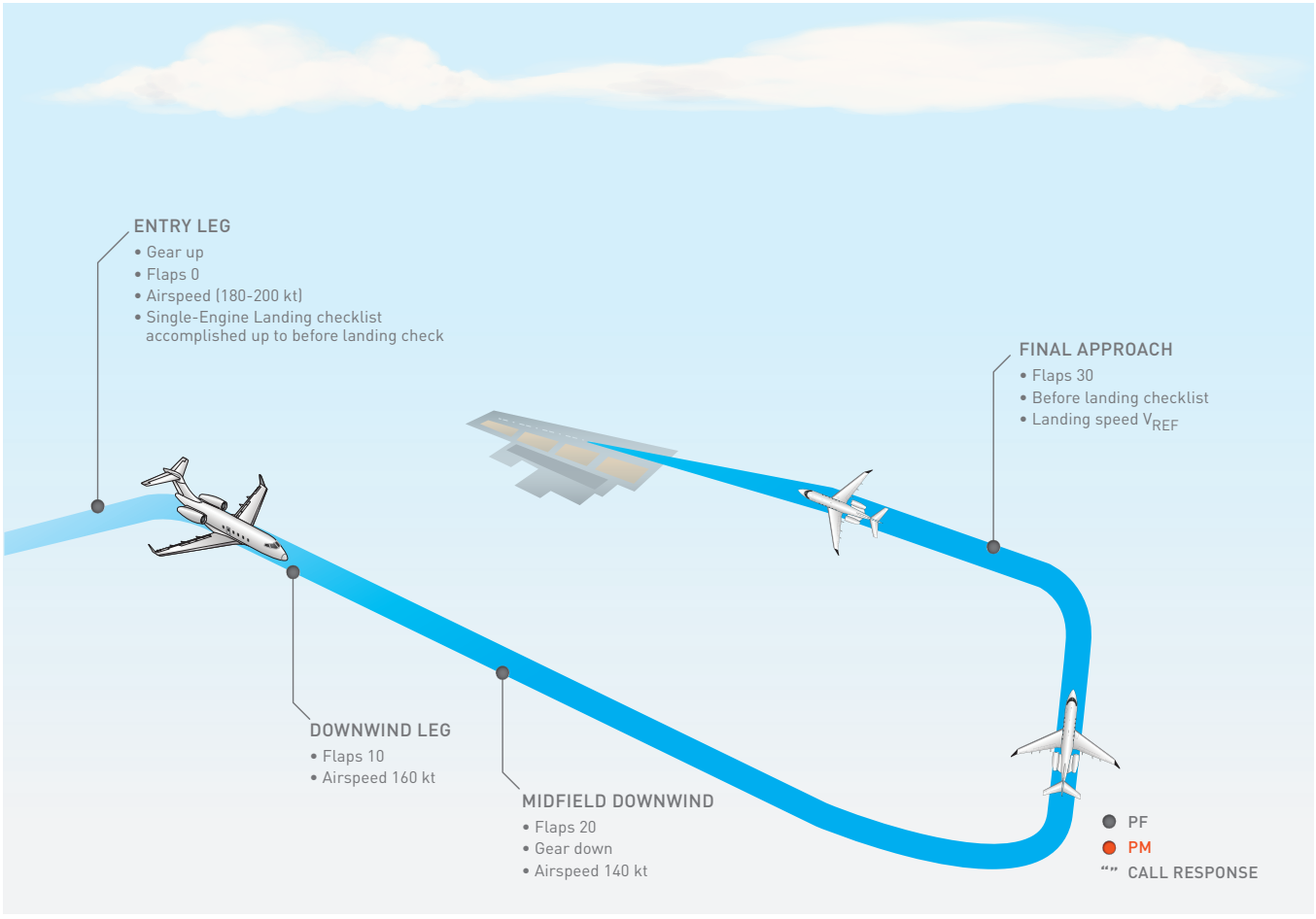
B. NORMAL VISUAL APPROACH

1. **Setup**
    - Approach checklist: COMPLETE
    - Weather conditions verified (ceiling and visibility adequate)
    - Airport environment in sight
    - Traffic: IDENTIFIED or REPORTED IN SIGHT
    - Airspeed: Reduce to 200 KIAS or below in terminal area
2. **Procedure**
    1. **Descend to pattern altitude** — as cleared
    2. **Enter traffic pattern** — downwind, base, or straight-in as appropriate
    3. **Flaps 10°** — on downwind or when speed permits
    4. **Airspeed** — 160 KIAS on downwind
    5. **Approach checklist** — if not complete
    6. **Abeam touchdown point** — Flaps 20°, Gear DOWN
    7. **Before Landing checklist** — complete to flaps item
    8. **Base turn** — Flaps 30°, slow to VREF
    9. **Final approach** — stabilized by 500 ft AGL
    10. Before Landing checklist — COMPLETE

NORMAL VFR LANDING - TWO ENGINES



LANDING - SINGLE ENGINE



3. Crew Coordination

VISUAL APPROACH

Prerequisites: Approach checklist complete. Weather conditions verified. Airport environment in sight. Traffic identified or reported in sight.

PF (Pilot Flying)	PM (Pilot Monitoring)
Entering Pattern	
Call: "Approach checklist"	**Action:** Completes Approach checklist **Call:** "Approach checklist complete"
Downwind	
Call: "Flaps 10"	**Call:** "Speed check" **Call:** "Flaps 10, indicating 10"
Abeam Touchdown Point	
Call: "Flaps 20, Gear Down"	**Call:** "Flaps 20, indicating 20" **Call:** "Gear down, three green"
Base Turn	
Call: "Flaps 30, Before Landing checklist"	**Call:** "Flaps 30, indicating 30" **Action:** Completes Before Landing checklist **Call:** "Before Landing checklist complete"
Final Approach	**Call:** "500 feet, stabilized"
Call: "Check"	**Action:** Speed and sink rate calls
Call: "Landing"	
After Touchdown	**Call:** "Spoilers extended, TRs deployed" **Call:** "80, 60, 40"

C. FLAPS INOPERATIVE LANDING

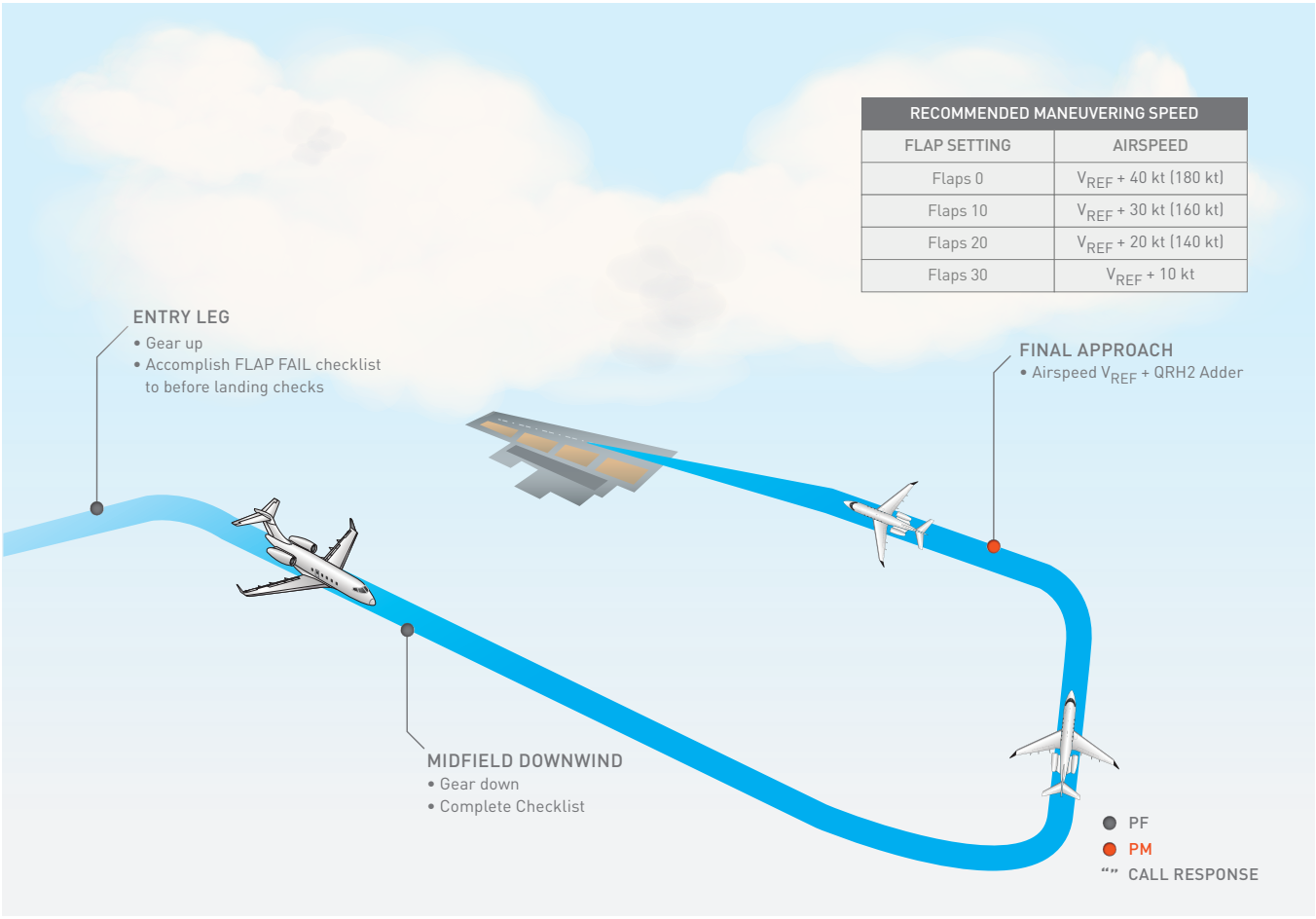
1. **Setup**
    - Flaps inoperative condition confirmed
    - Approach speeds calculated for zero-flap landing
    - Longer runway selected if available
    - VREF (flaps 0) calculated and posted

RECOMMENDED MANEUVERING SPEEDS

Flap Setting	Airspeed
Flaps 0	V_{REF} + 40 kt (180 kt)
Flaps 10	V_{REF} + 30 kt (160 kt)
Flaps 20	V_{REF} + 20 kt (140 kt)
Flaps 30	V_{REF} + 10 kt

2. **Procedure**
    1. **Maintain higher pattern altitude** — if necessary for extended final
    2. **Plan longer final approach** — to allow speed stabilization
    3. **Gear DOWN** — early (provides drag)
    4. **Airspeed** — VREF (flaps 0) + gust factor
    5. **Approach angle** — shallower due to higher speeds
    6. **Landing distance** — significantly increased

FLAP FAILURE LANDING - TWO ENGINES



3. **Crew Coordination**

FLAP FAILURE LANDING

PF (Pilot Flying)	PM (Pilot Monitoring)
Entry Leg	
Call: "Gear up"	**Call:** "Gear up" **Action:** Accomplish FLAP FAIL checklist to Before Landing Checks
Midfield Downwind	
Call: "Gear down"	**Call:** "Gear down" **Call:** "Gear indicating down" **Action:** Complete checklist
After Touchdown	
Action: Maintain airspeed VREF + QRH2 adder	**Action:** Monitor airspeed and approach

D. COMPLETION STANDARDS

- Stabilized approach by 500 ft AGL
- Airspeed: ±5 knots of VREF
- Proper glidepath and alignment
- Touchdown within normal zone
- Proper crew coordination throughout

XVIII. NORMAL VFR LANDING

See XVII. VISUAL APPROACH AND LANDING

XIX. CROSSWIND LANDING

C. INTRODUCTION

Crosswind landings are similar to those in other aircraft. Adequate aircraft control in a crosswind velocity (measured at a 10 m height) of 28 kt during takeoff and 24 kt during landing was demonstrated during certification tests.

B. TECHNIQUE

1. **Use crab approach** — to track centerline on final
2. **Transition to wing low —** slipped drift correction prior to touchdown
3. **Hold upwind aileron —** into the wind through touchdown
4. **Track centerline** — on the rollout

5. **Spoilers deploy automatically** — reducing lift, making brakes more effective
6. **Maintain roll control** — into the wind through rollout

C. CREW COORDINATION

CROSSWIND LANDING

NOTE: In extreme crosswind conditions, an airspeed slightly higher than VREF is warranted. As a general rule, an increase of one-half the gust factor up to a maximum of 10 kt over VREF may be appropriate on final approach.

CAUTION: Do not allow the aircraft to float with power off prior to touchdown. Fly the aircraft to touchdown with a mild flare. Upon touchdown, keep the aircraft on the surface.

PF (Pilot Flying)	PM (Pilot Monitoring)
Final Approach **Action:** Establishes crab angle	**Call:** "Wind [direction] at [speed], gusting [gust]" **Call:** "V_{REF} + [additive]"
Short Final **Action:** Transitions to sideslip (wing low)	**Call:** "50, 40, 30, 20, 10"
Touchdown **Action:** Touches down upwind wheel first **Action:** Maintains roll control into wind	**Call:** "Spoilers deployed"

D. COMPLETION STANDARDS

- Crosswind correction maintained throughout approach
- Touchdown on centerline
- No excessive drift at touchdown
- Directional control maintained throughout rollout
- Wind correction maintained until taxi speed

XX. SHORT-FIELD LANDING

A. INTRODUCTION

Short field approaches and landings should be made at VREF as much as possible, accounting for winds and increased distances as required. The primary objective is to touch down at the designated point and stop in the minimum distance while maintaining safety margins.

B. TECHNIQUE

1. **Maintain VREF** — on final approach
2. **Do not attempt to "grease it on"** — or flare as much as normal landing
3. **Touch down firmly** — at the designated point
4. **Lower nosewheel promptly** — to activate wheel brakes effectively
5. **Apply maximum braking** — primary means of stopping
6. **Deploy thrust reversers** — to assist deceleration

C. CREW COORDINATION

SHORT-FIELD LANDING

IMPORTANT: The wheel brakes are the primary means of stopping the aircraft and help achieve the calculated landing distance. Brake efficiency is reduced if the tires are not firmly on the runway surface.

PF (Pilot Flying)	PM (Pilot Monitoring)
Final Approach	Call: "On speed, on glidepath"
	Call: "500 feet, stabilized"
Call: "Landing"	
Touchdown	
Action: Firm touchdown at aiming point	Call: "Spoilers deployed"
Action: Maximum braking	
Deceleration	Call: "Two deployed"
Action: Maximum reverse	Call: "80, 60, 40"

D. COMPLETION STANDARDS

- Airspeed: ±5 knots of VREF
- Touchdown at or near aiming point
- Minimal float after touchdown
- Prompt application of maximum braking
- Aircraft stopped within calculated landing distance

XXI. TOUCH-AND-GO

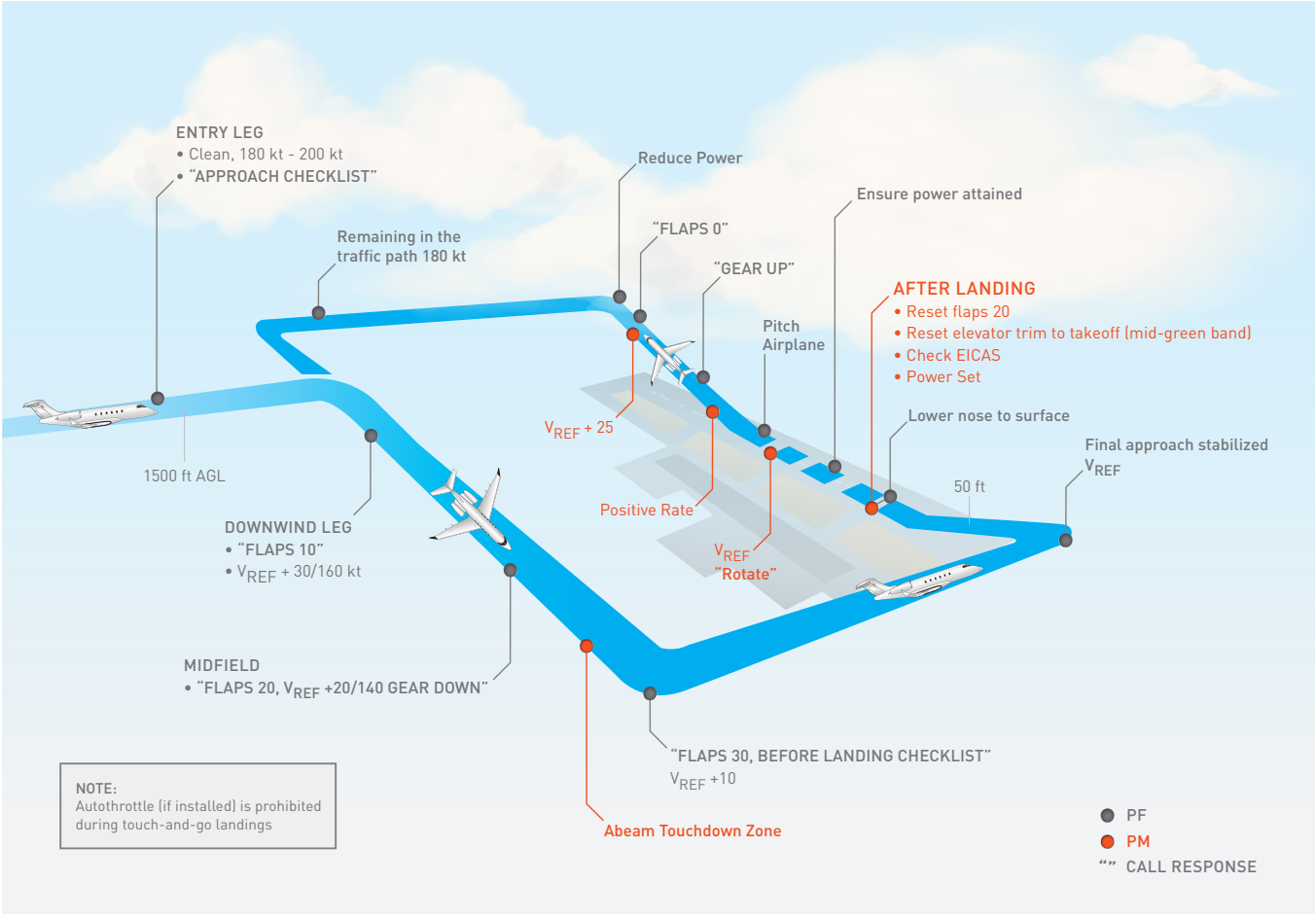
A. INTRODUCTION

A touch-and-go is a training maneuver that combines the landing and takeoff phases into a single operation. After touchdown, the aircraft is reconfigured for takeoff and the takeoff is initiated without coming to a full stop. This maneuver is used to practice multiple landings in a shorter time and is commonly used during training.

B. PROCEDURE

1. **Execute normal landing** — touchdown on centerline at aiming point
2. **Lower nosewheel** — to runway
3. **Retract spoilers** — if deployed
4. **Set flaps** — to takeoff position (10° or 20°)
5. **Verify trim** — set for takeoff
6. **Advance throttles** — to TAKEOFF detent
7. **Maintain centerline** — with rudder
8. **At VR** — rotate to approximately 10° pitch
9. **Execute normal climbout** — gear up at positive rate

TOUCH AND GO LANDING



C. CREW COORDINATION

TOUCH-AND-GO

PF (Pilot Flying)	PM (Pilot Monitoring)
After touchdown **Action:** Lower nosewheel	**Call:** "Spoilers deployed"
Call: "Flaps 10"	**Call:** "Flaps 10" **Call:** "Indicating 10"
Call: "Set takeoff thrust" **Action:** Advance to TO detent	**Call:** "N1 set"
Action: Rotate at VR	**Call:** "Rotate" **Action:** When VSI showing positive climb **Call:** "Positive rate"
Call: "Gear up"	**Call:** "Gear up" **Call:** "Gear indicating up"

CAUTION: Ensure adequate runway length is available for the touch-and-go. Consider aircraft weight, density altitude, runway condition, and any applicable limitations before executing.

NOTE: Do not deploy thrust reversers during a touch-and-go. Ensure the crew clearly understands the intent before touchdown.

D. COMPLETION STANDARDS

- Normal landing touchdown
- Proper reconfiguration for takeoff
- Centerline maintained throughout
- Normal rotation and climbout
- Proper crew coordination and callouts

XXII. PRECISION APPROACH (ILS/LPV)

A. INTRODUCTION

A precision approach provides both lateral and vertical guidance to the runway. The ILS (Instrument Landing System) and LPV (Localizer Performance with Vertical guidance) are the most common precision approaches. These approaches require precise tracking of the localizer/course and glideslope/glidepath to decision altitude (DA), where the pilot must have adequate visual references to continue to landing.

B. APPROACH PLANNING AND BRIEFING

Prior to 31 nm from destination or below FL180, accomplish approach planning and briefing during the cruise or initial descent, if possible, or at least when called for in the Approach Checklist.

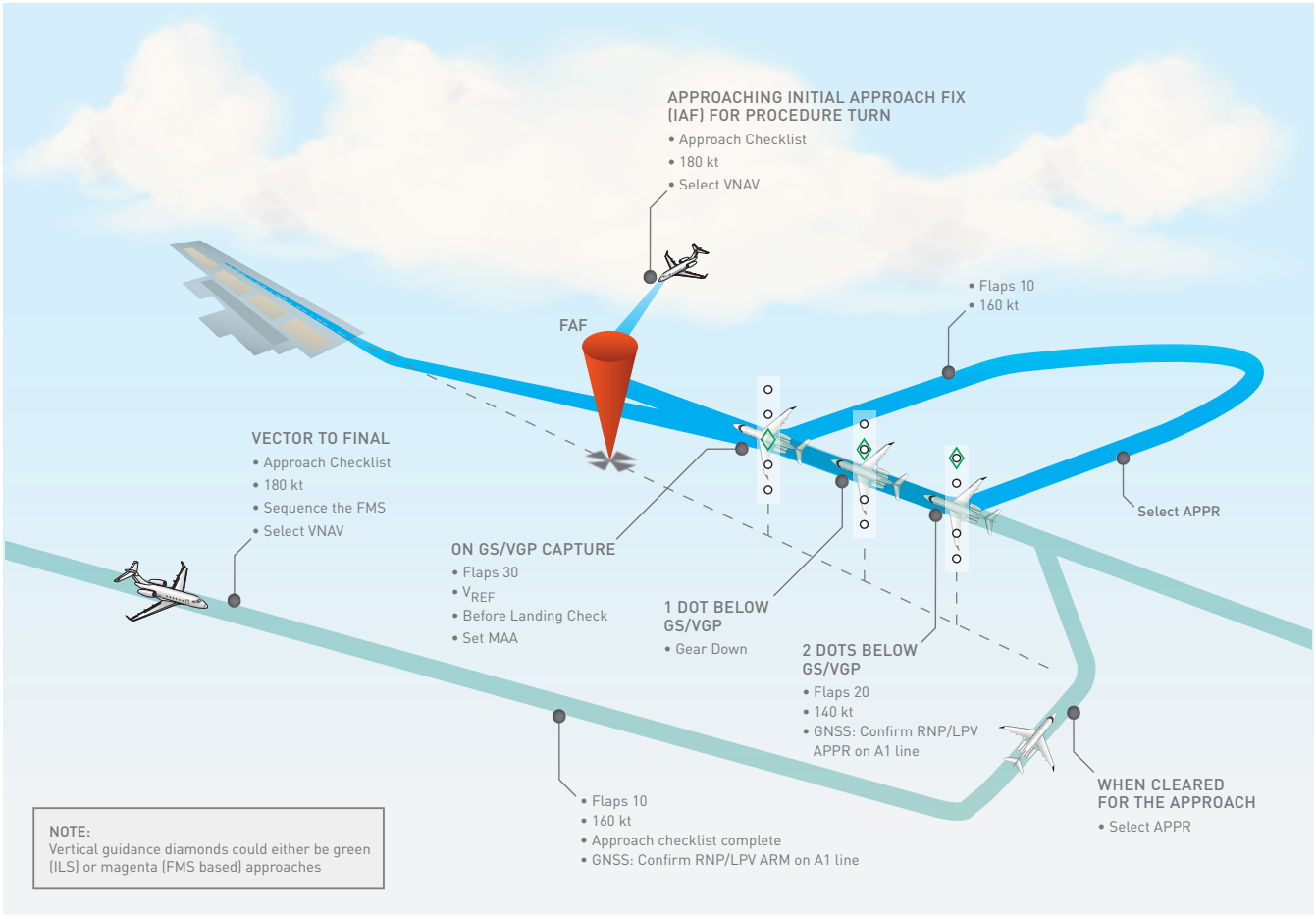
Briefing should include:

- Approach type and runway
- Frequencies (NAV, COM)
- Initial approach altitude
- FAF altitude and distance
- Decision altitude (DA)
- Missed approach procedure
- Approach lighting and runway environment

C. TWO ENGINE PRECISION APPROACH

1. **Setup**
    - Approach checklist: COMPLETE
    - NAV source: Verified
    - Course: SET
    - Altitude preselect: FAF altitude (initially)
    - Minimums: SET (DA on PFD)
2. **Procedure**
    1. **Within 10 NM of FAF** — slow to 160 KIAS, Flaps 10°
    2. **Localizer alive** — verify capture
    3. **Glideslope alive** — prepare for intercept
    4. **One dot below glideslope** — Flaps 20°, Gear DOWN
    5. **Before Landing checklist** — complete to flaps item
    6. **Glideslope intercept** — Flaps 30°, slow to VREF
    7. **Set missed approach altitude** — when established on glideslope
    8. **Before Landing checklist** — COMPLETE
    9. **Monitor approach** — CDI within ¼ scale, airspeed ±5 knots
    10. **At DA** — visual references and Landing or Go-Around/Missed Approach

APPROACH WITH VERTICAL GUIDANCE



3. Crew Coordination

PRECISION APPROACH (ILS/LPV) — TWO ENGINE

Prior to Beginning the Precision Approach (ILS/LPV)

Prior to 31 nm from destination or below FL180: Accomplish approach planning and briefing during the cruise or initial descent, if possible, or at least when called for in the Approach Checklist.

Entering the terminal area (31nm): Select within the FMS an approach. If performing an LPV approach, verify the PFD A1 line is showing "LPV ARM" and 1 nm scaling.

NOTE: Once on vectors, sequence the FMS. Recall the 3-2-1 Rule: Within controlled airspace of 3 = 3000', 2 = maximum 200 kts, and 1 = within 10 nm. For LOC based approaches, if the PFD is selected to ROSE format a dotted cyan preview of the HSI inbound course is displayed and superimposed on the active Magenta HSI. Verification of the LOC frequency should also be done. Within the airport environment and the course deviation indicator of the approach captured, verify the PFD A1 line for "LPV ARM" and the FMA vertical GP is armed. This confirms VNAV is engaged if required.

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Approach checklist"	
	Action: Complete the Approach checklist
	Call: "Approach checklist complete"
Call: "Flaps 10 (Slow to 160 kts)"	**Call:** "Speed check; flaps 10"
	Call: "Indicating 10"
Call: "Localizer/Course alive"	**Call:** "Localizer/Course alive"
Call: "Glideslope/Glidepath alive"	**Call:** "Glideslope/Glidepath alive"
Call: "Flaps 20 (Slow to 140 kts)"	
	Call: "Speed check; flaps 20"
	Call: "Indicating 20"
1 DOT below Glideslope/glidepath	
Call: "Gear down"	
	Call: "Gear down, three green"
Call: "Gear down, three green"	

PRECISION APPROACH (ILS/LPV) — CONTINUED

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Flaps 30, Before Landing checklist (Slow to Vref)"	
	Call: "Speed check; Flaps 30...Indicating 30"
	Call: "Before Landing complete"

NOTE: Verify the PFD A1 line for "LPV APPR" message and not "NO APPR"

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Glideslope/Glidepath captured"	
	Call: "Check"
Call: "Set missed approach altitude"	
	Call: "Missed approach altitude set"
At 1,000 ft above DH	**Call:** "1,000 above minimums"
If IMC, should be stable at 1000' above minimums If VMC, should be stable at 500' above minimums	
Call: "Check/Stable (IMC)"	
At 500 ft above DH	**Call:** "500 above minimums"
Call: "Check/Stable (VMC)"	
No flags	
At 100 ft above DH	**Call:** "Approaching minimums"
Call: "Check"	
At Minimums or when runway environment is in sight	**Call:** "Minimums"
	Or
Call: "Visual Landing"	**Call:** "Runway (or visual references) _____ o'clock (lead-in lights)"
Call: "Autopilot disconnect"	
	Call: "Check"

PRECISION APPROACH (ILS/LPV) — CONTINUED

PF (Pilot Flying)	PM (Pilot Monitoring)
After touchdown	
Action: Brakes applied and thrust reversers as required	**Call:** "Spoilers extended; TRs deployed" **Call:** "Airspeeds: 80, 60, 40 kts"

NOTE: Spoilers automatically extend after touchdown. Monitor both thrust reversers and spoilers.

PF (Pilot Flying)	PM (Pilot Monitoring)
After clearing the active runway	
Call: "After Landing/Clearing Runway checklist"	**Action:** Complete After Landing/Clearing Runway checklist **Call:** "After Landing/Clearing Runway checklist complete"

D. SINGLE ENGINE PRECISION APPROACH (OEI)

1. **Setup**
   - Single Engine Landing checklist
   - Approach speed: VREF
   - Expect higher power setting on operating engine
   - Plan for asymmetric thrust effects

2. **Procedure Modifications**

   The single engine precision approach follows the same procedure as the two-engine approach with the following modifications:
   - Be prepared for go-around with single engine

3. **Crew Coordination**

   The single engine approach and landing procedure is the same as with both engines running.

E. Completion Standards

- Localizer: ⩽¼ scale deflection
- Glideslope: ⩽¼ scale deflection
- Airspeed: ±5 knots of VREF/VAPP
- Proper callouts at appropriate points
- Go-around initiated if not visual at DA

XXIII. NON-PRECISION APPROACH (LNAV/VOR/NDB)

A. INTRODUCTION

Non-precision approaches provide lateral guidance only, requiring the pilot to manage the descent profile to the Minimum Descent Altitude (MDA). The Continuous Descent Final Approach (CDFA) technique is recommended to maintain a stabilized approach profile similar to a precision approach.

B. CDFA/SCDA PHILOSOPHY

The Stabilized Constant Descent Angle (SCDA) or Continuous Descent Final Approach (CDFA) technique involves a continuous descent from FAF to runway threshold at a constant angle, typically 3°. This technique:

- Reduces pilot workload
- Improves situational awareness
- Provides a stabilized approach profile
- Reduces CFIT risk

C. TWO ENGINE NON-PRECISION APPROACH

1. **Setup**
    - Approach checklist: COMPLETE
    - Timing or distance for descent calculated
    - MDA: SET on altitude preselect (initially)
    - Missed approach altitude: SET when level at MDA
2. **Procedure**
    1. **Within 10 NM of FAF** — slow to 160 KIAS, Flaps 10°
    2. **Inbound to IAF** — 170 KIAS, Flaps 10°, Approach checklist
    3. **3 NM prior to FAF** — Flaps 20°, Gear DOWN
    4. **Before Landing checklist** — complete to flaps item
    5. **At FAF** — begin descent, Flaps 30°, slow to VREF
    6. **Descent rate** — approximately 1000 fpm for 3° path
    7. **At MDA** — set missed approach altitude
    8. **VDP (if published)** — runway in sight, descend to land
    9. **At MAP** — visual references or Go-Around

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3. Crew Coordination

NON-PRECISION APPROACH (LNAV/VOR/NDB) — TWO ENGINE

CDFA Technique: Continuous descent from FAF to runway threshold at constant angle (~3°). Reduces pilot workload, improves situational awareness, provides stabilized approach profile, and reduces CFIT risk.

NOTE: For non-precision approaches with no published VDP, calculate a "time to see" point: Divide the HAT/HAA by 10. The result is the number of seconds the runway should be seen before arriving at the MAP.

PF (Pilot Flying)	PM (Pilot Monitoring)
Inbound to IAF — 170 KIAS	
Call: "Flaps Approach, Approach checklist"	Call: "Selected... indicated"
	Call: "Approach checklist complete"
3 Miles to FAF	
Call: "Gear Down, Before Landing checklist"	Call: "Gear down, three green"
	Call: "Before Landing checklist complete to flaps"
At FAF	
Call: "FLC XXX" or "VS XXX"	Call: "FLC XXX" or "VS XXX set"
Action: Begins descent	
	On Approach
	Call: "500' above MDA"
	Call: "100' above MDA"
At MDA	Call: "MDA"
Call: "Set missed approach altitude"	Call: "Missed approach altitude set"
	Call: "Approaching VDP" (for straight-in)
	Runway/Visual References in Sight
	Call: "Runway (or lights) at ___ o'clock"
Call: "Visual, Landing, Leaving MDA"	
Call: "Flaps Land, Before Landing checklist"	Call: "Flaps Land, selected... indicated"
	Call: "Before Landing checklist complete"
If PM does not call runway or lights in sight by MAP:	
Call: "Minimums – Go Around..."	

D. COMPLETION STANDARDS

- Course: ⩽¼ scale CDI deflection
- Altitude: MDA +50/–0 feet
- Airspeed: ±5 knots
- Stabilized descent profile
- Go-around initiated at MAP if not visual

XXIV. CIRCLING APPROACH

A. INTRODUCTION

A circling approach can be one of the most challenging instrument approach procedures. Turbulence, strong winds, poor visibility, and low maneuvering altitude can add to the challenge. Maintain proficiency and skills practice to minimize the high-risk maneuvering required for executing a circling approach. Advanced approach planning and briefing also add to the success of a circling maneuver.

Airspeed control is extremely important, and the handling characteristics and stability of the aircraft at slower speeds help flight crews reduce the high risks of these procedures. Anticipate the level-off at MDA and set sufficient thrust to maintain altitude and safe maneuvering speed throughout the procedure.

B. CIRCLING CATEGORY AND PROTECTED AIRSPACE

Under normal circumstances, the Challenger 350 falls into Category C for circling approaches, having a circling radius of 1.7 NM from the runway end.

Remember, a circling approach:

- Is an instrument approach procedure with a visual portion
- Must remain clear of clouds while maneuvering
- Must have the airport environment in sight while maneuvering (except when banking)
- Must remain within circling distance to runways for the appropriate category
- Remain at Circling Minimums until in normal landing position to the runway

NOTE: TERPS 8260.3B Change 21 has modified the criteria for circling approaches. A black diamond with a white C in the circle-to-land minimums box indicates the revised criteria.

C. SETUP

- Approach: BRIEF circling maneuver direction and pattern
- Circling MDA: SET
- Airspeed: VREF + 10 for circling
- Visual references: IDENTIFY

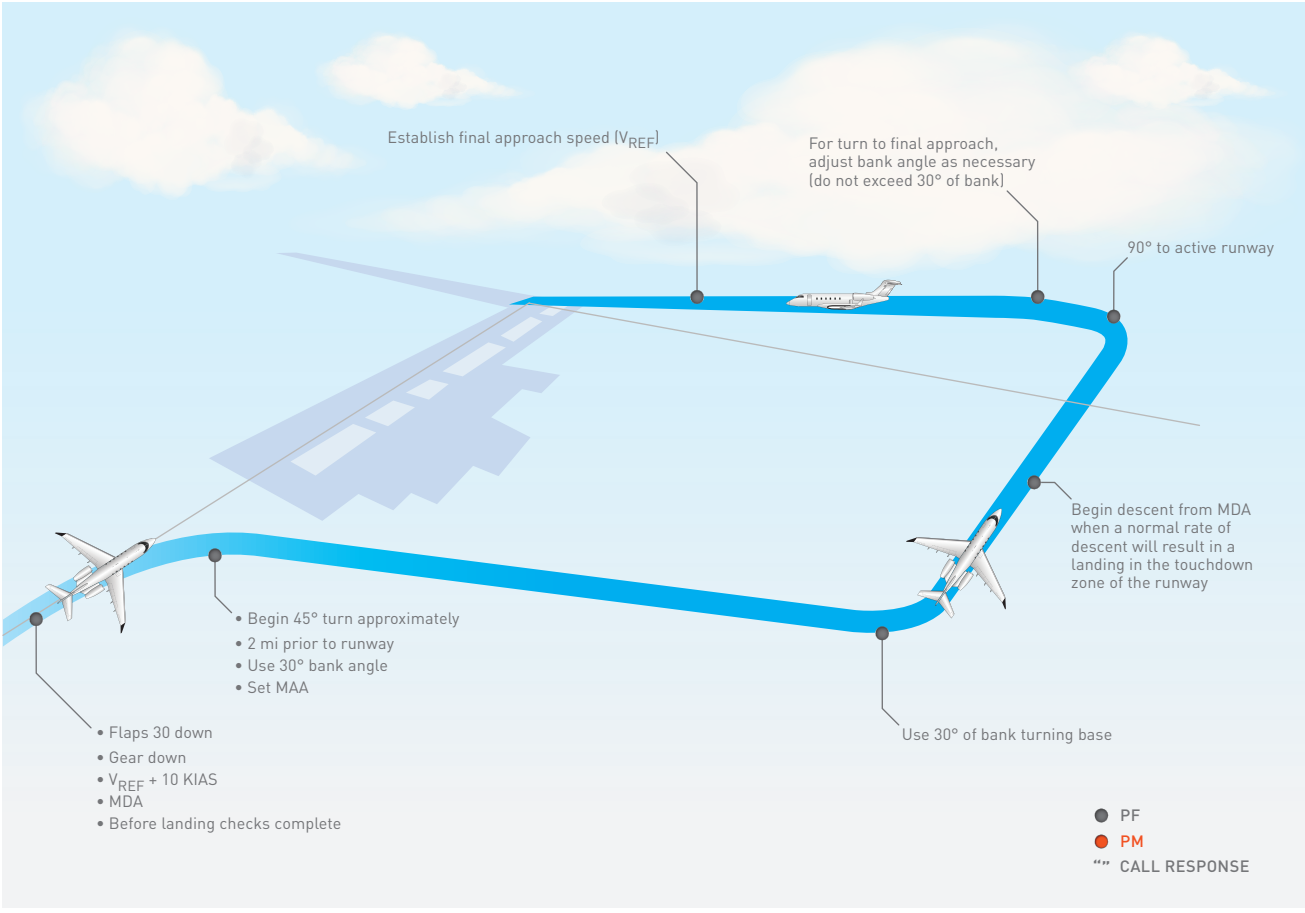
D. PROCEDURE

Since the circling approach is a non-precision approach, all items in the Non-Precision Approach up to MDA are the same.

1. **At MDA** — level off, set missed approach altitude
2. **Acquire airport environment** — visually
3. **Maneuver to landing runway** — shortest path to base or downwind

4. **Remain within circling distance** — 1.7 NM for Category C
5. **Maintain circling MDA** — until in position for normal descent
6. **When landing assured** — Flaps LAND, descend to runway

NONPRECISION CIRCLING APPROACH



E. CIRCLING MANEUVER TECHNIQUE

During the circling, use available automation, including autopilot and autothrottle (if installed) to help reduce pilot workload.

Key Techniques:

- Plan the maneuver before reaching MDA
- Fly shortest path to intercept base or downwind
- Use heading selections for precise ground track
- Keep runway environment in sight (except during bank)

- Lower airspeeds result in decreased turn radius
- Do not descend below MDA until landing is assured

F. CREW COORDINATION

CIRCLING APPROACH

Category C Protected Airspace: 1.7 NM radius from runway end. Must remain clear of clouds, have airport environment in sight (except when banking), remain within circling distance, and maintain Circling Minimums until in normal landing position.

PF (Pilot Flying)	PM (Pilot Monitoring)
	At MDA **Call:** "MDA"
Call: "Set missed approach altitude"	
	Airport/Environment in Sight **Call:** "Airport (Runway or lights) at ___ o'clock"
Call: "I have the airport"	
Circling Maneuver **Call:** "Set heading XXX" **Action**: Maneuvers aircraft in shortest path to base or downwind	**Action:** Monitors altitude, distance from airport
In Position for Normal Landing **Call:** "Flaps Land, Leaving MDA, Continue Before Landing checklist"	**Call:** "Flaps Land selected... indicated" **Call:** "Before Landing checklist complete"
If visual references to airport environment are lost during circling:	
Call: "Go-Around, lost visual" **Action:** Execute missed approach immediately	

CAUTION: It is easy to lose sight of the airport if circling approach speed is too high or bank is too shallow. If visual references to the airport environment are lost during the circling maneuver, immediately execute a missed approach.

G. COMPLETION STANDARDS

- Altitude: +100/–0 feet until descending below MDA
- Airspeed: ±5 knots of VREF + 10
- Heading: ±5°
- Remain within circling protected airspace
- Airport environment in sight during maneuver
- Proper missed approach if visual lost

XXV. GO-AROUND / MISSED APPROACH

A. INTRODUCTION

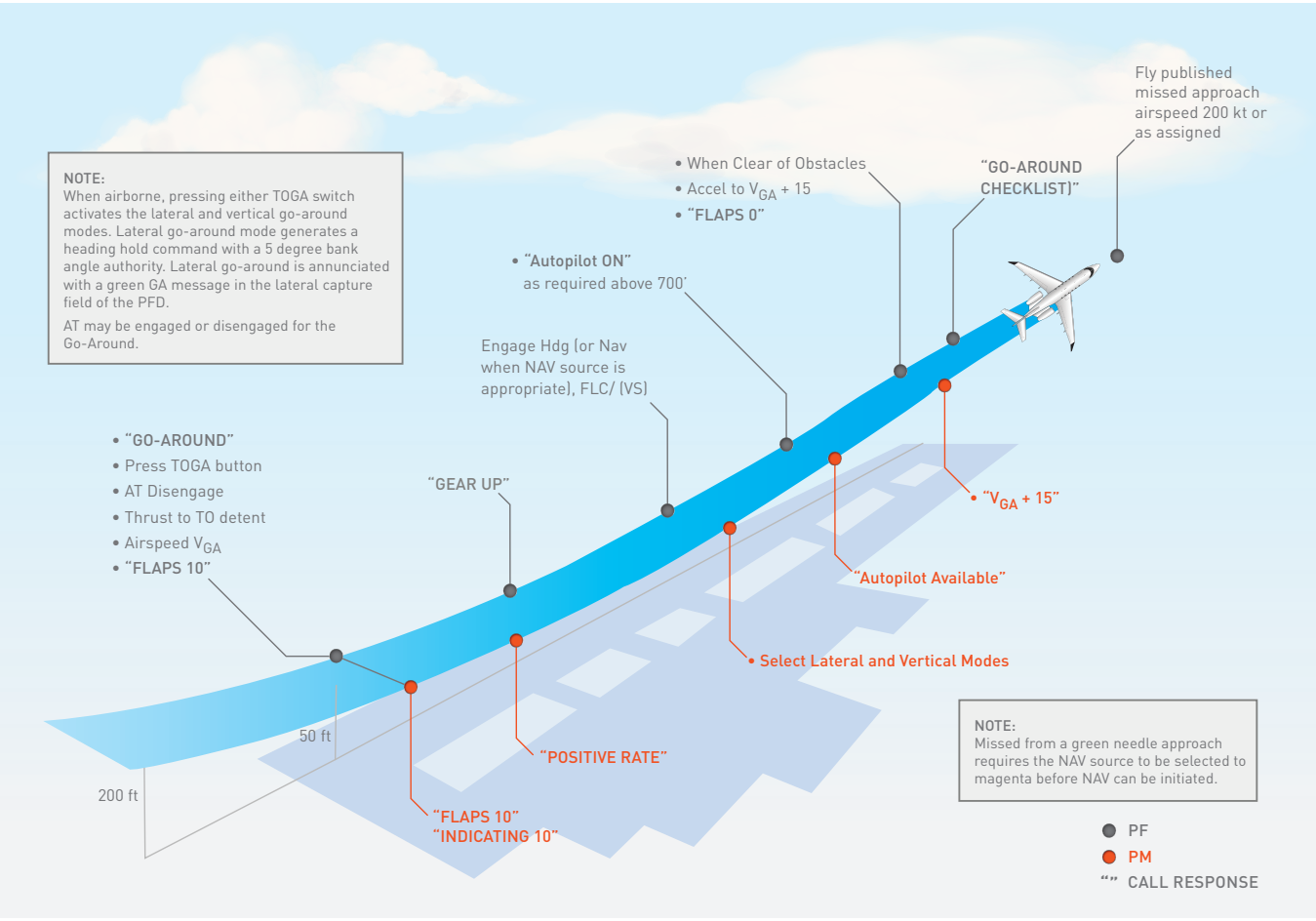
A missed approach is accomplished when at DH/DA or MDA without adequate visual references, when the time period expires, when the set distance is reached, when sight of the intended landing runway is lost, or when in a position from which a normal visual landing approach cannot be accomplished. Other situations could also warrant the initiation of a missed approach.

If a go-around is necessary, either pilot can call for a go-around. The PF acknowledges by calling "Go around, Set N1."

B. TWO ENGINE GO-AROUND

1. **Initiation Criteria**
    - At DA/MDA without required visual references
    - Approach becomes unstabilized
    - Runway environment lost
    - Traffic conflict
    - ATC instruction
    - Any condition precluding safe landing
2. **Procedure**
    1. **Press TO/GA button** —Autpilot disconnects
    2. **Advance thrust** — to TAKEOFF detent
    3. **Pitch up** — to command bars
    4. **Verify spoilers** — RETRACTED
    5. **Flaps 10°** — when speed trend increasing
    6. **At positive rate** — GEAR UP
    7. **Engage HDG (or NAV) & FLC/VS**
    8. **Autopilot on at 700'**
    9. **Climb at VGA**
    10. **Accelerate to VGA + 15** — Flaps 0°
    11. **Accelerate** — to 200 KIAS
    12. **Complete Go-Around checklist**
    13. **Fly published missed approach**

GO AROUND - MISSED APPROACH - TWO ENGINES



3. Crew Coordination

GO-AROUND, MISSED APPROACH — TWO ENGINES

At minimums and no runway environment in sight

PF (Pilot Flying)	PM (Pilot Monitoring)
	Call: " Minimums, Go-Around "
Call: " Go-Around, Set N1 "	**Action:** Verify the N1 setting for go-around
Action: Press the go-around TO/GA button, advance Thrust to Takeoff (TO) detent, Flight Spoilers retract (if extended), Pitch up to the command bars.	**Call:** " N1 Set "

GO-AROUND, MISSED APPROACH — TWO ENGINES — CONTINUED

At minimums and no runway environment in sight

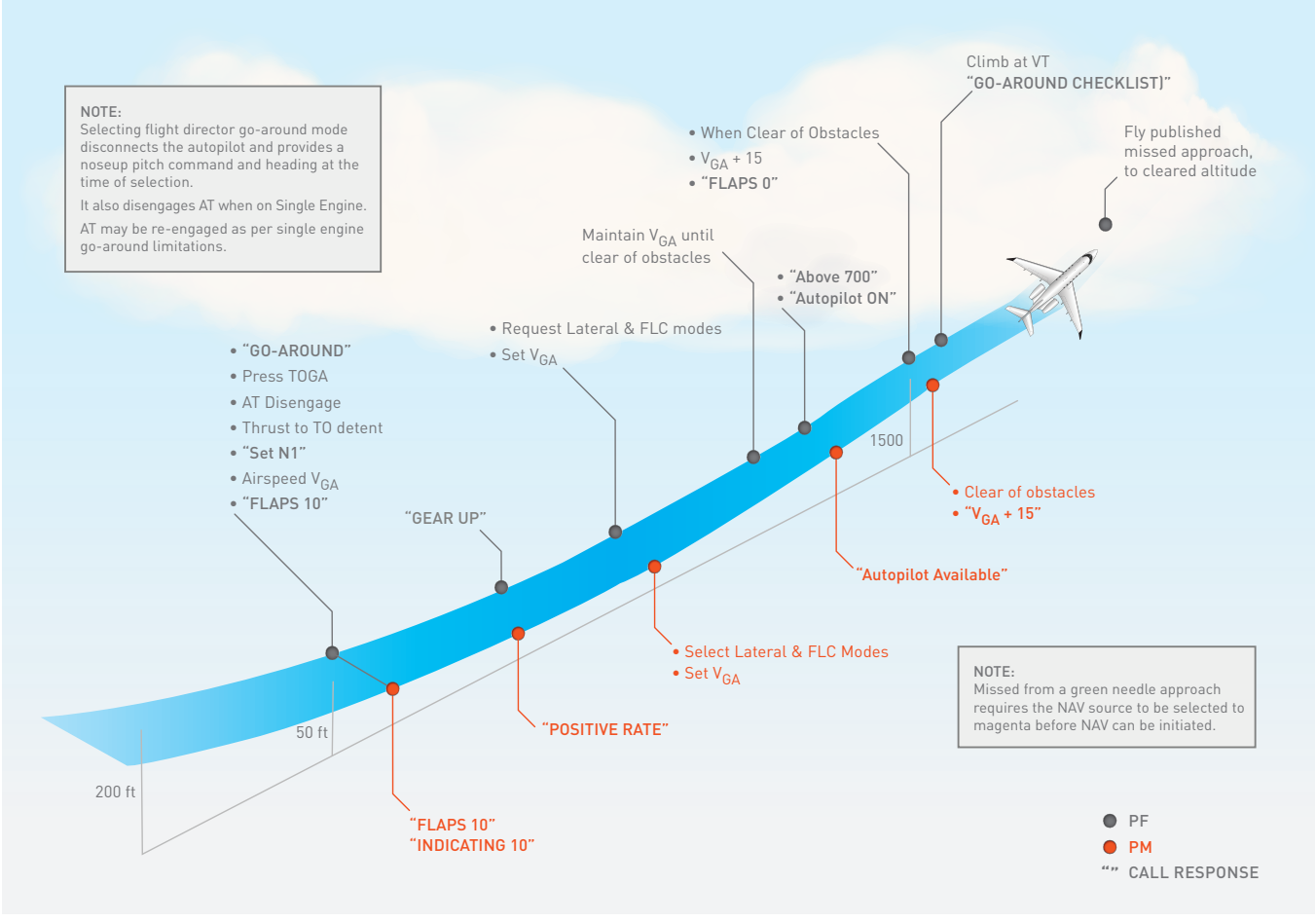
PF (Pilot Flying)	PM (Pilot Monitoring)
Call: " Airspeed V_{GA} " **Call:** " Flaps 10 "	
	Call: " Flaps 10 " **Call:** " Indicating 10 "
	Action: When the VSI is showing positive climb and the indicated altitude is increasing **Call:** " Positive rate "
Call: " Gear up "	
	Call: " Gear up " **Call:** " Indicating up "
Missed approach procedures **Call:** HDG/NAV (as appropriate), FLC/VS	
	Action: Select commanded Lateral and Vertical Modes
At or Above 700' **Call:** Autopilot On	**Call:** Autopilot Available
Clear of obstacles	**Call:** " V_{GA} + 15 KIAS "
Call: " Flaps 0 "	
	Call: " Flaps 0 " **Call:** " Indicating 0 "
Action: Climb at V_T **Call:** " Go-Around checklist "	**Action:** When at safe altitude and time permitting, accomplish the Go-Around checklist **Call:** " Go-Around checklist complete "

NOTE: If an FMS approach was flown, the FMS will auto sequence into the missed approach and only a vertical mode on the FGP is required for navigation purposes. If a LOC based approach is flown, the NAV source must be changed from Green to Magenta source and then the appropriate FGP selections can be made (SNAP).

C. SINGLE ENGINE GO-AROUND (OEI)

1. Procedure
    1. **Press TO/GA button**
    2. **Advance operating engine** — to TAKEOFF detent, rotate to 7.5° nose up, then to command bars
    3. **Flaps** — 10°
    4. **At positive rate** — GEAR UP
    5. **Airspeed** — VGA
    6. **Clear of obstacles (1500' AGL min)** – Accelerate to VT
    7. **At VGA + 15** — retract flaps
    8. **At VT** — Go-Around checklist
    9. **Fly published missed approach to cleared altitude**

GO AROUND - MISSED APPROACH - SINGLE ENGINE



2. Crew Coordination

GO-AROUND, MISSED APPROACH — SINGLE ENGINE

Minimum altitude: 1,500' AGL. Use TAKEOFF detent initially, transition to MCT. Climb at VT. Clear of obstacles before accelerating to VENR.

PF (Pilot Flying)	PM (Pilot Monitoring)
At minimums and no runway environment in sight **Call:** "Go Around, Set N_1" **Action:** Press the go-around TO/GA button, advance Thrust to Takeoff (TO) detent, Flight Spoilers retract (if extended), Pitch for VGA.	**Call:** "Minimums, Go-Around" **Action:** Verify the N1 setting for go-around **Call:** "N1 Set"
Airspeed V_{GA} **Call:** "Flaps 10"	**Call:** "Flaps 10" **Call:** "Indicating 10"
Positive Rate **Call:** "Gear Up"	**Call:** "Positive Rate" **Call:** Gear Up **Call:** "Indicating Up"
Missed approach procedures **Call:** HDG/NAV (as appropriate), FLC/VS, Set V_{GA}	**Action:** Select commanded Lateral and Vertical Modes, Set V_{GA}
At or Above 700' **Call:** Autopilot On	**Call:** Autopilot Available
Clear of Obstacles (1500' AGL minimum) **Action:** Accelerate to V_{GA} +15 **Call:** "Flaps 0"	**Call:** "Flaps 0" **Call:** "Indicating 0"
Climb at V_T **Call:** "Go-Around Checklist" **Action:** Fly published missed approach, to cleared altitude	**Action:** Completes Go-Around Checklist

D. BALKED LANDING / LOW ENERGY GO-AROUND

A low-energy go-around requires special consideration due to the aircraft's proximity to the ground and relatively low airspeed.

A Low-Energy landing regime is defined as a condition where a rejected or balked landing is commenced after a commitment to a landing has been made. In a low-energy landing regime, the aeroplane is in a descent at a height of 50 feet or less above the runway, in the landing configuration with thrust stabilized in the idle range, and airspeed decreasing (up to Vref-10). An attempt to conduct a rejected or balked landing from a low-energy landing regime may result in ground contact. Be prepared for a touchdown; airplane aligned with runway, bank angle minimized.

The engines are usually in, or close to, a low idle thrust setting and require several seconds to accelerate to MAX THRUST (TO). Missed approach obstacle clearance is often not considered from below the missed approach point. A mitigation strategy should be considered especially in obstacle rich environments. If there are any doubts regarding the probability of completing a safe landing, a Go-Around must be initiated.

Procedure:

- Initiate go-around and simultaneously select TOGA and advance thrust levers to TO thrust
- Confirm spoilers retracted
- Maintain landing gear and flap configuration (no configuration changes)
- Initially maintain or slightly increase pitch attitude (similar to a flare)
- Be prepared for a touchdown; airplane aligned with runway, bank angle minimized
- When safely established (speed at or above VAC and airplane climbing), set Flap 20°, raise gear
- Continue with GA profile
- Re-engage automation as desired

XXVI. EMERGENCY DESCENT / RAPID DECOMPRESSION

A. INTRODUCTION

Malfunctions at altitude require the same thought process as those on takeoff. Maintaining aircraft control is the number one priority. Someone should always be flying the aircraft. If an emergency descent is necessary due to rapid decompression, the primary crew concern should be to don the oxygen masks and establish communications.

B. TIME OF USEFUL CONSCIOUSNESS (TUC)

TIME OF USEFUL CONSCIOUSNESS (TUC)

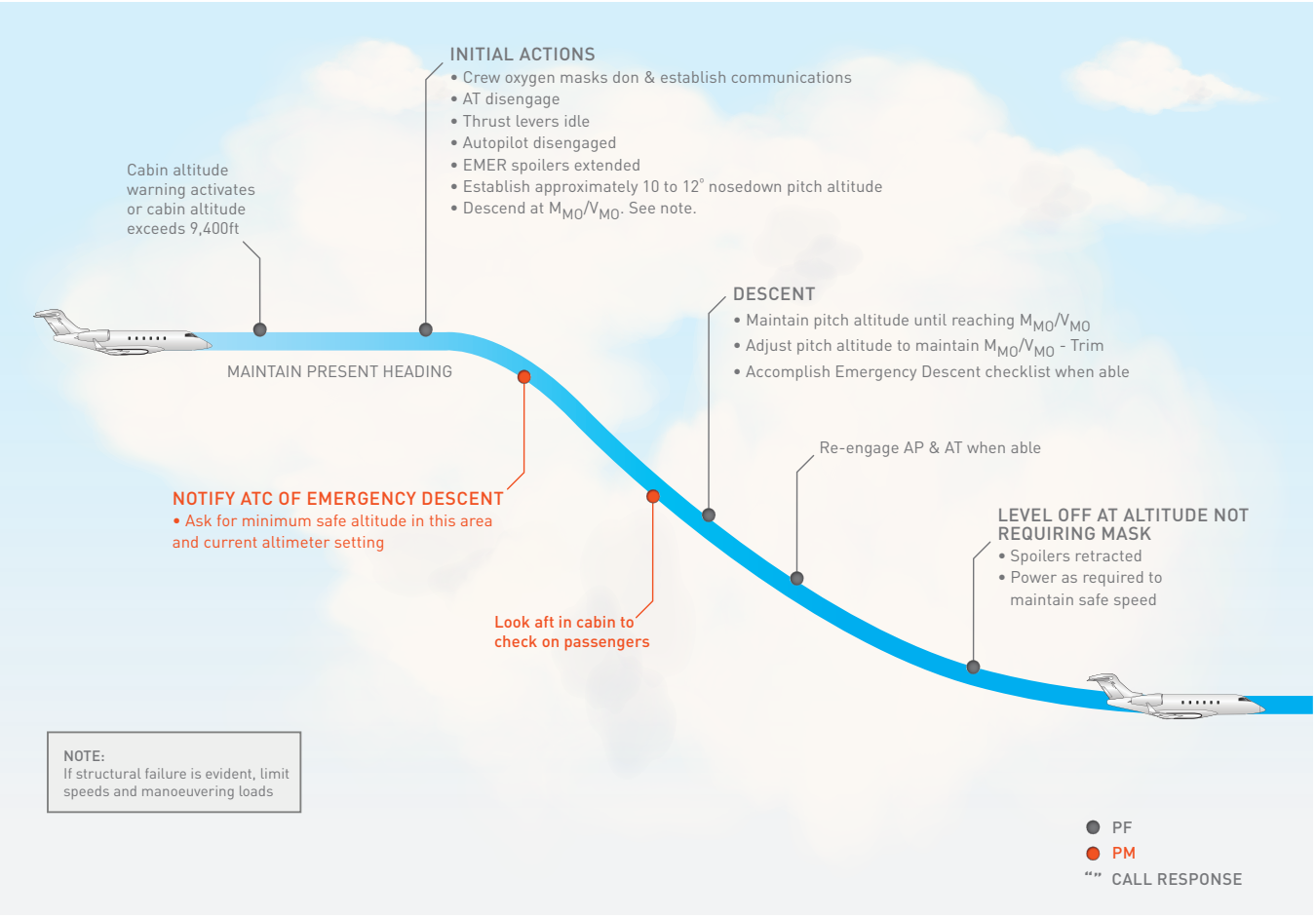
Altitude (measured barometrically)	TUC (rapid decompression)
FL180 (18,000 ft)	10 to 15 minutes
FL220 (22,000 ft)	5 minutes
FL250 (25,000 ft)	1.5 to 3.5 minutes
FL280 (28,000 ft)	1.25 to 1.5 minutes
FL300 (30,000 ft)	30 to 60 seconds
FL350 (35,000 ft)	15 to 30 seconds
FL400 (40,000 ft)	7 to 10 seconds
FL430 (43,000 ft)	5 to 6 seconds
FL500 (50,000 ft)	5 seconds

C. EMERGENCY DESCENT PROCEDURE

Immediate Action Items:

1. **Oxygen masks** — DON, 100%, verify flow
2. **Crew communications** — ESTABLISH
3. **Thrust levers** — IDLE
4. **Autopilot** — DISCONNECT
5. **Spoilers** — EMER (push button on top of handle)
6. **Pitch Down** — 10° to 12°
7. **Descend** — VMO/MMO, Trim
8. **ATC** — Advise, squawk 7700, Get MEA & QNH
9. **Check on Passengers**
10. **Complete Emergency Descent Checklist** — When Able
11. **Re-Engage AP** — When Able

EMERGENCY DESCENT



D. CREW COORDINATION

EMERGENCY DESCENT / RAPID DECOMPRESSION

WARNING: At altitudes above FL 410, the time of useful consciousness (TUC) decreases significantly without supplemental oxygen. Pilots always put on their oxygen masks first, before ensuring that the passengers' masks have dropped.

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Emergency descent"	**Call:** "Emergency descent"
Action: Don O_2 mask, 100%, Establish Communications	**Action:** Don O_2 mask, 100%, Establish Communications
Immediate actions	
Action: Thrust IDLE, spoilers EMER, A/P disconnect	**Action:** Advise ATC, squawk 7700, Ask for MSA and current QNH
Action: Pitch down 10° to 12°, descend VMO/MMO to altitude that does not require a mask	**Action:** Passenger signs ON
	Call: "Altitude passing ___"
WHEN ABLE	
Action: Re-Engage the Auto Pilot	
Call: "Emergency Descent checklist"	
	Call: "Emergency Descent checklist complete"

NOTE: To get the spoilers out to the EMER detent requires pushing the button on top of the handle which you normally never do. Also, if you have aft pressure on the handle as you try to push the button, it may hang up. Relax the pressure on the handle momentarily to be able to engage it. Once established in the descent, it may be wise to re-establish the automation.

E. COMPLETION STANDARDS

- Immediate recognition and response
- Oxygen masks donned within seconds
- Airspeed: Not to exceed VMO/MMO
- Proper use of spoilers and bank angle
- Level off at appropriate altitude
- Appropriate crew coordination and ATC notification

XXVII. WINDSHEAR RECOGNITION AND ESCAPE

A. INTRODUCTION

If extreme windshear is encountered, recommendations are the FAA technique of flying the attitude indicator, using APR thrust, and climbing at just above stick shaker (target low speed cue + 10 kts initially) until a safe altitude is reached. Do not rely on pressure instruments until after exiting windshear conditions; reference the radio altimeter.

Be alert for windshear reports and conditions. Study approach weather and wind conditions carefully. Be prepared to use thrust if a sudden sustained airspeed loss on final approach is encountered. During the approach, be cognizant of increased performance windshear and how likely it may be followed by decreased performance windshear.

B. WINDSHEAR RECOGNITION

Marginal aircraft control may be recognized by uncommanded changes in the flight path. These values are guidelines only:

- ±15 KIAS airspeed change
- ±500 ft/min vertical speed change
- ±5° pitch attitude change
- Rapid one dot displacement from glideslope
- Unusual throttle position for a significant period of time

C. TAWS WINDSHEAR ALERTS

Mode 7 of the TAWS provides alerts and warnings if significant windshear is detected below 1500 ft AGL. The system provides "WINDSHEAR" aural warning and PFD annunciation.

D. WINDSHEAR ESCAPE PROCEDURE

Windshear escape should be performed whenever TAWS gives a WINDSHEAR warning or whenever aircraft control becomes marginal below 1000 ft AGL:

1. **Autopilot** — DISCONNECT
2. **Thrust levers** — APR detent
3. **Flight spoilers** — RETRACT (verify)
4. **Rotate smoothly** — to takeoff/go-around pitch attitude (10-15° initial)
5. **Wings level** — maintain
6. **If descent continues** — increase pitch smoothly, trade airspeed for altitude
7. **Target airspeed** — Low speed cue + 10 KIAS (stick shaker is upper limit)
8. **Configuration** — DO NOT change flaps or gear until clear

E. RECOVERY AND CLEANUP

- Once clear of windshear, aircraft accelerates rapidly with APR set
- Once "WINDSHEAR" removed from PFD, resume normal flight
- Check airspeed and adjust thrust/configuration as required
- Advise ATC of windshear and any excursions from cleared altitude or heading

F. CREW COORDINATION

WINDSHEAR ESCAPE

CAUTION: Maximum aircraft performance is achieved with maximum N1 and a pitch attitude that tickles the stick shaker; however, care must be given to avoid overcontrolling and inducing stick pusher activation.

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Windshear Recovery, Check N_1"	**Call:** "N1 Set"
Action: Disconnect A/P, thrust APR, retract spoilers, pitch 10-15°, target lsc +10 kts	**Action:** Monitor VSI/RADALT, Call out speeds to PF
If descent continues	**Call:** "Sink or Climb rate"
Action: Increase pitch toward stick shaker, wings level, no config change	**Action:** Monitor radio altimeter
Action: Resume normal flight	
Call: "Clear of windshear"	**Action:** Report to ATC

CAUTION: Do not rely on pressure instruments until after exiting windshear conditions, reference the radio altimeter.

G. COMPLETION STANDARDS

- Immediate recognition and response to windshear
- Proper escape technique (pitch, power, configuration)
- Airspeed managed near low speed cue + 10 KIAS
- Configuration unchanged until clear
- Appropriate crew coordination

XXVIII. TAWS RECOVERY

A. INTRODUCTION

The terrain awareness warning system (TAWS) of the Challenger 350 has seven modes. Modes 1 through 6 are basic TAWS functions while mode 7 includes windshear alerting. TAWS terrain alerting can be split into two areas — Caution and Warning.

B. ALERT TYPES

1. **Caution Area**
    - Penetration into a caution area generates:
    - "CAUTION TERRAIN" aural warning
    - GND PROX annunciation on the PFD
    - Occurs approximately 60 seconds prior to predicted ground impact
2. **Warning Area**
    - Penetration into a warning area generates:
    - "PULL UP" aural warning
    - PULL UP annunciation on the PFD
    - Occurs approximately 30 seconds prior to predicted ground impact

C. TAWS PULL-UP ESCAPE PROCEDURE

1. **Autothrottle (if installed)** — DISENGAGE
2. **Autopilot** — DISCONNECT
3. **Thrust levers** — APR detent
4. **Flight spoilers** — RETRACT (verify)
5. **Climb** — at maximum practical rate (10-15° initial pitch)
6. **Landing gear** — UP
7. **Maintain climb** — until warning ceases
8. **Once clear** — resume normal flight
9. **Check airspeed** — adjust thrust/configuration as required

D. CREW COORDINATION

TAWS RECOVERY

IMPORTANT: If altitude for recovery is critical, maximum aircraft performance can be achieved by applying enough back pressure on the yoke to maintain the edge of (tickle) stick shaker until clear of obstacles or terrain. Target low speed cue + 10 kts initially.

PF (Pilot Flying)	PM (Pilot Monitoring)
TAWS Alert	
Call: "TERRAIN RECOVERY, CHECK THRUST"	
Action: Disengage AP, Thrust to APR, Check spoilers retracted	**Call:** "APR SET"
Escape Maneuver	**Action:** Monitor climb performance
Action: Roll wings level, Pitch-up 10° to 15°, Target low speed cue + 10 kts initially	
Call: "Gear up"	**Call:** "Gear up"
Clear of Terrain	
Action: Maintain climb until TAWS warnings stop	
Call: "Clear of terrain"	
Action: Resume normal flight	**Call:** "Clear of terrain"
	Action: Notify ATC

NOTE: Your PFD terrain indications are a good source indicating peaks in the general area if not visual. Approach callouts from TAWS at "1000 AGL" and "500 AGL" are RADALT calls and not an indication above minimums — they advise proximity to ground and relative position to the approach.

E. COMPLETION STANDARDS

- Immediate response to TAWS warning
- Proper escape procedure (disconnect automation, APR, climb)
- Maximum practical climb rate maintained
- Warning ceased before resuming normal flight
- Appropriate crew coordination

XXIX. TCAS RESOLUTION ADVISORY (RA) PROCEDURES

A. INTRODUCTION

Either pilot can call TCAS traffic as it is noticed on the MFD. When a Resolution Advisory (RA) is issued, the crew must respond immediately by following the RA guidance displayed on the vertical speed indicator. The RA provides the safest vertical path to avoid collision with conflicting traffic.

B. TRAFFIC ADVISORY (TA) RESPONSE

When TCAS traffic is observed:

- PF: Optimize MFD scale so traffic is on outer edge of display
- PF: Direct PM to look outside for traffic
- Turn on all exterior lights (See and be Seen)
- PM: Look for traffic, continue to monitor for changes
- If visual, PM informs PF and continues monitoring

C. RESOLUTION ADVISORY (RA) PROCEDURE

The PF should take whatever Resolution Advisory (RA) attitude is directed by TCAS:

1. **Autothrottle (if installed)** — DISENGAGE
2. **Autopilot** — DISCONNECT
3. **Follow VSI indications** — as indicated by green band
4. **PM advises ATC** — "TCAS RA"
5. **After "CLEAR OF CONFLICT"** — resume normal navigation
6. **Advise ATC** — of RA maneuver and return to assigned altitude

D. TCAS VSI DISPLAY

During a TCAS RA, the vertical speed display shows:

- Red zone: Prohibited vertical speeds (avoid)
- Green zone: Required vertical speeds (fly into)
- Corrective RA: Shows "CLIMB" or "DESCEND" zones
- Preventive RA: Shows "DO NOT CLIMB" or "DO NOT DESCEND" zones
- Zones dynamically adjust based on traffic geometry

VSI DISPLAY DURING TCAS RA

Zone	Meaning	Action
Red Zone	Prohibited vertical speeds	AVOID — do not fly into red
Green Zone	Required vertical speeds	FLY INTO — follow guidance
Corrective RA	CLIMB or DESCEND displayed	Requires immediate maneuver
Preventive RA	DO NOT CLIMB/DESCEND	Maintain current vertical speed

E. CREW COORDINATION

TCAS RESOLUTION ADVISORY (RA)

IMPORTANT: TCAS RA takes precedence over ATC instructions. Follow the VSI green band.

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "TCAS RA"	**Call:** "TCAS RA"
Action: Disconnect A/P, follow VSI green band	**Action:** Advise ATC: "TCAS RA"
	Action: Attempt visual acquisition
"Clear of Conflict"	**Action:** Advise ATC of RA maneuver
Action: Resume normal navigation	**Action:** Confirm return to assigned altitude
Call: "Clear of conflict, returning to ___"	

F. COMPLETION STANDARDS

- Immediate response to RA
- Autopilot/autothrottle disconnected
- VSI maintained in green band
- ATC notified of RA
- Normal navigation resumed after "Clear of conflict"
- Appropriate crew coordination throughout

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CL-350



CL-350 SUPPLEMENTAL MANUAL

COLD WEATHER OPERATIONS

02

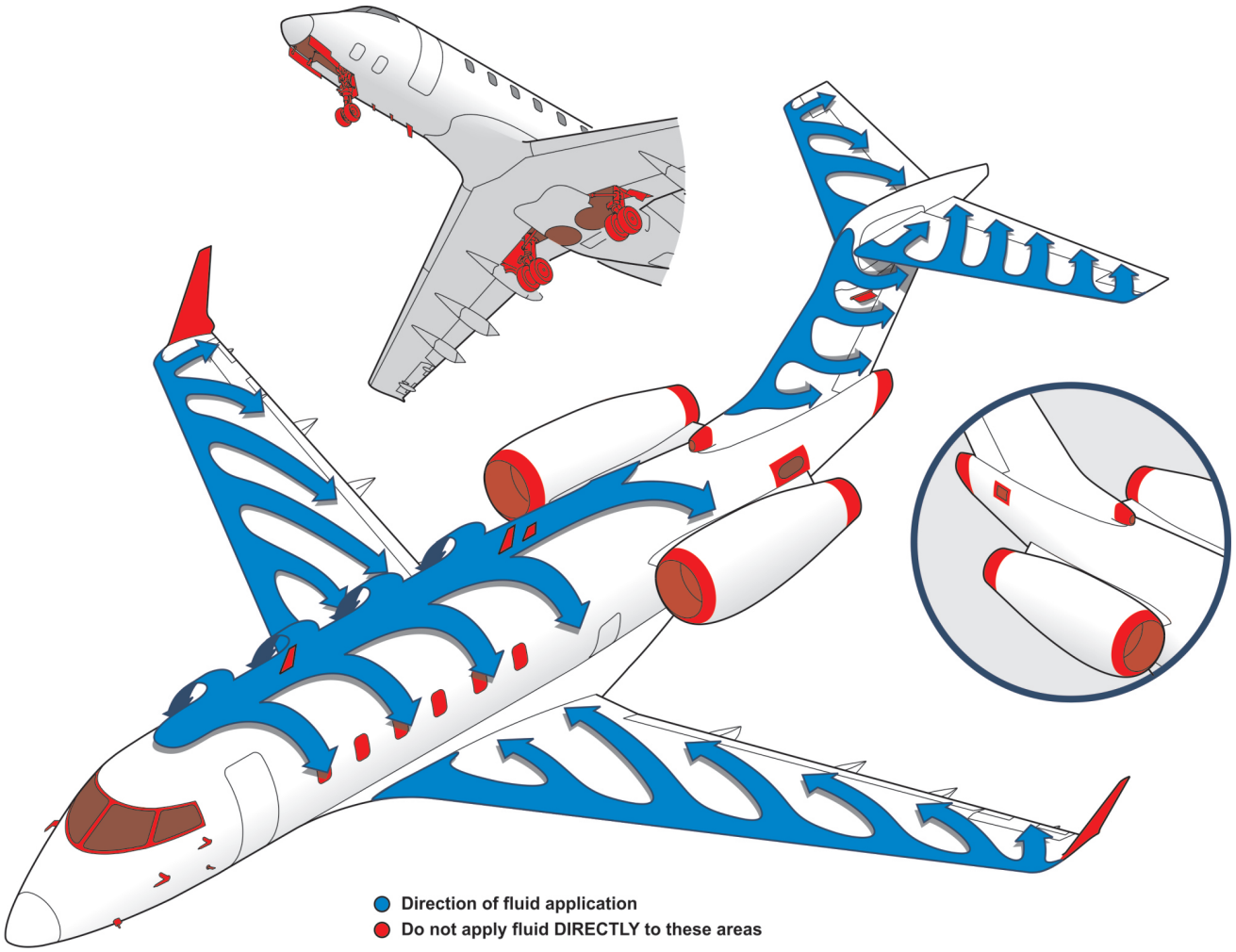
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COLD WEATHER OPERATIONS

I. INTRODUCTION

The winter season presents additional challenges to airplane operations resulting in low temperatures, the potentially hazardous effects of precipitation contaminating the airplane and the aircraft movement area, and extreme turbulence. It is the ultimate responsibility of the pilot-in-command to ensure the airplane is in a condition for safe flight prior to takeoff.

Adherence to the procedures in this section ensures an aerodynamically clean aircraft before takeoff. When operating in such conditions, these procedures account for operational hazards associated with frozen contamination. In all cases, the decision to operate should be based on the general rules of good airmanship applicable in cold weather operations and assurance that operational and system limitations will not be exceeded.



A. COLD WEATHER DEFINITIONS

Cold weather operations refer to ground handling, takeoffs and landings conducted on surface conditions where frozen moisture is present or conditions are conducive to moisture freezing. These conditions are commonly encountered when the surface temperature is at or below 0°C (32°F), although frozen moisture may persist at higher temperatures.

COMMON CONTAMINANTS

Contaminant	Description
Slush	Snow saturated with water which displaces with a splatter when stepped on firmly. Encountered at temperatures up to 5°C.
Wet Snow	Will easily stick together and tends to form a snowball if compacted by hand.
Dry Snow	Loose and can easily be blown. If compacted by hand, will readily fall apart again.
Frost	White crystalline deposit that develops uniformly on exposed surfaces during cold, calm, cloudless nights with high ambient dewpoint.
Rime Ice	Opaque and rough ice surface that adheres to surfaces exposed to wind. Easily detected and removed with deicing fluids.
Clear Ice	Hard, smooth, glassy coating that is very difficult to detect without tactile inspection. Adheres firmly and is difficult to remove.

B. CLEAN AIRCRAFT CONCEPT

The Clean Aircraft Concept prohibits takeoff when frost, ice, snow, or other contaminants are present on critical surfaces of the aircraft. All performance data are based on the airplane being aerodynamically clean prior to takeoff.

Adverse Effects of Contamination

- Decreased thrust and lift
- Increased drag and stall speeds
- Trim changes and altered stall characteristics
- Altered handling qualities

C. CRITICAL SURFACES

Critical surfaces include wings, horizontal stabilizer, vertical stabilizer, control surfaces, and engine inlets. Although the upper fuselage is not a critical surface, it must be deiced when wing and tail surfaces require deicing. The Challenger 350 utilizes a supercritical wing design with a fixed, highly polished leading edge that lacks movable high-lift devices (such as slats), making the aircraft more susceptible to loss of lift from contamination than aircraft equipped with leading-edge devices.

Even small amounts of frost, ice, snow, or slush adhering to the wing leading edges and forward upper wing surface will significantly increase drag and decrease lift, which adversely increases the aircraft's clean stall speeds and degrades stall characteristics.

This aerodynamic deterioration presents a severe safety risk because it reduces the margin of safety provided by the Stall Protection System (SPS); contaminated surfaces may cause the wing to stall at a lower angle of attack than the SPS is calibrated for, potentially resulting in a stall or loss of control on takeoff before the stick shaker or pusher can activate. Consequently, strictly adhering to the Clean Aircraft Concept is mandatory, and flight crews should utilize windshield contamination as a potential indicator of simultaneous contamination on the wing leading edges.

WARNING: Takeoff must not be attempted if snow, ice, or frost are present in any amount on the wings and tail surfaces. It must never be assumed that dry, loose snow will be removed by the slipstream during the takeoff roll.

II. DEICING/ANTI-ICING FLUIDS

The application of deicing/anti-icing fluid is the most common means of effecting ground deicing and anti-ice protection. These fluids are water/glycol solutions classified as Type I (AMS 1424), Type II, Type III, and Type IV (AMS 1428).

A. FLUID TYPES

DEICING/ANTI-ICING FLUID TYPES

Fluid Type	Characteristics	Notes
Type I	Minimum 80% glycol, no thickening agent, low viscosity	Very short holdover time; limited anti-ice protection unless takeoff is immediate
Type II & IV	Minimum 50% glycol with thickening agents, high viscosity	Significant holdover time; fluid flows off during takeoff from slipstream shear stress
Type III	Thickened fluid with properties between Types I and II	Longer holdover than Type I but less than Type II

B. HOLDOVER TIME

Holdover time is the estimated time that an application of approved deicing/antiicing fluid is effective in preventing frost, ice, or snow from adhering to treated surfaces. It begins at the start of final fluid application and expires when the fluid is no longer effective. The FAA publishes new hold over tables yearly.

CAUTION: Heavy weather, high precipitation rates, or high wind velocity may reduce holdover time below the lowest time stated. Holdover time may also be reduced when airplane skin temperature is lower than OAT.

C. DEICING/ANTI-ICING METHODS

Mechanical Removal

If significant amounts of loose snow are present, mechanical removal can reduce fluid expenditure. After removal, inspect for adhering ice, frost, or snow on critical surfaces.

One-Step Deicing/Anti-Icing

Fluid is applied in one step to remove frozen contamination and provide limited antiice protection. The residual fluid film provides only very limited duration of protection.

Two-Step Deicing/Anti-Icing

First step: Apply heated deicing fluid (pure water or Type I mixture). Second step: Apply anti-icing fluid (Type II, III, or IV mixture or undiluted Type I or III). The second step must be applied within 3 minutes of the first step or before the first step fluid freezes.

TYPE I DEICING FLUID APPLICATION GUIDELINES

Outside Air Temperature (OAT)	One-Step Procedure	Two-Step Procedure	
	Deicing/Anti-icing	First Step Deicing	Second Step Anti-icing [1]
–3°C (27°F) and above	Mix of fluid and water heated to 60°C (140°F) minimum at the nozzle with a freeze point of at least 10°C (18°F) below OAT.	Water or a mix of fluid and water, heated to 60°C (140°F) minimum at the nozzle.	Mix of fluid and water heated to 60°C (140°F) minimum at the nozzle with a freeze point of at least 10°C (18°F) below OAT.
Below –3°C (27°F)		Freeze point of heated fluid mixture not more than 3°C (5°F) above OAT.	

[1] To be applied before first step fluid freezes, typically within three (3) minutes.

***General Note for Heated Fluids:** A fluid temperature of not less than 60°C (140°F) at the nozzle is desirable.

TYPE II-III-IV ANTI-ICING FLUID APPLICATION GUIDELINES

Concentrations in % by Volume

Outside Air Temperature (OAT)	One-Step Procedure	Two-Step Procedure	
	Deicing/Anti-icing	First Step Deicing	Second Step Anti-icing [1]
–3°C (27°F) and above	50/50 heated [2] Type II-III or IV	Heated water or a heated mix of Type I-II-III or IV with water.	50/50 Type II-III or IV
–14°C (7°F) and above	75/25 heated [2] Type II-III or IV	Heated suitable mix of Type I or II-III-IV and water with a freeze point of not more than 3°C (5°F) above OAT.	75/25 Type II-III or IV
–25°C (–13°F) and above	100/0 heated [2] Type II-III or IV		100/0 Type II-III or IV
Below –25°C (–13°F)	Type II-III or IV fluid may be used below –25°C (–13°F) provided the freezing point of the fluid is at least 7°C (13°F) below OAT and the aerodynamic acceptance criteria, as defined by the fluid manufacturer's data sheets, are met. Consider use of Type I fluids when Type II-III or IV cannot be used.		

[1] To be applied before first step fluid freezes, typically within three (3) minutes.

[2] Clean aircraft may be anti-iced with unheated fluid.

***General Note for Heated Fluids:** A fluid temperature of not less than 60°C (140°F) at the nozzle is desirable.

III. DEICING/ANTI-ICING PROCEDURES

A. PREPARATION FOR DEICING

Before fluid is applied:

PREPARATION FOR DEICING

Before fluid is applied:

Item	Setting/Action
Airplane Position	Head into wind if possible
FLAPS	As required (Flaps 30 recommended)
Thrust Levers	IDLE for duration of operation
APU BLEED switch	OFF
APU	Shutdown
WING ANTI-ICE switch	OFF
L and R ENG ANTI-ICE switches	OFF
AIR SOURCE switch	OFF
STAB TRIM	0 recommended (set for takeoff after deicing)

B. FLUID APPLICATION SEQUENCE

Apply deicing/anti-icing fluid to the aircraft in the following sequence:

1. Horizontal stabilizer
2. Vertical stabilizer
3. Top of fuselage
4. Sides of fuselage
5. Wings

CAUTION: On flight control surfaces, apply fluid from leading edge to trailing edge, and from outer panels to inner panels. Never direct spray at trailing edges of control surfaces, as this may force contamination into hinge mechanisms.

C. AREAS TO AVOID DIRECT SPRAY

A spray trajectory of 10 ft is recommended. Avoid direct contact with:

- Windshields, side windows, and cabin windows
- Pitot/static and TAT probes
- AOA vanes and static pressure ports
- Engine air intake/exhaust, APU inlet
- Antennas, vents, and drains
- Wheels and brakes

D. POST-DEICING INSPECTION

After deicing, inspect the following areas to confirm complete deicing:

- Wings - leading edges, upper and lower surfaces
- Vertical and horizontal stabilizers - all surfaces
- Flaps, flap tracks, and flap drives
- Ailerons, elevators, rudder, and spoilers
- Air data probes/sensors, stall vanes
- Antennas, fuel drains, and NACA vent scoops
- Engine and APU intakes, APU exhaust
- Landing gear and landing gear bays
- Windshield, windows, door sills, and surrounds

CLEAR ICE DUE TO COLD FUEL

Cold fuel in wing tanks can cause clear ice to form on wing surfaces even when ambient temperature is above freezing.

CAUTION: Pilots must be aware of the effect that cold fuel in the tanks may have on moisture present on the wing upper and lower surfaces. If fuel temperature is 0°C (32°F) it is possible to have clear ice on the wing with the temperature above freezing.

Condition	Required Action
Fuel temperature at or below 0°C	Perform tactile (touch) check of wing upper surface
Clear ice detected	Must be removed before flight
OAT above freezing but fuel cold	Still inspect for clear ice formation

IV. PHASE OF FLIGHT PROCEDURES

A. EXTERNAL SAFETY INSPECTION

EXTERNAL SAFETY INSPECTION

The flight crew should be diligent during pre-flight to inspect areas where contamination could affect normal operations.

Item	Action
Protective covers	Removed (pitot, static, TAT, ice detector, AOA vane, fuel NACA vent, intake/exhaust covers)
Windshield and cockpit windows	Free of ice and snow
Airplane surfaces	Free of frost, ice, snow, and slush
Landing gear area	Check clear; latching mechanisms free
Engine inlet and cowlings	Check clear; verify fan rotation

NOTE: Clear Ice is difficult to detect visually. If conditions favor Clear Ice formation, examine surfaces by hand (tactile check) to confirm absence of contamination.

B. BEFORE STARTING ENGINES

Battery temperatures must be above -20°C before takeoff.

1. COCKPIT and CABIN COLD-HOT knobs: HOT
2. Warm cabin interior as soon as APU is started
3. Confirm N1 fan freedom to rotate before engine start

NOTE: LCD displays may not function at cabin temperatures below -20°C. At extremely low temperatures, the APU generator may not automatically come online; select APU GEN switch ON if this occurs.

C. STARTING ENGINES

During cold weather starts, initial oil pressure response may be slow. Oil pressure may indicate higher than normal range and should progressively reduce to normal readings as the engine achieves normal operating temperatures.

CAUTION: No oil pressure indication by the time idle RPM is achieved requires an immediate shutdown.

Oil Temperature Requirements

- Oil temperature must be 26°C or above for normal operations
- Between 15°C and 26°C: Operations permitted if fuel contains icing inhibitor
- Between 5°C and 15°C: Engine may be operated from idle up to but not including CLB power
- Do not advance engines above idle until oil temperature reaches 5°C

D. AFTER STARTING ENGINES

Anti-Ice System Requirements

ANTI-ICE SYSTEM REQUIREMENTS

Condition	Requirement
OAT ≤10°C with visible moisture	Engine inlet anti-ice ON
OAT ≤10°C on contaminated surfaces	Engine anti-ice ON
OAT ≤5°C with visible moisture for takeoff	Wing anti-ice ON
OAT ≤5°C on contaminated runway for takeoff	Wing anti-ice ON

WARNING: When Type II, III, or IV anti-icing fluids have been applied, use of wing anti-ice heat prior to takeoff can cook the fluid onto the leading edges of the wing causing contamination.

V. TAXI AND TAKEOFF

A. TAXI CONSIDERATIONS

- Avoid large nosewheel steering inputs
- Taxi at manageable speed (10 kt maximum on contaminated surfaces)
- Maintain greater distance between aircraft when contamination present
- Keep brake application to minimum during turns
- Be aware of increased residual thrust at cold temperatures
- Do not use thrust reversers on contaminated surfaces except for safety

Brake Warming Procedure

If conditions could result in water-saturated brakes, perform 7 consecutive brake applications from 20 kt to 5 kt during the last mile of taxi prior to takeoff. Do not drag the brakes. This prevents water-saturated brakes from freezing at altitude.

B. TAKEOFF LIMITATIONS

Takeoff is not recommended when:

TAKEOFF CONTAMINATION LIMITS

Takeoff is not recommended when runway contamination exceeds:

Contaminant	Maximum Depth
Standing Water	0.25 in
Slush	0.25 in
Wet Snow	0.50 in
Dry Snow	2.00 in

- During extreme weather conditions (freezing rain)
- When braking action is reported to be poor

C. TAKEOFF TECHNIQUE

- If wing leading edge roughness is observed or suspected, DO NOT attempt takeoff
- Apply power symmetrically to avoid yawing moments
- Anticipate lags in nosewheel steering response
- Use aerodynamic control as soon as available (ailerons improve directional control 60-100 kts)
- Anticipate tendency to overrotate at rotation
- Abort for minor discrepancies, even at low speeds

VI. CLIMB AND CRUISE

A. CLIMB PROCEDURES

- Delay landing gear retraction until excess water/snow/slush is thrown off by wheel rotation
- Increasing airspeed by 100 knots at low altitude can cause TAT rise of 16°F, helping shed ice formations

WARNING: Operation in areas where super-cooled large droplet (SLD) icing conditions exist is prohibited. SLD icing conditions are indicated by ice accretion on the flight compartment side windows.

B. CRUISE CONSIDERATIONS

WARNING: Even small accumulations of ice on the wing leading edge can change stall speed, stall characteristics, or warning margin. Do not reduce speed below VREF or land with visible ice on the wing except under failure conditions.

Icing Conditions

Icing conditions exist in flight at TAT of 50°F or below with visible moisture (clouds, rain, snow, sleet, or ice crystals), except when SAT is -40°F or below.

NOTE: Higher than normal engine vibration of a fluctuating nature may be experienced in icing conditions. Advancing engines to 70% N1 momentarily may shed the ice.

VII. DESCENT AND LANDING

A. APPROACH CONSIDERATIONS

- Avoid holding in icing conditions longer than necessary
- Coordinate intentions with ATC
- Ensure cleared runway width is sufficient
- Note applicable PIREPs for braking conditions
- Plan for stabilized approach on speed, on glide path
- Start APU early to help warm cabin

B. LANDING DIVERSION CRITERIA

A diversion should be considered when:

LANDING DIVERSION CRITERIA

A diversion should be considered when runway contamination exceeds:

Contaminant	Maximum Depth
Standing Water	0.50 in
Slush	0.50 in
Wet Snow	1.00 in
Dry Snow	2.40 in

C. LANDING TECHNIQUE

- Avoid landing during tailwind conditions on contaminated runways
- Make positive touchdown to ensure wheel spin-up and break out frozen brakes
- Lower nose wheel immediately; hold light forward column pressure
- Use maximum reverse thrust as soon as possible (most effective at high speed)
- Do not pump brakes; apply steadily increasing pressure
- Maintain directional control with rudder (effective to 50 kts)
- Anticipate skidding and hydroplaning

VIII. TAXI IN AND PARKING

CAUTION: Do NOT retract flaps to fully up position after landing on a contaminated runway. Confirm no significant ice/slush/snow in flap mechanism before completing retraction.

Taxi-In Considerations

- Anticipate that movement areas may be slippery
- Reverse thrust may be necessary to stop
- Park on clear or sanded area if possible
- Park into wind if possible

A. SHUTDOWN PROCEDURES

SHUTDOWN PROCEDURES

Item	Action
Wheel Chocks	Check in place
PARK/EMER BRAKE	OFF (to prevent brake freeze)
Protective Covers	Install
Water System	Perform cold weather servicing (purge if OAT <5°C)
Lavatory Waste System	Perform cold weather servicing (add anti-freeze)
Batteries	Remove if exposure to -22°F >10 hours
All Doors	Close

IX. SUPER-COOLED LARGE DROPLET (SLD) ICING

A. RECOGNITION

Super-cooled large droplet (SLD) conditions are distinct from normal icing due to the large mass and inertia of the water droplets, which impact leading edge surfaces further aft than smaller droplets. The presence of SLD can only be determined by observation of ice accumulation on the flight compartment side windows.

B. PROCEDURES

WARNING: Operation in SLD icing conditions is prohibited. Following recognition of SLD icing conditions by observation of side window icing, engine and wing anti-icing systems must be activated and it is necessary to leave SLD icing conditions immediately.

In case of inadvertent entry into SLD icing conditions:

- Leave icing conditions immediately when side window icing occurs
- Wing anti-icing system must be ON
- Engine anti-icing system must be ON
- After leaving SLD conditions, observe wing leading edges for ice formation on unheated surfaces aft of the leading edge

X. COLD TEMPERATURE COMPANSATION DURING APPROACHES

A. INTRODUCTION

Temperature has a significant effect on altimeter accuracy as it relates to true altitude. When the air is warmer than standard, the airplane is higher than the altimeter indicates. Conversely, when the air is colder than standard, the airplane is lower than indicated. When flying into a colder air mass while maintaining a constant indicated altitude, true altitude is decreasing.

B. ICAO COLD TEMPERATURE ERROR TABLE

The following table, derived from ICAO formulas, indicates how much error can exist when the temperature is extremely cold. Find the reported temperature in the left column, then read across to locate the height above the airport/reporting station. The intersection indicates how much lower the airplane may actually be:

ICAO COLD TEMPERATURE ERROR TABLE

Temperature has a significant effect on altimeter accuracy. When the air is colder than standard, the airplane is lower than indicated. The table below shows how much lower (in feet) the airplane may actually be:

WARNING: The colder the temperature, the greater the difference between true altitude and indicated altitude. In extreme cold conditions, especially in mountainous areas, pilots should exercise caution in flight planning both in regard to route and altitude to ensure adequate enroute and terminal area clearance.

°C	200	300	400	500	600	700	800	900	1000	1500	2000	3000	4000	5000
HEIGHT ABOVE AIRPORT IN FEET														
+10	10	10	10	10	20	20	20	20	20	30	40	60	80	90
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
–10	20	30	40	50	60	70	90	90	100	150	200	290	390	490
–20	30	50	60	70	90	100	130	130	140	210	260	420	570	710
–30	40	60	80	100	120	140	170	170	190	280	380	570	760	950
–40	50	80	100	120	150	170	220	220	240	360	480	720	970	1210
–50	60	90	120	150	180	210	270	270	300	450	590	890	1190	1500

C. EXAMPLE CALCULATION

Temperature –30°C (–22°F), and the airplane altitude is 3,000 ft above the airport elevation during a procedure turn. The chart shows that the reported current altimeter setting may place the airplane as much as 570 ft below the altitude indicated on the altimeter. When operating in a non-controlled environment, the procedure turn should be flown at 3,600 ft to ensure obstacle clearance. ATC radar vectoring altitudes are normally compensated for temperature.

D. FMS TEMPERATURE COMPENSATION

The altitude correction should be applied to all published altitudes, specifically minimum altitude (DA/MDA). The FMS INDEX Menu has a TEMP COMP feature. It is basically a calculator that can be used to find the corrected barometric altitude. Crew should use the TEMP COMP function of the FMS to carry on approaches in cold weather (usually below 0°C).

FMS TEMPERATURE COMPENSATION

The altitude correction should be applied to all published altitudes, specifically minimum altitude (DA/MDA).

Item	Procedure
FMS TEMP COMP Feature	Located in the FMS INDEX Menu; use as a calculator to find corrected barometric altitude
When to Use	Approaches in cold weather (usually below 0°C)
Baro Minimums	Set to compensated altitudes when temperature compensation is used
ATC Notification	Required when flying with temperature compensated altitudes

NOTE: The temperature restrictions in the notes section of approach charts must be observed. Temperatures that are well below standard cause a reduction in true altitude, which may infringe obstacle clearance criteria.

E. COLD WEATHER CONSIDERATIONS

COLD WEATHER CONSIDERATIONS SUMMARY

Key Points
• Apply temperature corrections to all published altitudes
• Use FMS TEMP COMP function for approaches in cold weather
• Be aware of icing conditions and activate anti-ice systems as required
• Consider increased fuel consumption at low temperatures
• Verify de-icing/anti-icing holdover times
• Monitor for any CAS messages related to ice protection systems
• Perform tactile checks for clear ice when cold fuel is suspected
• Notify ATC when flying temperature compensated altitudes

XI. REFERENCES

Transport Canada publishes guidance in the following documents:

- TP 14052 - Guidelines for Aircraft Ground-Icing Operations
- FAA Holdover Time Guidelines
- Airplane Flight Manual CSP 100-1 and CSP 100-6

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CL-350 SUPPLEMENTAL MANUAL

CONTAMINATED RUNWAY 03

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CONTAMINATED RUNWAY OPERATIONS

A. INTRODUCTION

Landing on a slippery surface requires careful consideration of many factors, such as type of runway surface, approach hazards, temperature, ice, water, snow, and other crosswind scenarios. Normally, thrust reverser operation helps achieve the computed stopping distance with a greater margin of safety. Wet and contaminated runway data is published in the AFM and AFM Supplements.

B. HYDROPLANING

If there is a possibility of hydroplaning, use aerodynamic braking to slow below hydroplaning speed.

Hydroplaning Speed Calculations:

- Accelerating aircraft: 9 × √(tire pressure) ≈ 112 kt (main gear at 167-175 psi)
- Decelerating aircraft: 8 × √(tire pressure) ≈ 100 kt

CAUTION: If brakes are applied while the tires are hydroplaning, the hydroplaning can continue to a much lower speed.

C. ONE ENGINE INOPERATIVE (OEI) LANDING ON SLIPPERY RUNWAYS

With one engine inoperative, thrust reversers may not be as effective on a contaminated runway as on a dry runway:

- Full single-engine reverse is acceptable on a dry runway from a directional control standpoint
- Do not attempt high power single-engine reverse on slippery runways
- Differential reversing on a slippery runway may not yield satisfactory performance
- Be prepared to stow thrust reversers immediately if the airplane begins to slide sideways

IMPORTANT: The effects of single-engine reverse may be substantially different in crosswind scenarios depending if the acting thrust reverser is upwind or downwind.

D. LANDING TECHNIQUE ON SLIPPERY SURFACES

- Firm touchdown to ensure positive wheel spin-up
- Lower nosewheel promptly
- Verify spoilers deploy automatically
- Deploy thrust reversers smoothly
- Use aerodynamic braking before applying wheel brakes
- Apply brakes smoothly and progressively
- Be prepared for reduced braking effectiveness

E. CROSSWIND CONSIDERATIONS

Crosswind landings on slippery runways require additional consideration. Maintain a positive de-crab just prior to touchdown and be prepared for the aircraft to weathervane into the wind after touchdown. Keep the upwind wing slightly low through the rollout to counteract the weathervaning tendency.

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CL-350 SUPPLEMENTAL MANUAL

CRM | 04

LOFT.AERO

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CREW COORDINATION, NORMAL PROCEDURES & CALLOUTS

INTRODUCTION: THE FOUNDATIONS OF CREW RESOURCE MANAGEMENT

Background

You're about to operate one of the most capable business jets ever built. The Challenger 350 is fast, efficient, and packed with technology that would have seemed like science fiction a generation ago. But here's what decades of accident investigation have taught us: the most sophisticated aircraft in the world is only as good as the crew flying it.

Crew Resource Management grew out of a hard truth. In 1979, NASA convened a workshop to examine why aircraft accidents kept happening even when nothing was mechanically wrong with the airplane. The answer was uncomfortable but undeniable: human error contributes to 60 to 80 percent of all aviation incidents and accidents. And the errors weren't about stick-and-rudder skills. They were about crews that didn't communicate, didn't challenge bad decisions, and didn't work together when it mattered most.

For decades, pilot training had focused almost exclusively on individual technical proficiency, how well you could fly the airplane alone. What the industry had overlooked was equally fundamental: how well you could fly it with someone else. Poor group decision-making, ineffective communication, weak leadership, and mismanaged workloads were taking down airplanes flown by technically competent pilots. CRM was the aviation community's response - a deliberate effort to train the human side of flying with the same rigor we apply to systems and procedures.

The Mission of CRM Training

The purpose of CRM training is simple and serious: prevent accidents by making crews more effective together. The briefings, callouts, and coordination procedures in this chapter aren't bureaucratic overhead. they're the practical tools that turn two pilots into a genuine team. These techniques benefit every crew, regardless of certification requirements, because they address something universal: the reality that two people working well together will always outperform two individuals working in parallel.

Flying the Challenger 350 as a well-coordinated crew is one of the most rewarding experiences in professional aviation. The jet's advanced systems and outstanding performance deserve a crew that matches its sophistication, pilots who communicate clearly, anticipate each other's needs, and bring out the best in one another. That's the standard we're working toward.

Communication

Step into the cockpit of a modern business jet and one thing becomes immediately clear: this is a team environment. Every phase of flight from preflight planning to the parking checklist requires constant, open communication between crewmembers. Sometimes it's a quick verification: "What altitude did he say?" Other times it's a quiet observation that heads off a bigger problem: "Did you notice that oil leak on the preflight?" This continuous cross-check of information is what separates professional crews from pilots who merely share a cockpit.

There's something genuinely satisfying about a crew that clicks, where questions flow freely, decisions are made collaboratively, and both pilots finish the flight knowing they brought out the best in each other. That kind of teamwork doesn't happen by accident. It's built through deliberate practice, mutual respect, and a shared commitment to getting it right.

Your responsibility as a crewmember is clear: if you see something that affects safety, say it. Ask questions. Offer recommendations. Test assumptions. If something doesn't sit right, speak up, with appropriate persistence, until the concern is addressed. This isn't just encouraged; it's expected.

The Captain holds final authority, but the best captains actively want input from their crew. Contributing to the decision-making process isn't a challenge to authority, it's exactly what professional crew coordination looks like. The key is balancing assertiveness with tact: saying what needs to be said while maintaining the professional respect that makes effective teamwork possible.

The Challenger 350 gives you the tools to fly with precision, efficiency, and confidence. CRM gives you the framework to do it together, and that's where the real satisfaction of professional crew operations begins.

I. RESPONSIBILITIES AND CREW COORDINATION

A. CREW ROLES

Pilot-in-Command (PIC):

- Designated by company; responsible for conduct and safety of flight
- Directs necessary operations to safely accomplish flight

Second-in-Command (SIC):

- Assists PIC in accomplishing safety goals

Pilot Flying (PF):

- Controls aircraft (heading, altitude, airspeed)
- Directs operations; calls for checklists and configuration changes

Pilot Monitoring (PM):

- Maintains ATC communications and obtains clearances
- Accomplishes checklists; makes altitude and deviation callouts
- Performs tasks as directed by PF

B. KEY PRINCIPLES

- Both crew members maintain situational awareness at all times
- Communicate and complement each other
- Work together as a team
- When action not completed, PM prompts via question: "Would you like...?"

II. CHECKLISTS

A. CHALLENGE-RESPONSE METHOD

- PF initiates the checklist
- PM challenges PF by reading item aloud
- PF accomplishes item and responds orally
- PM monitors accomplishment, moves to next item
- After completion: PM states "[checklist name] complete"
- Challenge-Response-Response is also acceptable

B. STANDARD RESPONSES (80% OF PF RESPONSES)

- Actual switch position (ON/OFF/ARMED, etc.)
- TEST/SET/CHECK

C. CRITICAL SWITCH PROCEDURES

For safety-critical controls (engine fire switches, generators, engine run switches):

- Pilot performing action verifies with other pilot before moving control
- Duplicated controls read with position and action (e.g., 'Left Thrust Lever - IDLE')

D. FLOW PATTERNS

- Used for normal procedures to accomplish cockpit setup
- After flow, accomplish checklist to verify proper setup
- Checklist becomes "done list" instead of "do list"
- NOT used for non-normal or emergency procedures

III. PILOT INCAPACITATION (TWO CHALLENGE RULE)

- If PM challenges deviation and PF doesn't respond orally
- PM issues second challenge (loud and clear)
- If no response after second challenge, PM assumes PF incapacitated
- PM announces "I have control" and takes necessary action
- Incapacitated PF responds "you have control" if able

IV. RADIO TUNING AND COMMUNICATION

- PM accomplishes NAV/COM radio tuning and identification
- PM handles ground contacts and clearances
- Before changing NAV radio, confirm no effect on autopilot
- After tuning: "(Facility) tuned and identified"

V. PREFLIGHT BRIEFINGS

A. STANDARD ITEMS

- Anticipated weather and low weather contingencies
- Potential problems (delays, unruly passengers)
- Safety considerations (evacuation, passenger count)
- Operational issues (deicing, performance-limited airports)
- Threats
- "Advise me" of any abnormality

VI. EMERGENCY EVACUATION PLAN

If no Flight Attendant, copilot assumes F/A duties:

- Upon command, leaves cockpit and opens proper exit
- Takes passengers upwind to rendezvous point
- Counts occupants; pilot completes checklist and joins outside

VII. CONFIGURATION CHANGES AND MALFUNCTIONS

A. CONFIGURATION CHANGE ADVISORIES

- Alert other crewmember before making control/config changes
- Announce abrupt flight path changes if time permits

B. CRITICAL MALFUNCTIONS

- Observing crewmember positively announces malfunction indication
- PM attempts to identify malfunction to PF
- PIC announces decision and commands checklist

C. NON-NORMAL/EMERGENCY PROCEDURES

Preflight briefing designates: who controls aircraft, who performs tasks, what items monitored. Both pilots must respond to emergencies requiring immediate action.

NOTE: QRC can be used to perform immediate action items without relying solely on memory.

VIII. REJECTED TAKEOFFS

A. REJECTION CRITERIA

Prior to 80 KIAS:

- Reject for ANY abnormality

Between 80 KIAS and V_1:

Reject ONLY for:

- Master warnings
- Directional control problems
- Safety of flight issues

B. REJECTED TAKEOFF PROFILE

Either pilot announces: “Stop, Stop, Stop” OR “Reject, Reject, Reject” OR “Abort, Abort, Abort”

PF immediately:

- Thrust levers - IDLE
- Brakes - Maximum or as required
- Thrust reversers - Max reverse or as required

PM immediately:

- Notifies ATC of the Abort
- Monitors TR and Spoiler Deployment
- Monitors Speeds

NOTE: Do not delay braking while thrust reversers deploy.

IX. DEVIATIONS DURING FLYING

PM calls out deviations from normal SOPs. Announcements should be specific and timely.

Deviation Callouts

Parameter	Threshold	PM	PF
Courses	±5°	"Left of Course"	"Correcting"
Altitudes	±100 ft from assigned	"Climbing through 9,000"	
Airspeed	±10 kt	"Airspeed high"	"Correcting"
Descent Rate	>1,000 fpm on final	"Sink rate"	"Correcting"
DH/DA	1/4 scale G/S or LOC	"Localizer"	"Correcting"
MDA	Below selected altitude	"MDA"	

X. GENERAL PROTOCOLS

1. **FMS Usage:** Never replace judgment or ability to revert to non-FMS navigation. FMS is only as good as it's programmer.
2. **Heads-Up Discipline:** One crewmember always heads-up. Avoid both pilots in FMS. No FMS programming during critical phases of flight.
3. **Cockpit Division:** Left switches = left-seat pilot. Right switches = right-seat pilot. Inform other pilot of selections.
4. **AFCS Communication:** Confirm who controls autopilot. Both pilots confirm transfer of control. PF informs PM of AP on/off.
5. **Flight Guidance Panel (FGP):** The 350 has a single FGP. When the autopilot is on the PF has control and makes all selections. When the autopilot is off the PM makes the selections at the request of the PF.
6. **Active FD Modes:** All active FD mode changes shall be confirmed on the FMA and verbalized by the crewmember managing the FGP. Normally the PF announces the change with a confirmation from the PM. However, if the PM observes the change and no call is made by the PF, the PM will verbalize the change, expecting confirmation from the PF.
7. **Landing Gear and Flap Handles:** Should only be moved by the PM but only at the command of the PF. The PM moving either handle on his own on an approach instead of at the direction of the PF, shows a breakdown of cockpit discipline.
8. **Heading Bug:** When the autopilot is on, the PF manipulates the heading bug. When the autopilot if off, the PM man manipulate the heading bug at the instruction of the PF.
9. **Altitude Selector:** Altitude preselector is always operated by the PM. That said, some SOPs may require it to be set by the PF when the autopilot is on.
10. **Precision Approach:** When cleared for the approach and at the glideslope (GS) intercept altitude, set the altitude preselect to the missed approach altitude (MAA). If the missed approach altitude is below the glideslope intercept altitude, the aircraft will fly through the altitude (rather than capturing it) provided the flight director (FD) captured the GS.
11. **LPV Approach (VGP):** VNAV should be engaged. When cleared for the approach and at the vertical glide-path (VGP) intercept altitude, set the altitude preselect to the missed approach altitude (MAA) once the VGP is captured. If the missed approach altitude is below the VGP intercept altitude, the aircraft will fly through the altitude (rather than capturing it) provided the flight director (FD) captured the VGP.
12. **Nonprecision Approach:** When cleared for the approach, select the next lower stepdown altitude at each intermediate altitude. Do not select the next lower altitude until the green ALTS illuminates. At the MDA, set the altitude preselect for the missed approach.
13. **Nonprecision Approach (VPATH):** When cleared for the approach, select the MDA (Minimum Descent Altitude). Monitor the vertical descent profile while respecting any approach altitude constraints. At the MDA, set the altitude preselector for the missed approach and continue to the MAP (Missed Approach Point).
14. **CDFA Approach:** Prior to passing the FAF (Final Approach Fix) deselect VNAV and select VS (Vertical speed) thereby respecting the AFM limitations and assuredly capturing the MDA while maintaining a constant descent rate which matches the original VPATH profile.
15. **Autopilot Trim:** Properly trim before engaging autopilot to prevent trim clacker events and facilitate handling if AP disconnects.

XII. PILOT TAKEOFF BRIEFING

A. BRIEFING ITEMS

- Takeoff runway and SID; altitude/speed restrictions, gradients
- Calculated takeoff distance vs. runway available
- Taxi plan (RVO/LVO, hotspots)
- Takeoff FLAP setting
- Bleed/Anti-Ice requirements
- Takeoff weight
- N_1 thrust setting
- V_1 / V_R / V_2 / V_{FTO}
- Noise abatement procedures (if applicable)
- Acceleration altitude
- Standard takeoff callouts
- Transition altitude
- FGP Modes
- Non-Normal/emergency briefing
- Rejected takeoff criteria
- Evacuation plan
- Weather
- Threats or deviations from standard (reported windshear, etc)
- Ask if any questions

B. T-S-R-E-D EMERGENCY BRIEFING MNEMONIC

	Item	Content
T	Type of Takeoff	Flaps setting, rolling/standing start Runway, length, takeoff distance required V-speeds: V_1, V_R, V_2, V_{FTO} N_1 setting
S	Standard Calls	"Airspeed alive", "N_1 set", "80 kts crosscheck", "V_1", "V_R", "Positive rate"
R	Reject Items	"Prior to 80 kts - any abnormality" "80 kts to V_1 - Master warnings, Directional control, Safety of flight"
E	Emergency Plan	Engine failure after V_1 plan Return airport/approach (Discuss Overweight landing if necessary)
D	Departure	SID name Noise abatement (NADP1/NADP2) Initial heading/altitude

C. EXAMPLE T-S-R-E-D BRIEFING

	Item	Content
T	Type of Takeoff	This will be a Flaps 10, rolling takeoff on runway 24 right, length is 11,000 ft., takeoff distance required with rolling takeoff is 4,933 ft. V_1 is 128 V_R is 132 V_2 is 139 V_{FTO} is 157 N_1 is 88.6
S	Standard Calls	Calls are "Airspeed alive", "N_1 set", "80 kts crosscheck", "V_1", "V_R", and "Positive rate"
R	Reject Items	Takeoff will be rejected Prior to 80 kts for any abnormality" Between "80 kts to V_1 – We will reject for Master warnings, Directional control, or Safety of flight issues"
E	Emergency Plan	In the event Engine failure after V_1, we will continue the takeoff. We will plan to remain VFR and return for a visual approach to runway 24 right. We will not be overweight.
D	Departure	This is the Montreal One departure using Noice Abatement procedure NADP1/NADP2, runway heading to 5,000ft. ANY QUESTIONS?

XII. STANDARD CALLOUTS

A. TAKEOFF

A. TAKEOFF

PF (Pilot Flying)	PM (Pilot Monitoring)
Cleared for takeoff	
Call: "Runway Lineup checklist"	**Action:** Complete Runway Lineup checklist **Call:** "Runway Lineup checklist complete"
Action: Place hand on thrust levers. Move up two clicks to the TO detent. **Call:** "Set N1" **Action:** Verify Thrust levers in the TO detent	**Call:** "N1 set"
	Action: At first sign of airspeed **Call:** "Airspeed alive"
Call: "Check"	**Action:** At 80 KIAS **Call:** "80 knots...crosscheck"
Action: Move hand from thrust levers to control wheel	**Call:** "V1" **Call:** "Rotate"
Action: Rotate to takeoff attitude	**Action:** When the VSI is showing positive climb and the indicated altitude is increasing **Call:** "Positive rate"
Call: "Gear up"	**Call:** "Gear up" **Action:** When all gear lights extinguished: **Call:** "Gear indicating up"
	Call: "V2+15 (Flaps 10) or V2+25 (Flaps 20)"

A. TAKEOFF continued

PF (Pilot Flying)	PM (Pilot Monitoring)
Action: Above 400 ft AGL and clear of obstacles: **Call:** "Flaps up"	**Call:** "Flaps up" **Action:** Verify flap position indication up **Call:** "Indicating up"
	Above 700 ft **Call:** "Autopilot is available"
Call: "Autopilot On"	
Call: "After Takeoff checklist"	**Action:** After contacting departure control or the next radar center, do the After Takeoff checklist. **Call:** "After Takeoff checklist complete"
Call: "CLIMB Check"	**Action:** Pressurization check every 10,000 ft **Call:** "Climb Check complete"

B. CLIMB

B. CLIMB

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Climb – Transition checklist"	**Action:** Complete Climb – Transition checklist **Call:** "Climb – Transition checklist complete"
	Call: "_____ (altitude) climbing _____ (altitude)"
Call: "_____ (altitude) climbing _____ (altitude)"	

C. CRUISE

C. CRUISE

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Cruise checklist"	
	Action: Complete the Cruise checklist
	Call: "Cruise Checklist complete"

D. DESCENT / TRANSITION

D. DESCENT / TRANSITION

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Descent checklist"	
	Action: Complete the Descent checklist
	Call: "Descent Checklist complete"
Call: "Descent – Transition checklist"	
	Action: Complete Descent – Transition checklist
	Call: "Descent – Transition checklist complete"
Call: "_____ (altitude) descending _____ (altitude)"	
At 1,000 ft before assigned altitude	
	Call: "_____ (altitude) descending _____ (altitude)"
Call: "_____ (altitude) descending _____ (altitude)"	

E. PRECISION APPROACH (ILS/LPV)

E. PRECISION APPROACH (ILS/LPV)

Prior to Beginning the Precision Approach (ILS/LPV)

Prior to 31 nm from destination or below FL180: Accomplish approach planning and briefing during the cruise or initial descent, if possible, or at least when called for in the Approach Checklist.

Entering the terminal area (31nm): Select within the FMS an approach. If performing an LPV approach, verify the PFD A1 line is showing "LPV ARM " and 1 nm scaling.

NOTE: Once on vectors, sequence the FMS. Recall the 3-2-1 Rule: Within controlled airspace of 3 = 3000', 2 = maximum 200 kts, and 1 = within 10 nm. For LOC based approaches, if the PFD is selected to ROSE format a dotted cyan preview of the HSI inbound course is displayed and superimposed on the active Magenta HSI. Verification of the LOC frequency should also be done. Within the airport environment and the course deviation indicator of the approach captured, verify the PFD A1 line for "LPV ARM " and the FMA vertical GP is armed. This confirms VNAV is engaged if required.

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Approach checklist"	
	Action: Complete the Approach checklist
	Call: "Approach checklist complete"
Call: "Flaps 10 (Slow to 160 kts)"	
	Call: "Speed check; flaps 10"
	Call: "Indicating 10"
Call: "Localizer/Course alive"	**Call:** "Localizer/Course alive"
Call: "Glideslope/Glidepath alive"	**Call:** "Glideslope/Glidepath alive"
Call: "Flaps 20 (Slow to 140 kts)"	
	Call: "Speed check; flaps 20"
	Call: "Indicating 20"
1 DOT below Glideslope/glidepath	
Call: "Gear down"	
	Call: "Gear down, three green"
Call: "Gear down, three green"	

E. PRECISION APPROACH (ILS/LPV) continued

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Flaps 30, Before Landing checklist (Slow to Vref)"	
	Call: "Speed check; Flaps 30...Indicating 30"
	Call: "Before Landing complete"

NOTE: Verify the PFD A1 line for "LPV APPR" message and not "NO APPR"

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Glideslope/Glidepath captured"	
	Call: "Check"
Call: "Set missed approach altitude"	
	Call: "Missed approach altitude set"
At 1,000 ft above DH	**Call:** "1,000 above minimums"
If IMC, should be stable at 1000' above minimums If VMC, should be stable at 500' above minimums	
Call: "Check/Stable (IMC)"	
At 500 ft above DH	**Call:** "500 above minimums"
Call: "Check/Stable (VMC)"	
No flags	
At 100 ft above DH	**Call:** "Approaching minimums"
Call: "Check"	

E. PRECISION APPROACH (ILS/LPV) continued

PF (Pilot Flying)	PM (Pilot Monitoring)
At Minimums or when runway environment is in sight	
	Call: "Minimums"
	or
	Call: "Runway (or visual references) _____ o'clock (lead-in lights)"
Call: "Visual Landing"	
Call: "Autopilot disconnect"	
	Call: "Check"
After touchdown	
Action: Brakes applied and thrust reversers as required	
	Call: "Spoilers extended; TRs deployed "
	Call: "Airspeeds: 80, 60, 40 kts"

NOTE: Spoilers automatically extend after touchdown. Monitor both thrust reversers and spoilers

PF (Pilot Flying)	PM (Pilot Monitoring)
After clearing the active runway	
Call: "After Landing/Clearing Runway checklist"	
	Action: Complete After Landing/Clearing Runway checklist
	Call: "After Landing/Clearing Runway checklist complete"

F. PRECISION MISSED APPROACH / GO-AROUND

F. PRECISION MISSED APPROACH

At minimums and no runway environment in sight

PF (Pilot Flying)	PM (Pilot Monitoring)
	Call: "Minimums, Go-Around"
Call: "Go-Around Set N1"	**Action:** Verify the N1 setting for go-around
Action: Press the go-around TO/GA button, advance Thrust to Takeoff (TO) detent, Flight Spoilers retract (if extended), Pitch up to the command bars.	**Call:** "N1 Set"
Call: "Flaps 10"	**Call:** "Flaps 10"
	Call: "Indicating 10"
	Action: When the VSI is showing positive climb and the indicated altitude is increasing
	Call: "Positive rate"
Call: "Gear up"	**Call:** "Gear up "
	Call: "Gear indicating up"

NOTE: If an FMS approach was flown, the FMS will auto sequence into the missed approach and only a vertical mode on the FGP is required for navigation purposes. If a LOC based approach is flown, the NAV source must be changed from Green to Magenta source and then the appropriate FGP selections can be made (SNAP).

PF (Pilot Flying)	PM (Pilot Monitoring)
Missed approach procedures	**Action:** Announce initial heading and altitude for missed approach
	Clear of obstacles
	Call: "VGA+15 KIAS"
Call: "Flaps 0"	
	Call: "Flaps 0"
	Call: "Indicating 0"
Call: "Go-Around checklist"	When at safe altitude and time permitting, accomplish the Go-Around checklist
	Call: "Go-Around checklist complete"

G. NON-PRECISION APPROACH

G. NON-PRECISION APPROACH

Prior to 31 nm from destination or below FL180: Accomplish approach planning and briefing during the cruise or initial descent, if possible, or at the latest when called for in the Approach checklist.

Within the terminal area (31nm): Select an approach in the FMS. Verify the PFD A1 line is showing "RNP ARM" and 1 nm Scaling.

NOTE: Once on vectors, sequence the FMS. Recall the 3-2-1 rule: Within controlled airspace of 3 = 3000', 2 = maximum 200 kts, 1 = within 10 nm. Within the airport environment and the course deviation indicator of the approach captured, verify the PFD A1 line for "RNP ARM" and the FMA vertical GP is armed. This confirms VNAV is engaged if required.

PF (Pilot Flying)	PM (Pilot Monitoring)
Call: "Approach checklist"	
	Action: Initiate the Approach checklist
	Call: "Approach checklist complete"
After level-off intermediate approach segment	
Call: "Flaps 10 (Slow to 160 kts)"	
	Call: "Speed check; flaps 10"
	Call: "Indicating 10"
At initial convergence of course deviation indicator	
	Call: "Course alive"
Call: "Course alive"	
When course deviation indicates captured and tracking inbound	
	Call: "Course captured"
Call: "Course captured"	

NOTE: Verify the PFD A1 line for "RNP APPR" message. Also verify the FMA vertical mode GP is armed.

PF (Pilot Flying)	PM (Pilot Monitoring)
5 nm prior to FAF or 2 dots below VGP	
Call: "Flaps 20 (Slow to 140 kts)"	
	Call: "Speed check; flaps 20"
	Call: "Indicating 20"

G. NON-PRECISION APPROACH continued

PF (Pilot Flying)	PM (Pilot Monitoring)
At one DOT below VGP	
Call: "Gear down"	Call: "Gear down"
	Call: "Gear down three green"
Call: "Gear down three green"	
Prior to the FAF: Confirm the PFD A1 line is indicating "RNP APPR"	
PF (Pilot Flying)	**PM (Pilot Monitoring)**
1 nm prior to FAF or VGP intercept	
Call: "Flaps 30, Before Landing Check (Slow to Vref)"	Call: "Speed check, flaps 30"
	Call: "Indicating 30"
	Call: "Landing Checklist Complete"
At Final Approach Fix (FAF)	**Action:** Start timing
	Action: Visually crosscheck that both altimeters agree
	Action: Set MDA (to nearest 10 ft above) in Preselected Altitude
At 1,000 ft above MDA	Call: "1,000 above minimums"
If IMC, should be stable at 1000' above minimums If VMC, should be stable at 500' above minimums	
Call: "Check/Stable if IMC"	
At 500 ft above MDA	Call: "500 above minimums"
Call: "Check/Stable if VMC"	
At 100 ft above MDA	Call: "Approaching minimums"
Call: "Checked"	

G. NON-PRECISION APPROACH continued

PF (Pilot Flying)	PM (Pilot Monitoring)
At minimum descent altitude (MDA)	**Call:** "Minimums, (time) or (remaining distance) to go"
Call: "Checked"	
At point where the runway or runway environment is in sight	**Call:** "Runway (or visual references) _____ o'clock (lead-in lights)"
Call: "Visual"	
Call: "Autopilot disconnect"	**Call:** "Check"
After touchdown	
Action: Maintain runway alignment. Brakes applied and thrust reversers as required.	**Call:** "Spoilers extended, TRs deployed"
	Call: "Airspeeds during deceleration (80, 60, 40 kt)"

NOTE: Spoilers automatically extend after touchdown. Monitor the thrust reversers.

PF (Pilot Flying)	PM (Pilot Monitoring)
After clearing the active runway	
Call: "After Landing/Clearing Runway checklist"	**Action:** Complete After Landing/Clearing Runway checklist
	Call: "After Landing/Clearing Runway checklist complete"

H. NON-PRECISION MISSED APPROACH / GO-AROUND

H. NON-PRECISION MISSED APPROACH / GO-AROUND

At MAP and no runway environment in sight

PF (Pilot Flying)	PM (Pilot Monitoring)
	Call: "Minimums (or MAP), Go-Around"
Call: "Go-Around, set N1"	**Action:** Verify the N1 setting for go-around
Action: Press the go-around TO/GA button. Advance Thrust to the Takeoff (TO) Detent unless AT engaged, Flight Spoilers Retract (if extended). Pitch up to the command bars.	**Call:** "N1 set"
Call: "Flaps 10"	**Call:** "Flaps 10"
	Call: "Indicating 10"
	Action: When the VSI is showing positive climb and the indicated altitude is increasing
	Call: "Positive rate"
Call: "Gear up"	**Call:** "Gear up"
	Call: "Gear indicating up"
Missed approach procedures	**Action:** Announce initial heading and altitude for missed approach
Action: Announce initial heading and altitude for missed approach	Clear of obstacles
	Call: "VGA + 15 KIAS"
Call: "Flaps 0"	
	Call: "Flaps 0"
	Call: "Indicating 0"
Call: "Go-Around checklist"	**Action:** When at safe altitude and time permitting, accomplish the Go-Around checklist
	Call: "Go-Around check complete"

NOTE: These procedures are not SOPs. Each operator develops their own SOPs. AFM takes precedence over this guidance.

NOTE: Additional standard callouts for other maneuvers are included in the maneuvers section of the manual.

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CL-350



CL-350 SUPPLEMENTAL MANUAL

HIGH ALTITUDE OPERATIONS 05

LOFT.AERO

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HIGH ALTITUDE OPERATIONS

A. INTRODUCTION

The Challenger 350 is certified for flight up to FL 450. High altitude operations require special consideration of physiological factors, aircraft performance, and procedural requirements. Crews must be thoroughly familiar with emergency descent procedures and oxygen system operation. During your training you will experience both emergency descents as well as high altitude stalls.

B. PHYSIOLOGICAL CONSIDERATIONS

Time of Useful Consciousness (TUC):

At altitudes above FL 350, TUC decreases rapidly. The times shown are for average, healthy individuals at rest. Physical activity or underlying health conditions can significantly reduce these times.

TIME OF USEFUL CONSCIOUSNESS (TUC)

Altitude (measured barometrically)	TUC (rapid decompression)
FL180 (18,000 ft)	10 to 15 minutes
FL220 (22,000 ft)	5 minutes
FL250 (25,000 ft)	1.5 to 3.5 minutes
FL280 (28,000 ft)	1.25 to 1.5 minutes
FL300 (30,000 ft)	30 to 60 seconds
FL350 (35,000 ft)	15 to 30 seconds
FL400 (40,000 ft)	7 to 10 seconds
FL430 (43,000 ft)	5 to 6 seconds
FL500 (50,000 ft)	5 seconds

C. RVSM OPERATIONS

Reduced Vertical Separation Minimum (RVSM) airspace exists between FL 290 and FL 410. Operating in RVSM airspace requires:

- Aircraft RVSM approval
- Two independent altitude measurement systems
- Altitude alerting system
- Autopilot with altitude hold capability
- Transponder with altitude reporting

RVSM ALTITUDE KEEPING REQUIREMENTS:

- Altitude: ±65 feet of assigned flight level
- Altitude alerting within ±300 feet
- Autopilot use recommended
- See in Airwork and Manu chapter

NOTE: When safe, practical, and in accordance with the carrier's approved operating procedures, pilots should limit vertical speeds to 1,500 fpm or less when within 2,000 feet of assigned altitudes. This procedure will reduce the frequency of unnecessary RAs.

D. HIGH ALTITUDE CLIMB CONSIDERATIONS

During climbs in FLC mode at higher altitudes (high FL 300s and above), it is possible that air mass variations may contribute to slight pitch variations. These variations are more noticeable in the flight compartment than in the cabin.

- FLC is the recommended vertical mode for normal climbs
- If pitch variations are excessive, VS mode may be used with caution
- Check pressurization system at each 10,000 ft interval during climb
- Monitor pressure differential vs. cabin altitude

E. HIGH ALTITUDE STALL RECOVERY

If a stall occurs at high altitudes, it will be necessary to pitch the aircraft below the horizon to obtain sufficient airspeed to not encounter a secondary stall. Altitude loss will occur in order to increase airspeed. Reference the AOA indicator and low speed cue for recovery guidance.

WARNING: At high altitude, the margin between stall speed and maximum operating speed (coffin corner) is significantly reduced. Maintain awareness of both speed limits and avoid abrupt control inputs.

F. PRESSURIZATION MONITORING

- Monitor cabin altitude and differential pressure
- Be aware of maximum differential pressure limits
- Know the emergency descent procedure
- Verify crew oxygen availability
- Confirm passenger oxygen system functionality during preflight

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CL-350



CL-350 SUPPLEMENTAL MANUAL

EMERGENCY PROCEDURES 06

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GENERAL

Procedures given in this chapter of the Airplane Flight Manual are concerned with foreseeable but unusual situations in which immediate and precise crew action is taken consistent with controlling the aircraft on the desired flight path, as indicated by the items within the "boxed" area at the beginning of each procedure, will substantially reduce the risk of disaster. These "boxed" items are considered immediate action items.

TERMINOLOGY

Land as soon as possible – A landing should be accomplished at the nearest suitable airfield considering the severity of the emergency, weather conditions, field facilities, ambient lighting, and aircraft gross weight.

Land as soon as practical – Emergency conditions are less urgent, and landing at the nearest suitable airfield may not be necessary.

AIR CONDITIONING & PRESSURIZATION

CABIN ALTITUDE (W)  **"CABIN ALTITUDE"**

1. **Crew Oxygen Masks ..... Don**
2. **Pilot and Copilot O2 MASK/NORM switches ..... O2 MASK**
3. **Autothrottle (if installed) ..... Disengage**
4. **Thrust levers ..... IDLE**
5. **Autopilot ..... Disconnect**
6. **FLIGHT SPOILERS lever ..... EMER**
7. **Descend at M_{MO}/V_{MO}, but not below minimum safe altitude.**

WARNING: – If structural failure is evident, limit speeds and maneuvering loads as much as possible in descent.

– Operation above 20,000 ft cabin altitude may result in decompression sickness.

NOTE: Descent from 45,000 ft to 15,000 ft requires approximately 4 minutes.

8. Pilot and Copilot INPH switches ..... INPH

If time and conditions permit:

9. Controlling Agency ..... Notify
10. Transponder ..... Emergency 7700
11. Passengers ..... Check condition and provide assistance

END

AIR CONDITIONING & PRESSURIZATION

Effectivity:

For aircraft 20501 to 20886:

CABIN DELTA P (W)

Cabin Delta P is greater than 9.2 psid:

Yes

1. MANUAL PRESSURIZATION switch ..... ON
2. MAN RATE control ..... UP, as required to reduce differential pressure.

Refer to the Pressurization Schedule in the following page.

CABIN DELTA P (W) remains on:

Yes

3. One L or R BLEED switch ..... OFF
4. Adjust N_1 on opposite engine to control cabin pressurization.

If still unable to regulate the over pressurization:

5. AIR SOURCE switch ..... OFF
6. Descend, but not below minimum safe altitude.

– END –

No

– END –

No

Cabin Delta P is less than –0.5 psid:

1. MANUAL PRESSURIZATION switch ..... ON
2. MAN RATE control ..... DN, as required to increase differential pressure.

Refer to the Pressurization Schedule in the following page.

CABIN DELTA P (W) remains on:

3. Decrease aircraft descent rate.

END

AIR CONDITIONING & PRESSURIZATION

Effectivity:

For aircraft 20501 to 20886:

PRESSURIZATION SCHEDULE — CLIMB AND CRUISE

Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)
-1500	-1786	0.2	15 000	1379	5.7	33 000	4955	8.5
-1000	-1273	0.2	16 000	1504	6.0	34 000	5272	8.5
0	-245	0.1	17 000	1637	6.2	35 000	5612	8.5
1000	-135	0.6	18 000	1778	6.4	36 000	5877	8.5
1500	-81	0.8	19 000	1926	6.7	37 000	6076	8.6
2000	-26	1.0	20 000	2091	6.9	38 000	6331	8.6
3000	81	1.5	21 000	2258	7.1	39 000	6586	8.7
4000	187	1.9	22 000	2429	7.2	40 000	6827	8.7
5000	294	2.3	23 000	2608	7.4	41 000	7056	8.7
6000	399	2.7	24 000	2795	7.6	42 000	7272	8.8
7000	504	3.1	25 000	2984	7.7	43 000	7476	8.8
8000	610	3.5	26 000	3189	7.9	44 000	7669	8.8
9000	716	3.8	27 000	3404	8.0	45 000	7850	8.8
10 000	816	4.2	28 000	3628	8.1	-	-	-
11 000	925	4.5	29 000	3864	8.2	-	-	-
12 000	1036	4.8	30 000	4111	8.3	-	-	-
13 000	1150	5.1	31 000	4375	8.4	-	-	-
14 000	1268	5.4	32 000	4653	8.4	-	-	-

PRESSURIZATION SCHEDULE — DESCENT AND HOLD (<25 000 FT)

Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)
-1500	-1786	0.2	15 000	1118	5.8	33 000	4699	8.6
-1000	-1291	0.2	16 000	1229	6.1	34 000	5098	8.6
0	-299	0.2	17 000	1347	6.3	35 000	5487	8.6
1000	-202	0.6	18 000	1473	6.6	36 000	5782	8.6
1500	-155	0.9	19 000	1606	6.8	37 000	6064	8.6
2000	-107	1.1	20 000	1756	7.0	38 000	6332	8.6
3000	-13	1.5	21 000	1907	7.2	39 000	6587	8.7
4000	80	2.0	22 000	2063	7.4	40 000	6828	8.7
5000	173	2.4	23 000	2226	7.6	41 000	7057	8.7
6000	264	2.8	24 000	2396	7.8	42 000	7273	8.8
7000	356	3.2	25 000	2569	7.9	43 000	7477	8.8
8000	448	3.5	26 000	2754	8.1	44 000	7670	8.8
9000	540	3.9	27 000	2948	8.2	45 000	7850	8.8
10 000	626	4.3	28 000	3151	8.3	-	-	-
11 000	721	4.6	29 000	3366	8.4	-	-	-
12 000	818	4.9	30 000	3591	8.5	-	-	-
13 000	918	5.2	31 000	3873	8.6	-	-	-
14 000	1022	5.5	32 000	4291	8.6	-	-	-

AIR CONDITIONING & PRESSURIZATION

Effectivity:

For aircraft 20887 to 22999:

CABIN DELTA P (W)

Cabin Delta P is greater than 10.1 psid:

Yes

1. MANUAL PRESSURIZATION switch ..... ON
2. MAN RATE control ..... UP, as required to reduce differential pressure.

Refer to the Pressurization Schedule in the following page.

CABIN DELTA P (W) remains on:

Yes

3. One L or R BLEED switch ..... OFF
4. Adjust N_1 on opposite engine to control cabin pressurization.

If still unable to regulate the over pressurization:

5. AIR SOURCE switch ..... OFF
6. Descend, but not below minimum safe altitude.

– END –

No

– END –

No

Cabin Delta P is less than –0.5 psid:

1. MANUAL PRESSURIZATION switch ..... ON
2. MAN RATE control ..... DN, as required to increase differential pressure.

Refer to the Pressurization Schedule in the following page.

CABIN DELTA P (W) remains on:

3. Decrease aircraft descent rate.

END

AIR CONDITIONING & PRESSURIZATION

Effectivity:

For aircraft 20887 to 22999:

PRESSURIZATION SCHEDULE – CLIMB AND CRUISE

Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)
–1,500	–1,786	0.2	15,000	756	6.0	33,000	3,300	9.2
–1,000	–1,273	0.1	16,000	845	6.3	34,000	3,525	9.3
0	–245	0.1	17,000	933	6.6	35,000	3,742	9.3
1,000	–180	0.6	18,000	1,022	6.8	36,000	3,926	9.4
1,500	–148	0.9	19,000	1,111	7.1	37,000	4,111	9.5
2,000	–116	1.1	20,000	1,201	7.3	38,000	4,295	9.5
3,000	–53	1.6	21,000	1,311	7.5	39,000	4,479	9.6
4,000	11	2.0	22,000	1,422	7.7	40,000	4,650	9.7
5,000	75	2.4	23,000	1,534	7.9	41,000	4,848	9.7
6,000	139	2.8	24,000	1,646	8.1	42,000	5,114	9.7
7,000	203	3.2	25,000	1,775	8.3	43,000	5,369	9.7
8,000	268	3.6	26,000	1,920	8.5	44,000	5,614	9.7
9,000	333	4.0	27,000	2,099	8.6	45,000	5,850	9.7
10,000	397	4.4	28,000	2,271	8.7	–	–	–
11,000	469	4.7	29,000	2,443	8.9	–	–	–
12,000	540	5.1	30,000	2,625	9.0	–	–	–
13,000	612	5.4	31,000	2,830	9.1	–	–	–
14,000	684	5.7	32,000	3,050	9.2	–	–	–

PRESSURIZATION SCHEDULE – DESCENT AND HOLD

Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)
–1,500	–1,786	0.2	15,000	712	6.0	33,000	2,989	9.4
–1,000	–1,290	0.2	16,000	801	6.3	34,000	3,206	9.4
0	–299	0.2	17,000	891	6.6	35,000	3,423	9.5
1,000	–235	0.6	18,000	980	6.8	36,000	3,629	9.6
1,500	–202	0.9	19,000	1,070	7.1	37,000	3,837	9.6
2,000	–170	1.1	20,000	1,161	7.3	38,000	4,064	9.7
3,000	–106	1.6	21,000	1,273	7.6	39,000	4,294	9.7
4,000	–42	2.0	22,000	1,385	7.8	40,000	4,572	9.7
5,000	23	2.5	23,000	1,498	8.0	41,000	4,848	9.7
6,000	88	2.9	24,000	1,611	8.2	42,000	5,114	9.7
7,000	153	3.3	25,000	1,726	8.3	43,000	5,369	9.7
8,000	218	3.7	26,000	1,867	8.5	44,000	5,614	9.7
9,000	283	4.0	27,000	2,011	8.7	45,000	5,850	9.7
10,000	349	4.4	28,000	2,155	8.8	–	–	–
11,000	421	4.8	29,000	2,299	8.9	–	–	–
12,000	494	5.1	30,000	2,445	9.1	–	–	–
13,000	566	5.4	31,000	2,625	9.2	–	–	–
14,000	639	5.7	32,000	2,807	9.3	–	–	–

AIR CONDITIONING & PRESSURIZATION

L (R) BLEED LEAK (W)

1. **XBLEED switch ..... Closed**
2. **Affected BLEED switch ..... OFF**

If R BLEED LEAK (W) is on:

3. **L BLEED switch ..... On**
4. **APU BLEED switch ..... OFF**

END

PACK LEAK (W)

1. **AIR SOURCE switch ..... TRIM AIR ONLY**

PACK LEAK (W) remains on after 90 seconds:

Yes

2. AIR SOURCE switch ..... OFF
3. Altitude ..... 9,000 ft maximum, but not below minimum safe altitude.
4. EMER DEPRESS switch ..... ON
5. RAM AIR switch ..... ON

– END –

No

PACK LEAK (W) extinguishes:

2. Altitude ..... 35,000 ft maximum
3. COCKPIT COLD–HOT knob (for cockpit & cabin) ..... As Desired

On approach below 9000 ft but not below minimum safe altitude:

4. AIR SOURCE switch ..... OFF
5. EMER DEPRESS switch ..... ON
6. RAM AIR switch ..... ON

END

AIR CONDITIONING & PRESSURIZATION

L (R) PYLON BLEED LEAK (W)

1. Autothrottle (if installed) ..... Disengage

Affected Engine:

2. Thrust lever ..... IDLE

CAUTION: If caution persists, do not engage Autothrottle.

If PYLON BLEED LEAK (W) remains on:

3. Affected engine RUN switch ..... OFF
4. Refer to Engine Shutdown In Flight procedure in the NON–NORMAL PROCEDURES Chapter.

END

TRIM AIR LEAK (W)

1. AIR SOURCE switch ..... PACK ONLY

TRIM AIR LEAK (W) remains on after 90 seconds:

Yes

2. AIR SOURCE switch ..... OFF
3. Altitude ..... 9,000 ft maximum, but not below minimum safe altitude.
4. EMER DEPRESS switch ..... ON
5. RAM AIR switch ..... ON

– END –

No

TRIM AIR LEAK (W) extinguishes:

2. COCKPIT COLD–HOT knob (for cockpit & cabin) ..... As Desired

END

AUTO FLIGHT

AP STAB TRIM FAIL (C)

1. **Airspeed ..... Stabilize**
   and return to speed when AP STAB TRIM FAIL posted or when AP HOLDING message goes out.

WARNING:
- An abrupt change in control force up to approximately 50 lbs, or an out of trim situation may be experienced when disconnecting the autopilot especially if combined with AP HOLDING NOSE DOWN. NOSE UP.
- SMKG/BELTS should be selected on.
- Minimize changes to airspeed and configuration prior to autopilot disconnect to minimize control forces and out of trim situation.

2. Flight controls ..... Hold firmly
3. Autopilot ..... Use control wheel MSW switch to disconnect
4. Autopilot ..... Do not use
5. Retrim airplane if necessary.

Stabilizer trim unresponsive in one or both directions, trim moving slower than normal or inconsistently, trim moving opposite to command.

Yes

6. Refer to Chapter 5, CAUTIONS PROCEDURES, FLIGHT CONTROLS, Stabilizer Trim Malfunction

– END –

No

END

AUXILIARY POWER UNIT

APU FIRE (W)



"APU FIRE"

1. APU FIRE switch ..... FIRE push
2. FIRE EXT 2 switch ..... ARMED push

APU is supplying bleed air for air conditioning

Yes

3. XBLEED switch ..... Closed
4. L BLEED switch ..... ON
5. APU BLEED switch ..... OFF
6. R BLEED switch ..... ON
7. APU switch ..... OFF
8. Land as soon as possible.

– END –

No

3. APU switch ..... OFF
4. Land as soon as possible.

END

APU OVERTEMP (W)

1. APU switch ..... OFF

2. XBLEED switch ..... Closed
3. L BLEED switch ..... ON
4. APU BLEED switch ..... OFF
5. R BLEED switch ..... ON

END

AVIONICS

MULTI–FUNCTION DISPLAY (MFD) ANNUNCIATIONS

The following messages will indicate in red.

HDG

If HDG is displayed on left MFD:

1. ATT/HDG REVERSION switch 2

If HDG is displayed on right MFD:

1. ATT/HDG REVERSION switch 1

Following reversion, if HDG is displayed on both MFDs:

2. Monitor standby compass.
3. Land as soon as possible.

END

PRIMARY FLIGHT DISPLAY (PFD) ANNUNCIATIONS

ALT

1. Monitor standby instrument.

If ALT is displayed on left PFD:

2. AIR DATA REVERSION switch 2

If ALT is displayed on right PFD:

2. AIR DATA REVERSION switch 1

Effectivity:

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

3. Cross check standby instrument.

NOTE: If any of the following occurs, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed:

- Pitch attitude, thrust setting or external noise not consistent with indicated airspeed,
- Large airspeed differences between PFDs and/or ISI,
- Loss of multiple airspeed indications.

END

AVIONICS

PRIMARY FLIGHT DISPLAY (PFD) ANNUNCIATIONS

AP

1. Control wheel MSW switch..... Depress and release

NOTE: – An autopilot monitored disconnect is not always accompanied by a yaw damper failure/disconnect.

– Depressing the MSW will cancel the AP disconnect aural warning.

END

ATT

1. Monitor standby instrument.

If ATT is displayed on the left PFD:

2. ATT/HDG REVERSION switch 2

If ATT is displayed on the right PFD:

2. ATT/HDG REVERSION switch 1

Effectivity:

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

3. Cross check standby instrument.

Following reversion, if ATT is displayed on both PFDs:

4. Monitor standby instrument.
5. Land as soon as possible.

END

FD

If the FD flag is displayed on the side the transfer arrow is pointing to:

1. Flight Guidance Panel XFR button..... Select opposite side

NOTE: If a red FD flag is displayed during an LPV approach with indications of an air data or attitude/heading failure, refer to IAS Failure or ATT/HDG Failure in this chapter.

END

AVIONICS

PRIMARY FLIGHT DISPLAY (PFD) ANNUNCIATIONS

FMS 1 FMS 2
LOC 1 LOC 2
VOR 1 VOR 2

1. NAVSRC button ..... Select cross−side source

NOTE: If a red FMS flag is displayed during an LPV approach with indications of an air data or attitude/heading failure, refer to IAS Failure or ATT/HDG Failure in this chapter.

2. LNDG ALT SOURCE SELECT ..... Select cross−side source (when FMS flag is shown)

END

HDG

If HDG is displayed on the left PFD:

1. ATT/HDG REVERSION switch 2

If HDG is displayed on the right PFD:

1. ATT/HDG REVERSION switch 1

Following reversion, if HDG is displayed on both PFDs:

2. Monitor standby compass.
3. Land as soon as possible.

END

IAS

1. Monitor standby instrument.

If IAS is displayed on the left PFD:

2. AIR DATA REVERSION switch 2

If IAS is displayed on the right PFD:

2. AIR DATA REVERSION switch 1

▼

AVIONICS

PRIMARY FLIGHT DISPLAY (PFD) ANNUNCIATIONS

IAS (Cont)

Effectivity:

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

3. Cross check standby instrument.

NOTE: If any of the following occurs, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed:

- Pitch attitude, thrust setting or external noise not consistent with indicated airspeed,
- Large airspeed differences between PFDs and/or ISI,
- Loss of multiple airspeed indications.

END

MACH

1. Monitor standby instrument.

If MACH is displayed on the left PFD:

2. AIR DATA REVERSION switch 2

If MACH is displayed on the right PFD:

2. AIR DATA REVERSION switch 1

Effectivity:

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

3. Cross check standby instrument.

NOTE: If any of the following occurs, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed:

- Pitch attitude, thrust setting or external noise not consistent with indicated airspeed,
- Large airspeed differences between PFDs and/or ISI,
- Loss of multiple airspeed indications.

END

AVIONICS

PRIMARY FLIGHT DISPLAY (PFD) ANNUNCIATIONS

RA

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL with a failed radio altimeter. AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

1. Autothrottle (if installed) ..... Disengage prior to 200 feet AGL
2. Do not conduct Cat II approaches.
3. Normal actual landing distance ..... Multiply by:
   1.20 without thrust reversers
   1.15 with thrust reversers

After Touchdown:

4. FLIGHT SPOILERS lever ..... EMER

END

VNV

1. Use alternate means of vertical navigation.

END

VS

If VS is displayed on the left PFD:

1. AIR DATA REVERSION switch 2

If VS is displayed on the right PFD:

1. AIR DATA REVERSION switch 1

END

AVIONICS

TCAS Aurals  **“TCAS Aurals”**

"CLEAR OF CONFLICT"

Resume normal flight.

Resolution Advisory (RA)

For a Resolution Advisory (RA), Autopilot and Autothrottle (if installed) should be disengaged to adjust flight path and thrust manually.

"CLIMB, CLIMB"

Change vertical speed to 1,500 feet/min. climbing or as indicated on the VSI.

"CLIMB, CROSSING, CLIMB – CLIMB, CROSSING, CLIMB"

Change vertical speed to 1,500 feet/min. climbing or as indicated on the VSI. The converging flight paths will cross at some altitude.

"DESCEND, DESCEND, DESCEND"

Change vertical speed to 1,500 feet/min. descending or as indicated on the VSI.

"DESCEND, CROSSING, DESCEND – DESCEND, CROSSING, DESCEND"

Change vertical speed to 1,500 feet/min. descending or as indicated on the VSI. The converging flight paths will cross at some altitude.

"LEVEL–OFF, LEVEL–OFF"

Bring the airplane to level flight.

"INCREASE CLIMB – INCREASE CLIMB"

This follows a CLIMB advisory. The climb vertical speed should be increased, typically to 2,500 feet/min., as shown on the VSI.

"INCREASE DESCENT – INCREASE DESCENT"

This follows a DESCEND advisory. The descent vertical speed should be increased, typically to 2,500 feet/min., as shown on the VSI.

"CLIMB, CLIMB NOW"

This follows a DESCEND advisory. This advisory indicates that a reversal of vertical speed from descent to climb is needed to provide adequate separation.

"DESCEND, DESCEND NOW"

This follows a CLIMB advisory. This advisory indicates that a reversal of vertical speed from climb to descent is needed to provide adequate separation.

"MAINTAIN VERTICAL SPEED, MAINTAIN"

Maintain present vertical speed and direction.

▼

AVIONICS

TCAS Aurals (Cont)

"MAINTAIN VERTICAL SPEED, CROSSING, MAINTAIN"

A flight path crossing is predicted, but being monitored by TCAS. Maintain present vertical speed and direction.

Traffic Advisory (TA)

"MONITOR VERTICAL SPEED"

Be alert for approaching traffic.

"TRAFFIC, TRAFFIC"

Gain visual contact with traffic. Check TCAS display for traffic bearing and range if necessary.

END

TAWS Aurals



"TAWS Aurals"

"PULL UP" or

"TERRAIN, TERRAIN, PULL UP" or

"OBSTACLE, OBSTACLE, PULL UP"

1. **Autopilot ..... Disconnect**
2. **Autothrottle (if installed) ..... Disengage**
3. **Thrust levers ..... APR**
4. **FLIGHT SPOILERS ..... RETRACT**
5. **Climb at maximum practical rate.**
6. **LANDING GEAR switch ..... UP**
7. Maintain climb until the warning ceases.

– END –

"WINDSHEAR, WINDSHEAR"

1. **Autopilot ..... Disconnect**
2. **Autothrottle (if installed) ..... Disengage**
3. **Thrust levers ..... APR**
4. **FLIGHT SPOILERS ..... RETRACT**
5. **Rotate smoothly to the takeoff/go around pitch attitude, allowing airspeed to decrease if necessary. Maintain wings level. Do not retract flaps or landing gear.**

▼

AVIONICS

TAWS Aurals (Cont)

6. If the airplane continues to descend, increase pitch attitude smoothly and in small increments, bleeding airspeed as necessary to stop descent. Use stall warning onset (stick shaker) as the upper limit of pitch attitude.
7. Maintain escape attitude and thrust and delay retracting flaps or landing gear until safe climb out is assured.

END

ROAAS (If Installed)

RWY LENGTH (Red annunciation on PFD)



"RUNWAY LENGTH, RUNWAY LENGTH"

1. **Execute a go–around.**

NOTE: Contact with the ground may be unavoidable if go–around is initiated from a low altitude or high sink rate. If the airplane contacts the ground during the go–around, maintain the normal landing attitude or slightly higher. Airplane configuration (landing gear/flaps) should not be changed until the airplane is climbing if ground contact is made or not.

– END –

DECELERATE (Red annunciation on PFD)



"DECELERATE NOW"

1. **Brakes ..... Maximum**
2. **Thrust reversers ..... MAX REV**

END

RADIO ALTIMETER FAILURE

False or intermittent radio altimeter height and/or amber RA miscompare flag and/or red RA fail flag on PFD.

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL with a failed radio altimeter. AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

1. Autothrottle (if installed) ..... Disengage prior to 200 feet AGL

AVIONICS

RADIO ALTIMETER FAILURE

2. ROAAS (if installed) ..... OFF
3. Do not conduct Cat II approaches.
4. Normal actual landing distance ..... Multiply by:
   1.20 without thrust reversers
   1.15 with thrust reversers

After Touchdown:

5. FLIGHT SPOILERS lever ..... EMER

NOTE:
1. Do not rely on affected radio altitude displays.
2. TCAS and TAWS are inoperative. TCAS FAIL message on PFD or MFD and TAWS BASIC FAIL advisory message on.
3. Windshear detection and guidance is inoperative. TAWS WINDSHEAR FAIL advisory message on.
4. For an intermittent or undetected radio altimeter error, the following may be incorrect/inaccurate or inactive:
   - Displayed radio altitudes
   - LOC/GS comparators
   - Excessive deviation alerts
   - Expanded lateral deviation scale
   - Approach minimums annunciation.
5. For an intermittent or undetected radio altimeter error, localizer and/or glideslope AP/FD commands could be adversely affected.

END

AVIONICS

UNRELIABLE AIRSPEED

Indication:

- Pitch attitude, thrust setting or external noise not consistent with indicated airspeed.
- Loss of multiple airspeed indications.
- Multiple airspeed indications remain constant regardless of pitch or thrust adjustments.
- Airspeed difference between primary flight displays is more than 10 KIAS and/or more than 15 KIAS between any primary flight display and ISI and no reliable airspeed source can be determined.

NOTE:

1. If doubt exists about the reliability of aircraft speed indications, aircraft control must be established and maintained by the use of pitch and thrust settings.
2. Autopilot may not be available.
3. No crew action is required for the following procedures:
   - Caution messages: EFIS MISCOMPARE, EFIS COMPARATOR INOP, ADC Failure – Single, ADC Failure – Dual, ALT flag, IAS flag, MACH Flag, RUDDER LIMITER FAIL, SPOILERS FAIL,SPOILERS FAULT.

1. Autothrottle (if installed) ..... Disengage
2. Autopilot ..... Disconnect
3. FDs ..... Deselect
4. Airplane Altitude ..... Maintain a safe altitude

If Climb or Go–Around is required:

5. Pitch/N_1 ..... 15 degrees/TO from SL to 15,000 ft
10 degrees / CLB above 15,000 ft

6. Airplane Configuration ..... Flaps 10/ Gear Up for Go–Around
Flaps 0 / Gear Up once Climbing

CAUTION: Respect stall warning/stick shaker and stick pusher.

AVIONICS

UNRELIABLE AIRSPEED

At desired altitude:

7. Autopilot or Flight Director (if required and available) ..... Engage basic PTCH/ROLL

NOTE: 1. Using the FD/autopilot in PTCH, ALT, HDG and ROLL modes will help reduce workload.

2. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION: 1. Do not use FLC mode or Autothrottle (if installed).

2. Rudder travel limits may be inappropriate for phase of flight. For cruise and descent flight, excessive rudder input may result in unacceptable handling characteristics or exceedance of structural limits. For approach, landing and go–around flight, rudder authority may be limited. Differential thrust and aileron input may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

8. Pitch/N_1 ..... Set as per Table A.

NOTE: Leave current environmental conditions if they are considered to be a reason for unreliable airspeed. Refer to Tables B or C as required for climb or descent.

9. L and R ENG ANTI–ICE switches ..... As required
10. WING ANTI–ICE switch ..... As required

AVIONICS

UNRELIABLE AIRSPEED

NOTE:

1. SAT and TAT (if installed) indications may be unreliable. Wing and engine anti–ice systems must be ON when the ICE DETECTED CAS message is on, or when visible moisture in any form is encountered (such as clouds, rain, snow, sleet or ice crystals).
2. Autopilot/yaw damper should only be engaged once N_1 is set.
3. AOA indication (if equipped) is unreliable for flaps 0.
4. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Adjust pitch to stop climb/descent.
5. Disregard low speed cue, flight path vector and airspeed trend vector as these may be erroneous.
6. If overspeed warning sounds, select the affected AURAL WARNING switch off to mute aural and disregard.
7. A nuisance ELEVATOR SPLIT caution message can be disregarded.
8. Altitude, Mode C and TCAS may be in error by up to 600 feet. Vertical speed indications may also be unreliable.
9. Groundspeed indication may be unreliable.
10. FMS cruise time and fuel predictions may be incorrect.
11. Pri Stab Trim may be inoperative or operate erratically. Disengage autopilot and select Stab Trim to SEC if erratic stabilizer motion is observed.
12. Rudder Travel Limiter (RTL) display on EICAS synoptic will display actual RTL limits even if RTL goal posts are amber. These limits may be inappropriate for the phase of flight.
13. L (R) THRUST FAULT advisory message may post. Thrust lever adjustments may be required to keep engine parameters within limits.

Evaluate indicated airspeed sources in level flight as follows:

CAUTION: Airspeed should be considered reliable only if the following two conditions both exist:

1. Airspeed indication is consistent with pitch, thrust and airspeed range from Table A, and
2. Airspeed indication changes and speed trend vector are consistent with pitch and thrust adjustments.

11. AIR DATA reversion switch ..... Select to NORM

AVIONICS

UNRELIABLE AIRSPEED

12. Both PFDs and ISI ..... Compare airspeed to expected speed range from Table A.
13. Determine which of the following conditions apply:
    - If no indicated airspeed is considered reliable from Table A, proceed to step (13).
    - If one or more airspeed source is considered reliable from Table A, proceed to step (17).

NO RELIABLE AIRSPEED SOURCE

14. Airspeed Indications ..... Disregard
15. Pitch/N_1 ..... Set using Table A, B, C, D 1, D 2, D 3, or E as appropriate for phase of flight.
16. Land at the nearest suitable airport.
17. When ready to start descent, proceed to step (22)

ONE OR MORE AIRSPEED SOURCE IS CONSIDERED RELIABLE

18. AIR DATA reversion switch ..... Confirm NORM
19. Reliable airspeed source ..... MONITOR WITH CAUTION
20. Pitch/N_1 ..... Set using Table A, B, C, D 1, D 2, D 3 or E as appropriate for phase of flight and continue to monitor reliable airspeed source and airspeed range.

CAUTION:
1. Disregard airspeed indication if at any time it becomes unreliable.
2. AIR DATA reversion switch must remain in NORM position.

21. Land at the nearest suitable airport.
22. When ready to start descent, proceed to step (22)

Recovery to an airfield

23. Descent ..... Initiate when ready

AVIONICS

UNRELIABLE AIRSPEED

CAUTION: Rudder travel limits may be inappropriate for phase of flight. For cruise and descent flight, excessive rudder input may result in unacceptable handling characteristics or exceedance of structural limits. For approach, landing and go–around flight, rudder authority may be limited. Differential thrust and aileron input may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

To avoid significant flap overspeed and flap damage:

1. Transition from FLAPS 0 to FLAPS 20 must be accomplished in level flight (Table D 1, D 2 or D 3).
2. Select FLAPS 30 at the start of final descent on the glideslope/glidepath (Table E).

NOTE: 1. Plan to intercept a long final to allow time to re–configure for approach/landing and set pitch/N_1.

2. Plan to recover to an airfield with an ILS, LNAV or VNAV under Visual Meteorological Conditions on a wide runway of sufficient length with minimum turbulence and crosswind.

24. Unreliable aircraft systems ..... Review

- Ground proximity warning
- Windshear detection
- Landing gear warning horn
- Flap overspeed

25. Actual landing distance ..... Increase

WITHOUT THRUST REVERSERS	WITH THRUST REVERSERS
1.25 (25%)	1.20 (20%)

26. ROAAS (If installed) ..... OFF

NOTE: In the event of a go–around, refer to the immediate actions at the beginning of this procedure.

AVIONICS

UNRELIABLE AIRSPEED

NOTE:
1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected speed range by delta KIAS/delta Mach.
4. If pitch is decreased, INCREASE expected speed range by delta KIAS/delta Mach.

TABLE A – LEVEL FLIGHT CRUISE – FLAPS 0

	WEIGHT (LB)								EXPECTED SPD RANGE	EXPECTED SPD CHANGE FOR 0.5° CHANGE IN PITCH ΔKIAS/ ΔMACH
	24000		26000		28000		30000			
ALT (1000 FT)	PTCH (°)	N1 (%)	PTCH (°)	N1 (%)	PTCH (°)	N1 (%)	PTCH (°)	N1 (%)	KIAS/ MACH	
45	0.5	81.2*	1.0	82.0*	1.0	82.8*	1.0	83.9*	195–215/ .73–.79	5/0.01
40	0.5	78.0	0.5	78.7	1.0	79.3	1.0	79.9*	210–230/ .70–.76	5/0.01
35	–0.5	77.1	0.0	77.5	0.5	78.0	0.5	78.5	235–255/ .70–.75	10/0.02
30	–0.5	76.7	–0.5	77.0	0.0	77.4	0.0	77.8	260–280	10
25	–0.5	73.7	–0.5	74.0	–0.5	74.4	0.0	74.7	260–280	10
20	–0.5	70.6	–0.5	70.9	–0.5	71.2	0.0	71.5	260–280	10
15	–0.5	67.3	–0.5	67.7	–0.5	68.0	0.0	68.3	260–280	10
10	1.0	52.8	1.5	53.6	1.5	54.2	2.0	54.7	190–210	5
5	1.0	49.4	1.5	50.2	1.5	50.8	2.0	51.2	190–210	5

*At higher altitudes, it may not be possible to achieve the target N1 value with wing anti–ice ON. Initiate a descent to a lower altitude.
If any indicated speed is outside the expected indicated airspeed range, it should be considered UNRELIABLE.

AVIONICS

UNRELIABLE AIRSPEED

NOTE:
1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected speed range by delta KIAS/delta Mach.
4. If pitch is decreased, INCREASE expected speed range by delta KIAS/delta Mach.

TABLE A – LEVEL FLIGHT CRUISE – FLAPS 0 (CONT'D)

	WEIGHT (LB)						EXPECTED SPD RANGE	EXPECTED SPD CHANGE FOR 0.5° CHANGE IN PITCH ΔKIAS/ ΔMACH
	32000		34000		36000			
ALT (1000 FT)	PTCH (°)	N1 (%)	PTCH (°)	N1 (%)	PTCH (°)	N1 (%)	KIAS/ MACH	
45	2.0	84.5*	2.0	85.1*	2.5	85.2*	195–215/ .73–.79	5/0.01
40	1.0	80.7*	1.5	81.5*	1.5	82.2*	210–230/ .70–.76	5/0.01
35	0.5	79.0	0.5	79.5	1.0	80.0	235–255/ .70–.75	10/0.02
30	0.0	78.0	0.5	78.6	0.5	79.0	260–280	10
25	0.0	75.0	0.5	75.3	0.5	75.6	260–280	10
20	0.0	71.8	0.5	72.1	0.5	72.4	260–280	10
15	0.0	68.6	0.5	69.0	0.5	69.3	260–280	10
10	2.5	55.5	2.5	56.5	3.0	57.3	190–210	5
5	2.5	52.0	2.5	52.8	3.0	53.6	190–210	5

*At higher altitudes, it may not be possible to achieve the target N1 value with wing anti–ice ON. Initiate a descent to a lower altitude.
If any indicated speed is outside the expected indicated airspeed range, it should be considered UNRELIABLE.

AVIONICS

UNRELIABLE AIRSPEED

NOTE:
1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected speed range by delta KIAS/delta Mach.
4. If pitch is decreased, INCREASE expected speed range by delta KIAS/delta Mach.

TABLE A – LEVEL FLIGHT CRUISE – FLAPS 0 (CONT'D)

	WEIGHT (LB)						EXPECTED SPD RANGE	EXPECTED SPD CHANGE FOR 0.5° CHANGE IN PITCH ΔKIAS/ ΔMACH
	38000		40000		40600			
ALT (1000 FT)	PTCH (°)	N1 (%)	PTCH (°)	N1 (%)	PTCH (°)	N1 (%)	KIAS/ MACH	
45	NA	NA	NA	NA	NA	NA	195–215/ .73–.79	5/0.01
40	2.0	82.8*	2.0	83.5*	2.0	83.7*	210–230/ .70–.76	5/0.01
35	1.0	80.5	1.0	81.1	1.0	81.3	235–255/ .70–.75	10/0.02
30	0.5	79.4	0.5	79.8	0.5	79.9	260–280	10
25	0.5	75.9	0.5	76.2	0.5	76.3	260–280	10
20	0.5	72.7	0.5	73.0	0.5	73.1	260–280	10
15	0.5	69.6	0.5	69.9	0.5	70.0	260–280	10
10	3.0	58.2	3.5	59.1	3.5	59.3	190–210	5
5	3.0	54.4	3.5	55.3	3.5	55.5	190–210	5

*At higher altitudes, it may not be possible to achieve the target N1 value with wing anti–ice ON. Initiate a descent to a lower altitude.
If any indicated speed is outside the expected indicated airspeed range, it should be considered UNRELIABLE.

AVIONICS

UNRELIABLE AIRSPEED

NOTE: 1. Use FD in PTCH, ALT, HDG or ROLL modes only.

2. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION: 1. Rudder travel limits may be inappropriate for phase of flight. For cruise flight, excessive rudder input may result in unacceptable handling characteristics or exceedance of structural limits.

2. Do not use FLC mode.

Table B – Climb – FLAPS 0

ALT (ft)	Pitch (°)	N_1 (%)	Expected SPD Range	
			KIAS	MACH
0	14.5	TO	225–275	
5000	15.5	TO	205–255	
10000	14.0	TO	210–280	
15000	10.0	CLB	235–290	
20000	9.5	CLB	215–250	
25000	8.5	CLB	205–235	0.50–0.57
30000	7.0	CLB	205–225	0.55–0.61
35000	4.5	CLB	225–245	0.67–0.73

AVIONICS

UNRELIABLE AIRSPEED

NOTE: 1. Use FD in PTCH, ALT, HDG or ROLL modes only.

2. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION: 1. Rudder travel limits may be inappropriate for phase of flight. For cruise and descent flight, excessive rudder input may result in unacceptable handling characteristics or exceedance of structural limits. For approach, landing and go–around flight, rudder authority may be limited. Differential thrust and aileron input may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

2. Do not use FLC mode.

Table C – Descent – FLAPS 0

ALT (ft)	Pitch (°)	N_1 (%)	Expected SPD Range	
			KIAS	MACH
45000	–1.5	IDLE	200–220	0.75–0.81
40000	–2.5	IDLE	220–240	0.73–0.79
35000	–3.5	IDLE	240–260	0.71–0.77
30000	–4.5	IDLE	255–275	0.68–0.73
25000	–3.5	IDLE	240–260	0.58–0.63
20000	–3.5	IDLE	235–255	
15000	–1.5	IDLE	200–220	
10000	–1.5	IDLE	200–220	
5000	–2.0	IDLE	205–225	
0	–2.0	IDLE	200–220	

AVIONICS

UNRELIABLE AIRSPEED

NOTE:

1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected speed range by delta KIAS.
4. If pitch is decreased, INCREASE expected speed range by delta KIAS.
5. Use FD in PTCH, ALT, HDG or ROLL modes only.
6. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION:

1. Do not use FLC mode.
2. Rudder travel limits may be inappropriate for phase of flight. For descent excessive rudder input may result in unacceptable handling characteristics or exceedance of structural limits. For approach, landing and go–around, rudder authority may be limited. Differential thrust and aileron may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

To avoid significant flap overspeed and flap damage:

Transition from FLAPS 0 to 20 must be done in level flight.

Select FLAPS 30 at the start of final descent on the GS/GP.

Table D 1 – Approach – Level Flight – FLAPS 0 – GEAR UP

			WEIGHT (LB)					Expectd SPD Range KIAS	Expectd ΔKIAS per 0.5°Δ pitch
			24000	26000	28000	30000	32000		
ALT (1,000ft)	10	Pitch(°)	1.0	1.5	1.5	2.0	2.5	190– 210	5
		N1 (%)	52.8	53.6	54.2	54.7	55.5		
	5	Pitch(°)	1.0	1.5	1.5	2.0	2.5	190– 210	5
		N1 (%)	49.4	50.2	50.8	51.2	52.0		
	0	Pitch(°)	1.0	1.5	1.5	2.0	2.5	190– 210	5
		N1 (%)	46.6	47.3	47.8	48.2	48.9		

AVIONICS

UNRELIABLE AIRSPEED

NOTE:
1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected speed range by delta KIAS.
4. If pitch is decreased, INCREASE expected speed range by delta KIAS.
5. Use FD in PTCH, ALT, HDG or ROLL modes only.
6. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION:
1. Do not use FLC mode.
2. Rudder travel limits may be inappropriate for phase of flight. For descent excessive rudder input may result in unacceptable handling characteristics or exceedance of structural limits. For approach, landing and go–around, rudder authority may be limited. Differential thrust and aileron input may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

To avoid significant flap overspeed and flap damage:

Transition from FLAPS 0 to 20 must be done in level flight.

Select FLAPS 30 at the start of final descent on the GS/GP.

Table D 1 – Approach – Level Flight – FLAPS 0 – GEAR UP (CONT'D)

			WEIGHT (LB)					Expectd SPD Range KIAS	Expectd ΔKIAS per 0.5°Δ pitch
			34000	36000	38000	40000	40600		
ALT (1,000ft)	10	Pitch(°)	2.5	3.0	3.0	3.5	3.5	190–210	5
		N1 (%)	56.5	57.3	58.2	59.1	59.3		
	5	Pitch(°)	2.5	3.0	3.0	3.5	3.5	190–210	5
		N1 (%)	52.8	53.6	54.4	55.3	55.5		
	0	Pitch(°)	2.5	3.0	3.0	3.5	3.5	190–210	5
		N1 (%)	49.7	50.5	51.2	52.0	52.2		

AVIONICS

UNRELIABLE AIRSPEED

NOTE:

1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected SPD range by delta KIAS.
4. If pitch is decreased, INCREASE expected SPD range by delta KIAS.
5. Use FD in PTCH, ALT, HDG or ROLL modes only.
6. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION:

1. Do not use FLC mode.
2. Rudder travel limits may be inappropriate for phase of flight. For approach, landing and go–around, rudder authority may be limited. Differential thrust and aileron input may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

To avoid significant flap overspeed and flap damage:

Transition from FLAPS 0 to 20 must be done in level flight.

Select FLAPS 30 at the start of final descent on the GS/GP.

Table D 2 – Approach – Level Flight – FLAPS 10 – GEAR UP

			WEIGHT (LB)					Expectd SPD Range KIAS	Expectd ΔKIAS per 0.5°Δ pitch
			24000	26000	28000	30000	32000		
ALT (1,000ft)	10	Pitch(°)	–1.0	–0.5	0.0	0.0	0.5	180–200	5
		N1 (%)	56.9	57.7	58.4	59.1	59.7		
		AoA (°)	0.2	0.2	0.3	0.3	0.3		
	5	Pitch(°)	–1.0	–0.5	0.0	0.0	0.5	180–200	5
		N1 (%)	55.4	56.3	57.0	57.7	58.4		
		AoA (°)	0.2	0.2	0.2	0.2	0.3		
	0	Pitch(°)	–1.0	–0.5	0.0	0.0	0.5	190–210	5
		N1 (%)	55.4	56.3	57.0	57.7	58.4		
		AoA (°)	0.2	0.2	0.2	0.2	0.2		

AVIONICS

UNRELIABLE AIRSPEED

NOTE:
1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected speed range by delta KIAS.
4. If pitch is decreased, INCREASE expected speed range by delta KIAS.
5. Use FD in PTCH, ALT, HDG or ROLL modes only.
6. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION:
1. Do not use FLC mode.
2. Rudder travel limits may be inappropriate for phase of flight. For approach, landing and go–around, rudder authority may be limited. Differential thrust and aileron input may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

To avoid significant flap overspeed and flap damage:

Transition from FLAPS 0 to 20 must be done in level flight.

Select FLAPS 30 at the start of final descent on the GS/GP.

Table D 2 – Approach – Level Flight – FLAPS 10 – GEAR UP (CONT'D)

			WEIGHT (LB)					Expectd SPD Range KIAS	Expectd ΔKIAS per 0.5°Δ pitch
			34000	36000	38000	40000	40600		
ALT (1,000ft)	10	Pitch(°)	1.0	1.0	1.5	NA	NA	180–200	5
		N1 (%)	60.4	61.0	61.6	NA	NA		
		AoA (°)	0.3	0.3	0.4	NA	NA		
	5	Pitch(°)	1.0	1.0	1.5	2.0	2.0	180–200	5
		N1 (%)	59.1	59.7	60.3	61.0	61.2		
		AoA (°)	0.3	0.3	0.3	0.4	0.4		
	0	Pitch(°)	1.0	1.0	1.5	2.0	2.0	190–210	5
		N1 (%)	59.1	59.7	60.3	61.0	61.2		
		AoA (°)	0.3	0.3	0.3	0.3	0.3		

AVIONICS

UNRELIABLE AIRSPEED

NOTE:

1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected speed range by delta KIAS.
4. If pitch is decreased, INCREASE expected speed range by delta KIAS.
5. Use FD in PTCH, ALT, HDG or ROLL modes only.
6. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION:

1. Do not use FLC mode.
2. Rudder travel limits may be inappropriate for phase of flight. For approach, landing and go–around, rudder authority may be limited. Differential thrust and aileron input may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

To avoid significant flap overspeed and flap damage:

Transition from FLAPS 0 to 20 must be done in level flight.

Select FLAPS 30 at the start of final descent on the GS/GP.

Table D 3 – Approach – Level Flight – FLAPS 20 – GEAR DN

			WEIGHT (LB)					Expectd SPD Range KIAS	Expectd ΔKIAS per 0.5°Δ pitch
			24000	26000	28000	30000	32000		
ALT (1,000ft)	10	Pitch(°)	–1.5	–1.0	–0.5	0.0	0.5	150–170	5
		N1 (%)	63.6	63.8	64.4	65.0	65.6		
		AoA (°)	0.3	0.3	0.3	0.3	0.3		
	5	Pitch(°)	–1.5	–1.0	–0.5	0.0	0.5	150–170	5
		N1 (%)	63.6	63.8	64.4	65.0	65.6		
		AoA (°)	0.2	0.3	0.3	0.3	0.3		
	0	Pitch(°)	–2.0	–1.5	–1.0	–0.5	0.0	150–170	5
		N1 (%)	57.5	57.7	58.1	58.9	59.7		
		AoA (°)	0.2	0.3	0.3	0.3	0.3		

AVIONICS

UNRELIABLE AIRSPEED

NOTE:
1. Pitch/Thrust settings will give approximate level flight, and may result in slight climb or descent. Interpolation is acceptable.
2. Adjust pitch to stop climb/descent.
3. If pitch is increased, REDUCE expected speed range by delta KIAS.
4. If pitch is decreased, INCREASE expected speed range by delta KIAS.
5. Use FD in PTCH, ALT, HDG or ROLL modes only.
6. If FD/autopilot engaged in PTCH mode, one click of PTCH wheel results in 0.5 degrees of pitch change.

CAUTION:
1. Do not use FLC mode.
2. Rudder travel limits may be inappropriate for phase of flight. For approach, landing and go–around, rudder authority may be limited. Differential thrust and aileron input may be required to assist in maintaining directional control. Select a runway with minimum cross–wind.

To avoid significant flap overspeed and flap damage:

Transition from FLAPS 0 to 20 must be done in level flight.

Select FLAPS 30 at the start of final descent on the GS/GP.

Table D 3 – Approach – Level Flight – FLAPS 20 – GEAR DN (CONT'D)

			WEIGHT (LB)					Expectd SPD Range KIAS	Expectd ΔKIAS per 0.5°Δ pitch
			34000	36000	38000	40000	40600		
ALT (1,000ft)	10	Pitch(°)	1.0	1.5	2.0	2.5	2.5	150–170	5
		N1 (%)	66.3	67.3	67.7	68.6	68.8		
		AoA (°)	0.3	0.4	0.4	0.4	0.4		
	5	Pitch(°)	1.0	1.5	2.0	2.5	2.5	150–170	5
		N1 (%)	66.3	67.3	67.7	68.6	68.8		
		AoA (°)	0.3	0.3	0.3	0.4	0.4		
	0	Pitch(°)	0.5	1.0	1.5	2.5	2.5	150–170	5
		N1 (%)	60.5	61.3	62.1	65.8	66.9		
		AoA (°)	0.3	0.3	0.3	0.4	0.4		

AVIONICS

UNRELIABLE AIRSPEED

NOTE: 1. Set N_1 to maintain AOA.

2. Adjust pitch as necessary to maintain required glideslope guidance/glidepath.

CAUTION: Select FLAPS 30 at the start of final descent on the glideslope/ glidepath.

Table E – Approach – FLAPS 30 – GEAR DN – 3° G/S

			WEIGHT (LB)					Expectd SPD Range KIAS	Expectd ΔKIAS per 0.5°Δ pitch
			24000	26000	28000	30000	32000		
ALT (1,000ft)	10	Pitch(°)	–1.5	–0.5	0.5	0.5	0.5	V_{REF} +/– 10	5
		N1 (%)	46.5	47.2	48.0	49.5	51.1		
		AoA (°)	0.5	0.5	0.6	0.6	0.6		
	5	Pitch(°)	–1.5	–0.5	0.5	0.5	0.5		5
		N1 (%)	43.9	44.5	45.2	46.3	47.6		
		AoA (°)	0.5	0.5	0.6	0.6	0.6		
	0	Pitch(°)	–1.5	–0.5	0.5	0.5	0.5		5
		N1 (%)	41.9	42.4	43.0	44.1	45.2		
		AoA (°)	0.5	0.5	0.6	0.6	0.6		

AVIONICS

UNRELIABLE AIRSPEED

NOTE: 1. Set N_1 to maintain AOA.

2. Adjust pitch as necessary to maintain required glideslope guidance/glidepath.

CAUTION: Select FLAPS 30 at the start of final descent on the glideslope/ glidepath.

Table E – Approach – FLAPS 30 – GEAR DN – 3° G/S (CONT'D)

			WEIGHT (LB)					Expectd SPD Range KIAS	Expectd ΔKIAS per 0.5°Δ pitch
			34000	36000	38000	40000	40600		
ALT (1,000ft)	10	Pitch(°)	0.5	0.5	0.5	0.5	0.5	V_{REF} +/– 10	5
		N1 (%)	52.8	54.3	55.7	57.4	57.8		
		AoA (°)	0.6	0.6	0.6	0.6	0.6		
	5	Pitch(°)	0.5	0.5	0.5	0.5	0.5		5
		N1 (%)	49.1	50.5	51.7	53.2	53.5		
		AoA (°)	0.6	0.6	0.6	0.6	0.6		
	0	Pitch(°)	0.5	0.5	0.5	0.5	0.5		5
		N1 (%)	46.4	47.5	48.4	49.8	50.1		
		AoA (°)	0.6	0.6	0.6	0.6	0.6		

END

ELECTRICAL

L (R) BATT OVERHEAT (W)

1. **Affected BATT switch ..... OFF**
2. Battery temperature ..... Monitor

If battery temperature increases:

3. Land as soon as possible.

END

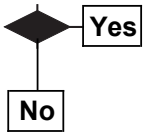
ESSENTIAL POWER ONLY (W)

The essential buses are powered by the batteries only. AUX and MAIN buses are automatically deactivated in flight.

NOTE: Should electrical system indication be flickering, cycling intermittently or behaving unexpectedly, accomplish the "Unexpected electrical indications" procedure at page 05–19–6.

1. DOME light switch ..... BRT for night operations
2. L and R GEN switches ..... One at a time, select ON

If a generator comes online:



– END –

3. HYD GEN (If installed) ..... ON

NOTE: The applicable procedures for the following CAS messages are consolidated within this procedure and do not need to be conducted separately:

L (R) GEN FAIL (C), L (R) PITOT HEAT FAIL (C), STALL PROTECT FAIL (C), R WING ANTI–ICE FAIL (C), HYD PTU FAIL (C), L (R) MAIN BUS OFF (A), L (R) AUX BUS OFF (A)

4. LEFT DISPLAYS REVERSION switch ..... MFD REV
5. TUNE REVERSION switch ..... CDU ONLY
6. Use the standby instrument for airspeed, attitude, and altitude.
7. Airspeed ..... 0.75 M_I/250 KIAS maximum
8. STAB TRIM switch ..... SEC

ELECTRICAL

ESSENTIAL POWER ONLY (W) (Cont)

9. AIR SOURCE switch ..... PACK ONLY
10. R BLEED switch ..... OFF
11. XBLEED switch ..... Closed
12. Altitude ..... 31,000 ft maximum
13. WING SOURCE switch ..... FROM L
14. AUX HYDRAULIC PUMP switch ..... OFF
15. EMER LTS switch ..... OFF
16. Leave icing conditions as soon as possible.
17. L and R WSHLD/WINDOW switches ..... Off
18. MAN TEMP switch ..... ON

NOTE: – If a generator does not come online, battery duration (with two 44 amp hour batteries) with the generators off is one hour. The integrated standby instrument (ISI) will be powered for a duration of 3.5 hours following loss of generated power.

Time duration predicated upon the following conditions:

– L WSHLD/WINDOW switch – On for no more than 15 minutes.

– No more than 3 APU start attempts.

– Any deviation from these conditions will significantly reduce the battery duration. Each additional APU start attempt will reduce battery endurance by approximately 2 minutes.

At 30,000 ft and below:

19. APU switch ..... START and release

The APU starts:

Yes

20. APU GEN ..... Verify ON
21. HYD GEN (If installed) ..... OFF
22. LEFT DISPLAYS REVERSION switch ..... NORM
23. TUNE REVERSION switch ..... NORM
24. STAB TRIM switch ..... PRI
25. AUX HYDRAULIC PUMP switch ..... AUTO
26. L and R WSHLD/WINDOW switches ..... On
27. MAN TEMP switch ..... Off
28. EMER LTS switch ..... ARM
29. Land as soon as practical.

– END –

No

ELECTRICAL

ESSENTIAL POWER ONLY (W) (Cont)

20. Land as soon as possible.

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

Descent checks:

21. Pressurization ..... LNDG ALT set
(LNDG ALT display is available on summary page using FRMT switch on display control panel).

22. Standby Altimeter ..... Set

23. Passenger Brief/Cabin Check ..... Complete

Approach checks:

24. Final approach speed ..... V_{REF} + 10

25. Normal actual landing distance ..... Multiply by:
1.80 without thrust reversers
1.55 with thrust reversers

26. L WSHLD/WINDOW switch ..... As required (to defog left window)

27. Approach setup and crew briefing ..... Complete

28. RA MIN or BARO MIN ..... Set

29. MIN ALERT ..... Set

30. L and R HYDRAULIC PUMP switches ..... AUTO

Before landing checks:

31. HYD GEN (If installed) ..... OFF

32. LANDING GEAR switch ..... DN

33. FLAPS selector 30

34. EMER LTS switch ..... ON

END

EVACUATION

Emergency Evacuation

1. **PARK/EMER BRAKE ..... Set**
2. **EMER DEPRESS switch ..... ON**
3. **L and R ENG, and APU FIRE switches ..... Push**
4. **Evacuation ..... Command**
5. **Controlling Agency ..... Notify**
6. **STBY INST switch ..... OFF**
7. **L and R BATT switches ..... OFF**
8. Evacuate the airplane using the passenger door and/or the emergency exit.

END

FLIGHT CONTROLS

Effectivity:

For aircraft 20595–22999 and aircraft incorporating SB 350–34–011.

Overspeed  **"overspeed clacker tone"**

1. **Autothrottle (if installed) ..... Disengage**
2. **Thrust levers ..... IDLE**
3. **Autopilot ..... Disconnect**
4. **FLIGHT SPOILERS lever ..... EMER**
5. **Level wings, then pitch up.**
6. Stab Trim ..... As required to raise the nose

END

Overspeed  **"OVERSPEED"**

1. **Autothrottle (if installed) ..... Disengage**
2. **Thrust levers ..... IDLE**
3. **Autopilot ..... Disconnect**
4. **FLIGHT SPOILERS lever ..... EMER**
5. **Level wings, then pitch up.**
6. Stab Trim ..... As required to raise the nose

END

FLIGHT CONTROLS

STALL on PFD  **"STALL"**

1. **Autopilot ..... Disconnect**
2. **Lower the pitch attitude to reduce angle–of–attack.**
3. **Autothrottle (if installed) ..... Disengage**
4. **Thrust levers ..... APR**
5. **FLIGHT SPOILERS lever ..... RETRACT**
6. **Level the wings.**

After airspeed increases and stall warning is extinguished:

7. Pitch attitude ..... Adjust to minimize altitude loss.
8. Thrust levers and aircraft configuration ..... Adjust as required

NOTE: If the aircraft is allowed to decelerate below stall warning angle–of–attack, priority must be given to immediately reducing the angle–of–attack rather than attempting to maintain altitude. Stall recovery from typical cruise altitudes and other relatively low thrust conditions will require a significant loss of altitude.

END

FLIGHT CONTROLS

Pitch Axis Uncommanded Motion or "Trim Clacker Tone"



"trim clacker tone"

1. Master disconnect switch (MSW) ..... Depress and hold

NOTE: The following conditions will exist when the MSW switch is depressed:

- The autopilot will disengage.
- Stabilizer, configuration, Mach, aileron, and rudder trims will be inoperative while the switch is depressed.
- The stall pusher is inoperative while the switch is depressed.

Control force is relieved with MSW depressed:

Yes

2. STALL PUSHER switch ..... OFF
3. Flight Guidance Panel AP/YD DISC bar ..... Pull Down
4. Master disconnect switch (MSW) ..... Release
5. Altitude ..... 31,000 ft maximum

Uncommanded motion reoccurs

Yes

6. MSW ..... Depress and hold

– END –

No

– END –

No

Control force continues with MSW depressed:

The malfunction is most likely a trim malfunction.

2. STAB TRIM switch ..... OFF
3. Master disconnect switch (MSW) ..... Release
4. Refer to Pri Stab Trim Fail procedure in the NON–NORMAL PROCEDURES Chapter.

END

FLIGHT CONTROLS

Effectivity:

EASA registered aircraft only.

Pitch Axis Uncommanded Motion or "Trim Clacker Tone"



"trim clacker tone"

1. **Master disconnect switch (MSW) ..... Depress and hold**
2. **STALL PUSHER switch ..... OFF**

NOTE: The following conditions will exist when the MSW switch is depressed:

- The autopilot will disengage.
- Stabilizer, configuration, Mach, aileron, and rudder trims will be inoperative while the switch is depressed.

Control force is relieved with MSW depressed or Stall Pusher OFF:

Yes

3. Flight Guidance Panel AP/YD DISC bar ..... Pull Down
4. Master disconnect switch (MSW) ..... Release
5. Altitude ..... 31,000 ft maximum

Uncommanded motion reoccurs

Yes

6. MSW ..... Depress and hold

– END –

No

– END –

No

Control force continues:

The malfunction is most likely a trim malfunction.

3. STAB TRIM switch ..... OFF
4. Master disconnect switch (MSW) ..... Release
5. Refer to Pri Stab Trim Fail procedure in the NON–NORMAL PROCEDURES Chapter.

END

FLIGHT CONTROLS

Roll or Yaw Axis Uncommanded Motion

1. Master disconnect switch (MSW) ..... Depress and hold

NOTE: The following conditions will exist when the MSW switch is depressed:

- The autopilot will disengage.
- Stabilizer, configuration, Mach, aileron, and rudder trims will be inoperative while the switch is depressed.
- *The stall pusher is inoperative while the switch is depressed. *(Not applicable to JAA aircraft).

Control force is relieved with MSW depressed:

Yes

2. Flight Guidance Panel AP/YD DISC Bar ..... Pull Down
3. Master disconnect switch (MSW) ..... Release

Uncommanded motion reoccurs

Yes

4. MSW ..... Depress and hold

– END –

No

– END –

No

Control force continues with MSW depressed:

The malfunction is most likely a trim malfunction.

2. AIL and RUD Trim indications ..... CHECK
3. Affected AIL or RUD circuit breaker ..... CB2 B14 or B15, Pull
4. Master disconnect switch (MSW) ..... Release

END

FLIGHT CONTROLS

Pitch Control Jam

1. **PITCH DISC handle ..... PULL & TURN**
   The pilot will control the left elevator and the copilot will control the right elevator.
2. **Determine the side without the jam and transfer control to that pilot.**
   a. **Do not** apply additional control force to a jammed control.
   b. **Do not** reconnect.
3. Airspeed ..... Airspeed at which the jam occurred or 200 KIAS maximum, whichever is greater.
4. Land as soon as possible.

NOTE:
- Avoid excessive elevator inputs. The ELEVATOR SPLIT (C) may be displayed if elevator use is aggressive.
- Use pitch trim as necessary to minimize elevator deflection.
- Use aileron control as necessary to stabilize the aircraft.

Descent Checks:

5. Pressurization ..... LNDG ALT set
6. WING ANTI–ICE switch ..... As required
7. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

8. Altimeters ..... Set
9. L and R LANDING light switches ..... On
10. Passenger Brief/Cabin Check ..... Complete
11. SMKG/BELTS switch ..... SMKG/BELTS
12. Fuel quantities and balance ..... Check

Approach Checks:

13. APU and Bleeds ..... Set
14. Final approach speed ..... V_{REF}
15. Normal actual landing distance ..... Multiply by:
    1.15 without thrust reversers
    1.10 with thrust reversers

FLIGHT CONTROLS

Pitch Control Jam (Cont)

16. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

17. Approach setup and crew briefing ..... Complete
18. RA MIN or BARO MIN ..... Set
19. MIN ALERT ..... Set
20. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks:

21. LANDING GEAR switch ..... DN
22. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
23. FLAPS 30

END

Roll Control Jam

1. **ROLL DISC lever ..... PULL TO ACTUATE**
2. **Determine the side without the jam and transfer control to that pilot.**

The jam is on the copilot's side:

Yes

3. **Do not** use the copilot's controls.
4. **Do not** use aileron trim.
5. **Do not** reconnect.

No

(The jam is on the pilot's side)

3. ROLL SPOILERS switch ..... OFF
4. **Do not** reconnect.
5. Land as soon as possible.

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

Descent Checks:

6. Pressurization ..... LNDG ALT set

FLIGHT CONTROLS

Roll Control Jam (Cont)

7. WING ANTI–ICE switch ..... As required
8. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

9. Altimeters ..... Set
10. L and R LANDING light switches ..... On
11. Passenger Brief/Cabin Check ..... Complete
12. SMKG/BELTS switch ..... SMKG/BELTS
13. Fuel quantities and balance ..... Check

Approach Checks:

14. APU and Bleeds ..... Set
15. Final approach speed ..... V_{REF} + 5
16. Normal actual landing distance ..... Multiply by:
    1.20 without thrust reversers
    1.15 with thrust reversers
17. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

18. Approach setup and crew briefing ..... Complete
19. RA MIN or BARO MIN ..... Set
20. MIN ALERT ..... Set
21. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks

22. LANDING GEAR switch ..... DN
23. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
24. FLAPS 30

END

FLIGHT CONTROLS

Yaw Control Jam

1. Use ailerons and asymmetric thrust as required.
2. Land as soon as possible.

NOTE:
- Limited travel may be available through the use of rudder trim.
- Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.
- Use asymmetric power if required to minimize sideslip.
- Flying the approach with minimum control and thrust inputs will help maintain directional control.

> ***Effectivity:***
>
> *For aircraft on the Russian Federation (RF) and Commonwealth of Independent States (CIS) countries' registry:*
>
> – Crosswind not to exceed 10 knots (5 meters/sec).

Descent Checks:

3. Pressurization ..... LNDG ALT set
4. WING ANTI–ICE switch ..... As required
5. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

6. Altimeters ..... Set
7. L and R LANDING light switches ..... On
8. Passenger Brief/Cabin Check ..... Complete
9. SMKG/BELTS switch ..... SMKG/BELTS
10. Fuel quantities and balance ..... Check

Approach Checks:

11. APU and Bleeds ..... Set
12. Final approach speed ..... V_{REF} + 5
13. Normal actual landing distance ..... Multiply by:
    1.20 without thrust reversers
    1.15 with thrust reversers
14. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

15. NWS switch ..... OFF
16. Approach setup and crew briefing ..... Complete

FLIGHT CONTROLS

Yaw Control Jam (Cont)

17. RA MIN or BARO MIN ..... Set
18. MIN ALERT ..... Set
19. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks:

20. LANDING GEAR switch ..... DN
21. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
22. FLAPS 30
23. Carry power down to touchdown to aid in directional control.

NOTE: Thrust reversers may be used. Stow the thrust reversers if directional control is in doubt.

END

HYDRAULICS

HYD PRESS LOW (W)

Inoperative equipment:

- Elevator hydraulic power (pitch forces will be high)
- Rudder hydraulic power may be lost
- All spoiler functions
- Normal brakes supplied by the accumulators only
- Thrust reversers
- Flaps
- Normal landing gear control
- Nose wheel steering.

1. L and R HYDRAULIC PUMP switches ..... OFF
2. Autopilot ..... Disconnect
3. L and R HYDRAULIC SOV switches ..... Closed

NOTE:
- The MLG downlock assist accumulator will retain pressure for 30 minutes after a complete hydraulic failure. The landing gear must be down prior to this time if the flaps are not at 0°.
- Avoid icing conditions for a prolonged period of time.

4. Altitude ..... 41,000 ft maximum
5. Land as soon as possible.

WARNING: Flaps 0 and Flaps 10 landing condition: Maximum brake energy may be exceeded for a landing weight above MLW and when landing at an airport pressure altitude of 4000 ft and above.

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended. If flaps are at any angle other than 30, divert to a suitable landing field with a glidepath angle of 3.5 degrees or less.

Descent Checks:

6. Pressurization ..... LNDG ALT set
7. WING ANTI–ICE switch ..... As required
8. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

9. Altimeters ..... Set
10. L and R LANDING light switches ..... On
11. Passenger Brief/Cabin Check ..... Complete
12. SMKG/BELTS switch ..... SMKG/BELTS
13. Fuel quantities and balance ..... Check

HYDRAULICS

HYD PRESS LOW (W) (Cont)

Approach Checks:

14. APU and Bleeds ..... Set
15. Final approach speed ..... As listed for flaps attained:
    - Flaps 0 ..... V_{REF} + 25
    - Flaps 10 ..... V_{REF} + 20
    - Flaps 20 ..... V_{REF} + 10
    - Flaps 30 ..... V_{REF} + 5
16. Normal actual landing distance ..... Multiply by:
    - Flaps 0 ..... 2.00
    - Flaps 10 ..... 2.05
    - Flaps 20 ..... 1.90
    - Flaps 30 ..... 1.80

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL if FLAPS are not at 30 degrees, AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

17. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

18. FLAPS TAWS WARN ..... OFF
19. Approach setup and crew briefing ..... Complete
20. RA MIN or BARO MIN ..... Set
21. MIN ALERT ..... Set
22. L and R HYDRAULIC PUMP switches ..... AUTO
23. Autothrottle (if installed) ..... Disengage prior to 200 feet AGL

Before Landing Checks:

24. LANDING GEAR switch ..... DN

CAUTION: Do not push PUSH TO STOW button while pulling handle.

25. LG PULL handle ..... PULL

NOTE: Performing a sideslip, to each side, may help achieve MLG downlock. Increased airspeed may be required to ensure downlock during sideslip.

HYDRAULICS

HYD PRESS LOW (W) (Cont)

26. GEAR Indication ..... Check, for three green DN indications

CAUTION: Do not stow handle until gear pins are installed.

27. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
28. NWS switch ..... OFF, maintain directional control using differential braking

After Touchdown:

29. Normal brakes ..... Apply, using one continuous application to a full stop

END

ICE AND RAIN PROTECTION

WING ANTI–ICE LEAK (W)

1. WING ANTI–ICE switch ..... Off

2. Leave icing conditions as soon as possible.

WING ANTI–ICE LEAK (W) occurred with CLB or TO thrust set:

Yes

After two minutes with WING ANTI–ICE LEAK message extinguished:

3. WING ANTI–ICE switch ..... ON

WING ANTI–ICE LEAK (W) illuminates within 2 minutes:

Yes

4. WING ANTI–ICE switch ..... Off
5. Leave icing conditions as soon as possible.
6. Refer to Wing Anti–Ice Failure Landing procedure in the NON–NORMAL PROCEDURES Chapter.

– END –

No

4. Wing Anti–Ice may be used as needed.

– END –

No

3. Refer to Wing Anti–Ice Failure Landing procedure in the NON–NORMAL PROCEDURES Chapter.

WARNING: Even **small** accumulations of ice on the wing leading edge can cause an increase in stall speed, and possibly a degradation in stall characteristics.

END

ICE AND RAIN PROTECTION

L (R) WING OVERHEAT (W)

1. **WING ANTI–ICE switch ..... Off**

L WING OVERHEAT (W) is displayed:

Yes

2. WING SOURCE switch ..... FROM R
3. AUTO SYNC switch ..... OFF
4. WING ANTI–ICE switch ..... ON

No

R WING OVERHEAT (W) is displayed:

2. WING SOURCE switch ..... FROM L
3. AUTO SYNC switch ..... OFF
4. WING ANTI–ICE switch ..... ON

If the message reappears:

5. WING ANTI–ICE switch ..... Off
6. Leave icing conditions as soon as possible.
7. Refer to Wing Anti–Ice Failure Landing procedure in the NON–NORMAL PROCEDURES Chapter.

WARNING: Even **small** accumulations of ice on the wing leading edge can cause an increase in stall speed, and possibly a degradation in stall characteristics.

END

LANDING GEAR, WHEELS & BRAKES

GEAR (W)  "GEAR"

NOTE: If the radio altimeter is inoperative, the "GEAR" aural may be muted via the Master WARNING/CAUTION switch.

Is adequate time available to extend gear:

Yes

1. LANDING GEAR switch ..... DN

– END –

No

1. Execute a go–around.

——— END ———

GEAR BAY OVHT (W)

1. **AIRSPEED ..... 250 KIAS maximum**
2. **LANDING GEAR switch ..... DN**

Wait 10 minutes:

3. LANDING GEAR switch ..... UP

If GEAR BAY OVHT occurs again:

4. LANDING GEAR switch ..... DN
5. Land as soon as possible.

——— END ———

Landing Gear Up/Unsafe Landing

1. Airspeed ..... 250 KIAS maximum
2. LANDING GEAR switch ..... DN

NOTE: Ensure landing gear switch is firmly in the "DN" position.

CAUTION: Do not push PUSH TO STOW button while pulling handle.

3. LG PULL handle ..... PULL

NOTE: Performing a sideslip to each side may help achieve MLG downlock. Increased airspeed may be required to ensure downlock during sideslip.

4. GEAR Indication ..... Check, for three DN indications

LANDING GEAR, WHEELS & BRAKES

Landing Gear Up/Unsafe Landing (Cont)

All landing gear are down (three DN indications):

Yes

5. Land as soon as practical.

CAUTION: Do not stow the handle until the gear pins are installed.

– END –

No

All landing gear are not down:

NOTE: If a gear up landing must be made, select a long, wide runway with as little crosswind as possible. If time and conditions permit, plan the descent to ensure minimum fuel remaining on the aircraft. Ensure sufficient fuel for a controlled, power–on approach.

Brief the passengers as required:

5. Location and operation of emergency exits ..... Indicate
6. All loose items ..... Secure
7. Seat belts and shoulder harnesses ..... Secure
8. Emergency landing brace position ..... Assume

Descent Checks:

9. Pressurization ..... LNDG ALT set
10. WING ANTI–ICE switch ..... As required
11. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

12. Altimeters ..... Set
13. L and R LANDING light switches ..... On
14. Passenger Brief/Cabin Check ..... Complete
15. SMKG/BELTS switch ..... SMKG/BELTS
16. Fuel quantities and balance ..... Check

Approach Checks:

17. APU and Bleeds ..... Set

CAUTION: Autothrottle will not arm RETARD mode at 200 ft AGL if landing gear is not indicating down. AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

18. ROAAS (if installed) ..... OFF
19. Approach setup and crew briefing ..... Complete
20. RA MIN or BARO MIN ..... Set
21. MIN ALERT ..... Set

LANDING GEAR, WHEELS & BRAKES

Landing Gear Up/Unsafe Landing (Cont)

22. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks:

23. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
24. AURAL WARNING DCU A and DCU B switches ..... OFF, this will disable **all** aural warnings
25. FLAPS selector 30
26. Autothrottle (if installed) ..... Disengage prior to 200 feet AGL

No landing gear is extended:

Yes

27. Plan to land slightly nose high. Perform normal power–on approach at V_{REF} and touchdown at the lowest possible airspeed with minimum sink rate. Do not decelerate below shaker speed. →

No

Partial Gear extended:

The nose gear fails to extend:

Yes

27. Relocate passengers aft to obtain aft C.G., if possible.
28. Hold the nose off the runway as long as elevator control is available. →

No

One main gear fails to extend:

27. Plan to land on the same side of the runway as the extended gear.
28. Hold the applicable wing up as long as possible. Maintain directional control with the rudder and the nose wheel steering.

At touchdown: ←

29. L and R ENG FIRE switches ..... PUSH
30. Normal braking may be used and spoilers deployed. Use the rudder and/or the brakes for directional control.

After aircraft stops:

31. PARK/EMER BRAKE ..... Set
32. APU switch ..... OFF
33. L and R BATT switches ..... OFF
34. STBY INST switch ..... OFF

LANDING GEAR, WHEELS & BRAKES

Landing Gear Up/Unsafe Landing (Cont)

35. Evacuate the aircraft using the passenger door and/or the emergency exit.

END

NORM BRAKES FAIL (W)



"NORMAL BRAKES FAIL"

1. Normal actual landing distance ..... Multiply by:
   1.65 without thrust reversers
   1.50 with thrust reversers
2. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

After landing:

1. **FLIGHT SPOILERS lever ..... EMER**
2. **PARK/EMER BRAKE handle ..... Pull smoothly**

END

LANDING PROCEDURES

Ditching

Time and conditions permit:

Yes

1. Proceed to nearest land or vessel.
2. Notify controlling agency.
3. Transponder ..... Emergency 7700
4. ELT switch ..... ON
5. Life Vests ..... On

NOTE: Inform passengers not to inflate life vests while inside aircraft.

6. Shoulder harnesses ..... Locked
7. Passenger Brief/Cabin Check ..... Complete
8. SMKG/BELTS switch ..... SMKG/BELTS

No

1. AURAL WARNING DCU A and DCU B switches ..... OFF
   This will disable **all** aural warnings.
2. TAWS circuit breaker (CB2 A6) ..... Pull
3. DITCHING switch ..... ON

At approximately 2,000 ft:

4. Plan landing direction as follows:
   - Calm Sea ..... Into wind
   - Moderate Swells ..... Parallel to swells
   - High Wind ..... Into wind, attempting to land on upwind (far) side of swell
5. L and R HYDRAULIC PUMP switches ..... AUTO
6. LANDING GEAR switch ..... UP
7. FLAPS selector 30
8. EMER LIGHTS switch ..... ON

Just before contact:

9. Perform normal power–on approach at V_{REF} and touchdown at the lowest possible airspeed with minimum sink rate. Do not decelerate below shaker speed.
10. Thrust levers ..... IDLE at touchdown

After contact:

11. L and R ENG, and APU FIRE switches ..... Push
12. L and R BATT switches ..... OFF
13. STBY INST switch ..... OFF

LANDING PROCEDURES

Ditching (Cont)

14. Emergency exit(s) ..... Open
after airplane comes to a complete stop.
Evacuate the aircraft using the passenger door and/or the emergency exit.

Effectivity:

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

15. Outside the aircraft, the Russian–made portable emergency VHF radio P855A1 should be used in accordance with the instructions attached to the unit.

END

Forced Landing – Both Engines Inoperative

Time and conditions permit:

Yes

1. Notify the controlling agency.
2. Transponder ..... Emergency 7700
3. ELT switch ..... ON
4. APU and Bleeds ..... Set
5. Passenger Brief/Cabin Check ..... Complete
6. SMKG/BELTS switch ..... SMKG/BELTS

No

1. TAWS circuit breaker (CB2 A6) ..... Pull

Before landing checks:

2. L and R HYDRAULIC PUMP switches ..... AUTO
3. LANDING GEAR switch ..... DN

CAUTION: Do not push PUSH TO STOW button while pulling handle.

4. LG PULL handle ..... PULL
5. FLAPS selector 30
6. EMER DEPRESS switch ..... ON
7. Shoulder harnesses ..... Locked
8. EMER LIGHTS switch ..... ON
9. L and R ENG FIRE switches ..... FIRE push
10. Touchdown at the lowest possible airspeed with minimum sink rate. Do not decelerate below shaker speed.

After airplane comes to a complete stop:

11. APU switch ..... OFF

LANDING PROCEDURES

Forced Landing – Both Engines Inoperative (Cont)

12. PARK/EMER BRAKE ..... Set
13. L and R ENG, and APU FIRE switches ..... Push
14. L and R BATT switches ..... OFF
15. STBY INST switch ..... OFF
16. Evacuate the aircraft using the passenger door and/or the emergency exit.

Effectivity:

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

17. Outside the aircraft, the Russian–made portable emergency VHF radio P855A1 should be used in accordance with the instructions attached to the unit.

END

POWERPLANT

L (R) ENGINE EXCEEDANCE (W)

1. Autothrottle (if installed) ..... Disengage

Affected Engine:

2. Thrust lever ..... Retard

Engine responds:

Yes

3. Continue flight.

– END –

No

3. Affected engine RUN switch ..... OFF

Engine shuts down:

Yes

4. Refer to Engine Shutdown In Flight procedure in the NON–NORMAL PROCEDURES chapter.

– END –

No

4. Affected ENG FIRE switch ..... Push
5. Refer to Engine Shutdown In Flight procedure in the NON–NORMAL PROCEDURES chapter.

Effectivity:

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

NOTE: If thrust exceedance occurs while flying on the glideslope for final approach:

a. Perform a go–around.

b. Follow the procedures for L(R) ENGINE EXCEEDANCE (W) for the affected engine.

END

POWERPLANT

L (R) ENGINE FIRE (W)  **"LEFT (RIGHT) ENGINE FIRE"**

DURING TAKEOFF

Below V_1 Speed:

1. **Autothrottle (if installed) ..... Disengage**
2. **Thrust levers ..... IDLE**
3. **Brakes ..... Maximum, or as required**
4. **Thrust reversers ..... MAX REV or as required**

After Stopping:

5. **PARK/EMER BRAKE ..... Set**
6. **Affected ENG FIRE switch ..... FIRE push**
7. **FIRE EXT 1 and 2 switches ..... ARMED push**
8. **EMER DEPRESS switch ..... ON**
9. **Non–affected ENG and APU FIRE switches ..... Push**
10. **Evacuation ..... Command**
11. **Controlling Agency ..... Notify**
12. **STBY INST switch ..... OFF**
13. **L and R BATT switches ..... OFF**

14. Evacuate the airplane using the passenger door and/or the emergency exit.

– END –

POWERPLANT

L (R) ENGINE FIRE (W) (Cont)

Above V_1 Speed:

1. Rotate at V_R.

2. Pitch attitude ..... Adjust as required
to achieve V_2.

NOTE: Initially rotate toward the flight director pitch guidance command. Adjust pitch as required to maintain V_2.

3. LANDING GEAR switch ..... UP
after positive rate of climb.

4. Autothrottle (if installed) ..... Disengage

5. Affected engine thrust lever ..... IDLE
unless a critical thrust situation exists.

6. Affected ENG FIRE switch ..... FIRE push

After 10 seconds if L (R) ENGINE FIRE CAS persists or there are other indications of fire:

7. FIRE EXT 1 switch ..... ARMED push

After 30 seconds if L (R) ENGINE FIRE CAS persists or there are other indications of fire:

8. FIRE EXT 2 switch ..... ARMED push

9. Affected engine RUN switch ..... OFF
10. Affected FUEL PUMP switch ..... OFF, if not required
11. Climb at V_2 until clear of obstacles, accelerate to V_2 + 15 (Flaps 10) [V_2 + 25 (Flaps 20)].

WARNING: It is prohibited to engage the Autothrottle until flaps are retracted and the aircraft has accelerated to en route climb speed.

12. Flaps ..... Retract to 0
13. Climb ..... At en route climb speed
14. Rudder trim ..... As required
15. N LDG/TAXI light switch ..... OFF
16. ANTI/ICE panel ..... As required
17. Monitor fuel balance. Transfer as required. Fuel PUMP may be used.
18. Land as soon as possible.
19. Refer to Single Engine Landing procedure in the NON–NORMAL PROCEDURES chapter.

– END –

POWERPLANT

L (R) ENGINE FIRE (W) (Cont)

IN FLIGHT

1. Autothrottle (if installed) ..... Disengage

Affected Engine:

2. Thrust lever ..... IDLE
unless a critical thrust situation exists.

3. Affected ENG FIRE switch ..... FIRE push

After 10 seconds if L (R) ENGINE FIRE CAS persists or there are other indications of fire:

4. FIRE EXT 1 switch ..... ARMED push

After 30 seconds if L (R) ENGINE FIRE CAS persists or there are other indications of fire:

5. FIRE EXT 2 switch ..... ARMED push

6. Affected engine RUN switch ..... OFF
7. Affected FUEL PUMP switch ..... OFF, if not required
8. Rudder trim ..... As required
9. Monitor fuel balance. Transfer as required. Fuel PUMP may be used.
10. Land as soon as possible.
11. Refer to Single Engine Landing procedure in the NON–NORMAL PROCEDURES chapter.

END

POWERPLANT

L (R) ENG OIL PRESS LOW (W)

ENG OIL PRESS LOW (W) CAS is displayed and L (R) OIL PRESS digits are red:

Yes

1. Autothrottle (if installed) ..... Disengage
2. Affected engine thrust lever ..... IDLE
3. Affected engine RUN switch ..... OFF
4. Refer to Engine Shutdown In Flight procedure in the NON−NORMAL PROCEDURES chapter.

– END –

No

Only the L (R) OIL PRESS digits are red:

1. Affected engine OIL TEMP ..... Check

OIL TEMP is high:

Yes

2. Autothrottle (if installed) ..... Disengage
3. Affected engine thrust lever ..... IDLE
4. Affected engine RUN switch ..... OFF
5. Refer to Engine Shutdown In Flight procedure in the NON−NORMAL PROCEDURES chapter.

– END –

No

2. OIL PRESS and OIL TEMP ..... Monitor

The most likely problem is a single pressure sensor failure.

END

POWERPLANT

L (R) REVERSER UNSAFE (W)
REV (EI icon)

DURING TAKEOFF

Below V_1 Speed:

1. **Autothrottle (if installed) ..... Disengage**
2. **Thrust levers ..... IDLE**
3. **Brakes ..... Maximum, or as required**
4. **Thrust reversers ..... MAX REV or as required**

– END –

Above V_1 Speed:

1. **Rotate at V_R.**
2. **Pitch attitude ..... Adjust as required to achieve V_2**

NOTE: Initially rotate toward the flight director pitch guidance command. Adjust pitch as required to maintain V_2. Flight director pitch guidance command may indicate high for conditions.

3. **LANDING GEAR switch ..... UP after positive rate of climb**
4. **Autothrottle (if installed) ..... Disengage**
5. **Affected engine thrust lever ..... IDLE**

CAUTION: If condition persists, do not engage Autothrottle.

6. Climb at V_2 until clear of obstacles, accelerate to V_2 + 15 (Flaps 10) [V_2 + 25 (Flaps 20)].

WARNING: It is prohibited to engage the Autothrottle until flaps are retracted and the aircraft has accelerated to en route climb speed.

7. Flaps ..... Retract to 0
8. Climb ..... At en route climb speed

Other indications of thrust reverser deployment are present (buffeting or excessive pitch, roll or yaw):

Yes

9. ENGINE RUN switch (deployed engine) ..... OFF
10. Rudder Trim ..... As required
11. Affected BLEED switch ..... OFF
12. XBLEED switch ..... Open

POWERPLANT

L (R) REVERSER UNSAFE (W) REV (EI icon) (Cont)

13. Affected ENG ANTI–ICE switch ..... OFF
14. N LDG/TAXI light switch ..... OFF
15. Monitor fuel balance. Transfer as required.
16. Land as soon as possible.
17. Go to Thrust Reverser Deployed Landing procedure in this section.

– END –

No

9. Thrust levers ..... As required

– END –

IN FLIGHT

1. Autothrottle (if installed) ..... Disengage
2. Affected thrust lever ..... IDLE

CAUTION: If condition persists, do not engage Autothrottle.

3. Airspeed ..... 190 KIAS maximum

Other indications of thrust reverser deployment are present (buffeting or excessive pitch, roll or yaw):

Yes

4. ENGINE RUN switch (deployed engine) ..... OFF
5. Rudder Trim ..... As required
6. Affected BLEED switch ..... OFF
7. XBLEED switch ..... Open
8. Affected ENG ANTI–ICE switch ..... OFF
9. Monitor fuel balance. Transfer as required.
10. Land as soon as possible.
11. Go to Thrust Reverser Deployed Landing procedure in this section.

– END –

No

4. Thrust levers ..... As required

END

POWERPLANT

Thrust Reverser Deployed Landing

WARNING: Go–around may not be possible with a deployed thrust reverser.

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

Descent Checks:

1. Pressurization ..... LNDG ALT set
2. WING ANTI–ICE switch ..... As required
3. L and R ENG ANTI–ICE switches ..... As required
4. Transponder ..... TA Only

Transition Level (or FL 180) Checks:

5. Altimeters ..... Set
6. L and R LANDING light switches ..... On
7. Passenger Brief/Cabin Check ..... Complete
8. SMKG/BELTS switch ..... SMKG/BELTS
9. Fuel quantities and balance ..... Check

Approach Checks:

10. APU and Bleeds ..... Set
11. Final approach speed ..... V_{REF}
12. Normal actual landing distance ..... Multiply by:
    1.15 without thrust reversers
    1.10 with thrust reversers
13. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

14. Approach setup and crew briefing ..... Complete
15. RA MIN or BARO MIN ..... Set
16. MIN ALERT ..... Set
17. L and R HYDRAULIC PUMP switches ..... AUTO

POWERPLANT

Thrust Reverser Deployed Landing (Cont)

Before Landing Checks:

18. LANDING GEAR switch ..... DN
19. N LDG/TAXI light switch ..... On
20. FLAPS 30

NOTE: After landing, use of the operative thrust reverser is allowable.

END

Dual Engine Flameout

1. **Crew oxygen masks (if above 14,000 ft) ..... Don**
2. **Pilot and Copilot O2 MASK/NORM switches ..... O2 MASK**
3. **Airspeed ..... Establish 185 KIAS**

Relight feasible:

Yes

4. Maintain 185 KIAS to ensure continued N2 rotation.

CAUTION: Failure to observe the minimum airspeed of 185 KIAS may result in engine core lock and the inability to restart engines in a timely manner.

5. Thrust levers ..... IDLE
6. ENGINE RUN switches ..... OFF
7. Pilot and Copilot INPH switches ..... INPH

No

4. Establish best glide speed.

AIRPLANE WEIGHT	BEST GLIDE SPEED
28,000 lb (12,701 kg)	160 KIAS
33,000 lb (14,969 kg)	174 KIAS
40,000 lb (18,144 kg)	185 KIAS

NOTE:
- Glide speed interpolation between weights is acceptable.
- Target glide speed provides a range of approximately 2.5 NM for each 1000 feet altitude.

5. Thrust levers ..... IDLE
6. ENGINE RUN switches ..... OFF
7. Pilot and Copilot INPH switches ..... INPH

POWERPLANT

Dual Engine Flameout (Cont)

8. Refer to Ditching or Forced Landing – Both Engines Inoperative procedure, this section.

– END –

Aircraft is above 20,000 ft:

Yes

8. Descend to below 30,000 ft.
9. APU switch ..... START and release
10. L and R BLEED switches ..... OFF
11. APU BLEED switch (above 20,000 ft) ..... OFF
12. Airspeed ..... Increase to 250 KIAS or greater
13. FUEL panel XFER switch ..... Closed
14. FUEL panel L and R PUMP switches ..... AUTO
15. ENG ANTI–ICE switches ..... Off
16. ENGINE RUN switch ..... RUN

Light off occurs within 45 seconds:

Yes

17. Other engine ..... Start
18. If only one engine is operating, refer to Engine Shutdown In Flight procedure in the NON–NORMAL PROCEDURES chapter.

– END –

No

17. ENGINE RUN switches ..... OFF
18. Attempt another windmill relight at a lower altitude or higher airspeed, or re–establish 185 KIAS to ensure continued N2 rotation and descend below 20,000 ft for starter assisted airstart.

CAUTION: Failure to observe the minimum airspeed of 185 KIAS may result in engine core lock and the inability to restart engines in a timely manner.

No

Aircraft is below 20,000 ft:

8. APU switch ..... START and release
9. L and R BLEED switches ..... OFF
10. APU BLEED switch ..... ON
11. XBLEED switch ..... OPEN

POWERPLANT

Dual Engine Flameout (Cont)

12. FUEL panel XFER switch ..... Closed
13. FUEL panel L and R PUMP switches ..... AUTO
14. ENG ANTI–ICE switches ..... Off
15. ENGINE RUN switch ..... RUN
16. STARTER switch ..... START

Light off occurs within 45 seconds:

Yes

17. Other engine ..... Start
18. If only one engine is operating, refer to Engine Shutdown In Flight procedure in the NON–NORMAL PROCEDURES chapter.

– END –

No

17. ENGINE RUN switches ..... OFF
18. Attempt another starter assisted airstart at a lower altitude or higher airspeed, or establish best glide speed and refer to Ditching or Forced Landing – Both Engines Inoperative procedure, this section.

——— END ———

Engine Failure

DURING TAKEOFF

Below V_1 Speed:

1. **Autothrottle (if installed) ..... Disengage**
2. **Thrust levers ..... IDLE**
3. **Brakes ..... Maximum or as required**
4. **Thrust reversers ..... MAX REV or as required**

– END –

Above V_1 Speed:

1. **Rotate at V_R.**
2. **Pitch attitude ..... Adjust as required** to achieve V_2.

NOTE: Initially rotate toward the flight director pitch guidance command. Adjust pitch as required to maintain V_2.

3. **LANDING GEAR switch ..... UP** after positive rate of climb.

POWERPLANT

Engine Failure (Cont)

4. Autothrottle (if installed) ..... Disengage
5. Climb at V_2 until clear of obstacles, accelerate to V_2 + 15 (Flaps 10) [V_2 + 25 (Flaps 20)].

NOTE: If engine failure occurs above V_2, maintain airspeed at current value (not more than V_2 + 10 KIAS).

WARNING: It is prohibited to engage the Autothrottle until flaps are retracted and the aircraft has accelerated to en route climb speed.

6. Flaps ..... Retract to 0
7. Climb ..... At en route climb speed
8. N LDG/TAXI light switch ..... OFF
9. ANTI/ICE panel ..... As required
10. Refer to Engine Shutdown In Flight procedure in the NON–NORMAL PROCEDURES chapter.

– END –

IN FLIGHT

1. Autopilot ..... Disconnect
2. Autothrottle (if installed) ..... Disengage
3. Thrust lever (operative engine) ..... Increase as required
4. Rudder Trim ..... As required
5. Refer to the following procedures in the NON–NORMAL PROCEDURES chapter as applicable:
   a. Engine Shutdown In Flight
   b. Single Engine Landing
   c. Single Engine Go–Around.

——— END ———

POWERPLANT

Engine Failure in Climb During (V) ALTS CAP or (V) ALTV CAP

WARNING: If an engine failure occurs during a climb while in any (V) ALTS CAP or (V) ALTV CAP vertical FD mode, crew intervention may be required to ensure that the aircraft maintains the safe single engine operating speed.

1. Autopilot/FD ..... Disconnect
2. Autothrottle (if installed) ..... Disengage
3. Thrust levers ..... APR
4. Pitch attitude ..... Adjust to maintain the required single engine operating airspeed.

NOTE: Vertical FD commands may be used and autopilot re−engaged after FCC mode changes to (V) ALTS or (V) ALTV at desired altitude.

5. Engine Shutdown In Flight ..... Accomplish
6. Refer to Engine Shutdown In Flight procedure in the NON−NORMAL PROCEDURES chapter.

END

REJECTED TAKEOFF

Rejected Takeoff

1. Autothrottle (if installed) ..... Disengage
2. Thrust levers ..... IDLE
3. Brakes ..... Maximum or as required
4. Thrust reversers ..... MAX REV or as required

END

SMOKE OR FIRE

Cabin/Cockpit Fire, Smoke or Fumes

WARNING: In the event of smoke or fire, prepare to land without delay while completing fire suppression and/or smoke evacuation procedures. Whether or not smoke has dissipated, if it can not be visibly verified that the fire has been extinguished following fire suppression and/or smoke evacuation procedures, land immediately at the nearest suitable airport.

1. **Crew oxygen masks ..... Don, select EMERGENCY**
2. **Smoke goggles ..... Don**
3. **Pilot and copilot O2 MASK/NORM switches ..... O2 MASK**
4. Pilot and copilot INPH switches ..... INPH
5. PAX OXYGEN switch ..... OFF
6. OXYGEN THERAPEUTIC switch ..... Off
7. EMER DEPRESS switch ..... ON

NOTE: During EMER DEPRESS operation in manual mode, the cabin rate digital value may be replaced with magenta dashes momentarily. The cabin rate will still be controlled within safe limits.

Cabin pressure remains unchanged:

Yes

8. MANUAL PRESSURIZATION switch ..... ON
9. MAN RATE control ..... Full UP

No

8. Descend as necessary but not below minimum safe altitude.
9. Land as soon as possible.

Source is Known:

Yes

10. Extinguish fire using hand–held extinguisher to eliminate the source of smoke or fumes. If fire is extinguished and can visibly be verified, the pressurization and oxygen systems may be returned to normal.

– END –

No

Source is not known:

Electrical system is suspected source:

Yes

10. Autopilot ..... Disconnect

SMOKE OR FIRE

Cabin/Cockpit Fire, Smoke or Fumes (Cont)

11. Autothrottle (if installed) ..... Disengage
12. EMER LTS switch ..... OFF

L GEN is operative:

Yes

13. APU GEN switch ..... OFF

No

13. APU GEN switch ..... ON
14. R GEN switch ..... OFF
15. R BATT switch ..... OFF
16. BUS TIE switch ..... Open

Smoke or fumes dissipate:

Yes

17. AIR SOURCE switch ..... PACK ONLY
18. WING SOURCE ANTI–ICE switch ..... FROM L
19. R BLEED switch ..... OFF
20. TUNE REVERSION switch ..... CDU ONLY
21. Transponder ..... Select ATC1
22. Flight Guidance Panel XFR switch ..... Select FD1
23. Airspeed ..... 0.75 M_I/250 KIAS maximum
24. Altitude ..... 25,000 ft maximum
25. Leave icing conditions as soon as possible.
26. STALL PUSHER ..... OFF

NOTE: Standby probes will not be anti–iced.

NOTE: The applicable procedures for the following CAS messages are consolidated within this procedure and do not need to be conducted separately:

OUTBD BRAKES FAIL (C), STALL PROTECT FAIL (C), R WING ANTI–ICE FAIL (C), R PITOT HEAT FAIL (C), STBY PITOT HEAT FAIL (C), R ESS BUS OFF (A), R MAIN BUS OFF (A), L (R) AUX BUS OFF (A)

Descent Checks:

27. Pressurization ..... LNDG ALT set
28. WING ANTI–ICE switch ..... As required
29. L and R ENG ANTI–ICE switches ..... As required

SMOKE OR FIRE

Cabin/Cockpit Fire, Smoke or Fumes (Cont)

Transition Level (or FL 180) Checks:

30. Altimeters ..... Set
31. L and R LANDING light switches ..... On
32. Passenger Brief/Cabin Check ..... Complete
33. SMKG/BELTS switch ..... SMKG/BELTS
34. Fuel quantities and balance ..... Check

Approach Checks:

35. Final approach speed ..... V_{REF} + 10
36. Normal actual landing distance ..... Multiply by 1.95

NOTE: Extend gear as soon as possible during approach (to ensure cool brakes).

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW or when landing at an airport pressure altitude of 4000 ft and above.

CAUTION: Reducing weight below MLW or landing at an alternate airport shall only be attempted at pilot discretion and only if this can be achieved in a safe manner and within a reasonable time period.

37. ROAAS (if installed) ..... OFF
38. Approach setup and crew briefing ..... Complete
39. RA MIN or BARO MIN ..... Set
40. MIN ALERT ..... Set

Before Landing Checks:

41. LANDING GEAR switch ..... DN
42. N LDG/TAXI switch ..... On
43. R HYDRAULIC PUMP switch ..... ON
44. FLAPS 30
45. EMER LIGHTS switch ..... ON

– END –

No

Smoke or fumes DO NOT dissipate:

17. R BATT switch ..... ON

R GEN is operative:

Yes

18. R GEN switch ..... ON

Transition to the standby instrument and magnetic compass until the AHRS realigns.

SMOKE OR FIRE

Cabin/Cockpit Fire, Smoke or Fumes (Cont)

NOTE: L and R WSHLD/WINDOW switches must be temporarily selected OFF while the standby compass is being read.

19. APU GEN switch ..... OFF

No

18. APU GEN switch ..... ON

Transition to the standby instrument and magnetic compass until the AHRS realigns.

NOTE: L and R WSHLD/WINDOW switches must be temporarily selected OFF while the standby compass is being read.

19. L GEN switch ..... OFF
20. L BATT switch ..... OFF
21. Airspeed ..... 0.75 M_I/250 KIAS maximum
22. STAB TRIM switch ..... SEC
23. AIR SOURCE switch ..... TRIM AIR ONLY
24. L BLEED switch ..... OFF
25. XBLEED switch ..... Closed
26. Leaving icing conditions as soon as possible.
27. WING SOURCE ANTI–ICE switch ..... FROM R
28. Airspeed ..... 185 KIAS/0.75 M_I maximum
29. TUNE REVERSION switch ..... MFD ONLY
30. Transponder ..... Select ATC2
31. Altitude ..... 25,000 ft maximum
32. Avoid excessive rudder inputs.

Descent Checks:

33. Pressurization ..... LNDG ALT set
34. WING ANTI–ICE switch ..... As required
35. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

36. Altimeters ..... Set
37. L and R LANDING light switches ..... On
38. Passenger Brief/Cabin Check ..... Complete
39. Fuel quantities and balance ..... Check

Approach Checks:

40. Final approach speed ..... V_{REF} + 10
41. Normal actual landing distance ..... Multiply by 1.95

SMOKE OR FIRE

Cabin/Cockpit Fire, Smoke or Fumes (Cont)

NOTE: Extend gear as soon as possible during approach (to ensure cool brakes).

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW or when landing at an airport pressure altitude of 4000 ft and above.

CAUTION: Reducing weight below MLW or landing at an alternate airport shall only be attempted at pilot discretion and only if this can be achieved in a safe manner and within a reasonable time period.

42. Approach setup and crew briefing ..... Complete
43. RA MIN or BARO MIN ..... Set
44. MIN ALERT ..... Set

NOTE: The applicable procedures for the following CAS messages are consolidated within this procedure and do not need to be conducted separately:

STALL PROTECT FAIL (C), L WING ANTI–ICE FAIL (C), INBD BRAKES FAIL (C), L PITOT HEAT FAIL (C), L ESS BUS OFF (A), L MAIN BUS OFF (A), L (R) AUX BUS OFF (A)

Before Landing Checks:

45. LANDING GEAR switch ..... DN
46. N LDG/TAXI light switch ..... On
47. L HYDRAULIC PUMP switch ..... ON
48. FLAPS 30
49. EMER LIGHTS switch ..... ON

– END –

No

Bleed air system is suspected source:

APU supplies bleed air:

Yes

10. XBLEED switch ..... Closed
11. L BLEED switch ..... ON
12. APU BLEED switch ..... OFF
13. R BLEED switch ..... ON

SMOKE OR FIRE

Cabin/Cockpit Fire, Smoke or Fumes (Cont)

Smoke or fumes are eliminated:

Yes

– END –

No

14. AIR SOURCE switch ..... TRIM AIR ONLY

Smoke or fumes are eliminated:

Yes

– END –

No

15. AIR SOURCE switch ..... PACK ONLY

– END –

No

If engines supply bleed air:

10. R BLEED switch ..... OFF
11. XBLEED switch ..... Closed

Smoke or fumes are eliminated:

Yes

– END –

No

12. R BLEED switch ..... ON
13. L BLEED switch ..... OFF

Smoke or fumes are eliminated:

Yes

– END –

No

14. AIR SOURCE switch ..... TRIM AIR ONLY

Smoke or fumes are eliminated:

Yes

– END –

No

15. AIR SOURCE switch ..... PACK ONLY
16. L BLEED switch ..... ON

END

SMOKE OR FIRE

CARGO SMOKE (W)

WARNING: In the event of smoke or fire, prepare to land without delay while completing fire suppression and/or smoke evacuation procedures. Whether or not smoke has dissipated, if it cannot be visibly verified that the fire has been extinguished following fire suppression and/or smoke evacuation procedures, land immediately at the nearest suitable airport.

1. Crew oxygen masks ..... Don, select EMERGENCY
2. Smoke goggles ..... Don
3. Pilot and copilot O2 MASK/NORM switches ..... O2 MASK
4. Pilot and copilot INPH switches ..... INPH (enabled)
5. PAX OXYGEN switch ..... OFF
6. OXYGEN THERAPEUTIC switch ..... Off
7. CABIN DC and AC PWR ..... OFF
8. EMER DEPRESS switch ..... ON
9. Descend as necessary but not below minimum safe altitude.
10. ROAAS (if installed) ..... OFF
11. Land as soon as possible.

Designated Crewmember:

12. Protective breathing equipment ..... Don
13. Fire extinguishing ..... Prepare for use
14. If conditions allow, close lavatory door to control smoke migration.
15. Fire or smoke source ..... Extinguish

END

TAKEOFF CONFIGURATION WARNINGS

Configuration Warning  **"CONFIGURATION"**

CONFIG AILERON TRIM (W)
CONFIG AUTOPILOT (W)
CONFIG FLAPS (W)
CONFIG RUDDER TRIM (W)
CONFIG SPOILERS (W)
CONFIG STAB TRIM (W)
PARK/EMER BRAKE ON (W)

1. Autothrottle (if installed) ..... Disengage
2. Thrust levers ..... IDLE
3. Brakes ..... Maximum or as required
4. Thrust reversers ..... MAX REV or as required
5. After stopping, takeoff configuration ..... Check
6. For CONFIG STAB TRIM (W) perform the following:

WARNING: If any anomalies occur during the stab trim check below, the indicated stabilizer position may be grossly incorrect. Do not fly the aircraft until resolved.

(a) Stab Trim ..... Set to 1.0

NOTE: Monitor STAB indicated position from 1.0 to 3.0 units. Trim digits and pointer should move continuously with no skips, hesitations or reversals.

(b) Stab Trim ..... Set to 3.0

(c) Stab Trim ..... Set for takeoff

END

TAKEOFF CONFIGURATION WARNINGS

PITCH DISCONNECT (W)

1. Thrust levers ..... IDLE
2. Brakes ..... Maximum or as required
3. Thrust reversers ..... MAX REV or as required
4. After stopping, align control columns.
5. PULL & TURN the PITCH DISC handle to release, and push to full stow position.
6. Verify PITCH DISCONNECT (W) CAS extinguishes. Slight movement of the control columns may be required to reconnect the controls.

END

ROLL DISCONNECT (W)

1. Thrust levers ..... IDLE
2. Brakes ..... Maximum or as required
3. Thrust reversers ..... MAX REV or as required
4. After stopping, align control wheels.
5. Release the small locking lever and push the ROLL DISC lever forward.
6. Verify ROLL DISCONNECT (W) CAS extinguishes. Slight movement of the control wheels may be required to reconnect the controls.

END

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GENERAL

The procedures in this section of the manual have been developed by Bombardier Inc. for the certification of this aircraft. This section contains those procedures which may be considered routine in day–to–day operations. The presentation includes, but is not limited to, detailed checklist procedures by flight phase.

FIRST FLIGHT OF THE DAY

The " [1] " symbol in the procedure means that the associated procedure is accomplished only on the first flight of the day.

THROUGH–FLIGHT PROCEDURES (BOTH ENGINES SHUT DOWN)

Normal preflight procedures (all checklist line items) must be accomplished prior to takeoff at the original departure point of a flight. At each intermediate stop of flight where both engines are shut down, the Through–Flight Checklist may be used for preflight, provided certain criteria are met. In the following procedures (Exterior Preflight, Cabin Preflight, and Before Starting Engines), steps marked with this symbol (♦) denote Through–Flight Checklist items. When permitted, accomplishment of all Through–Flight Checklist items fulfills a minimum preflight requirement.

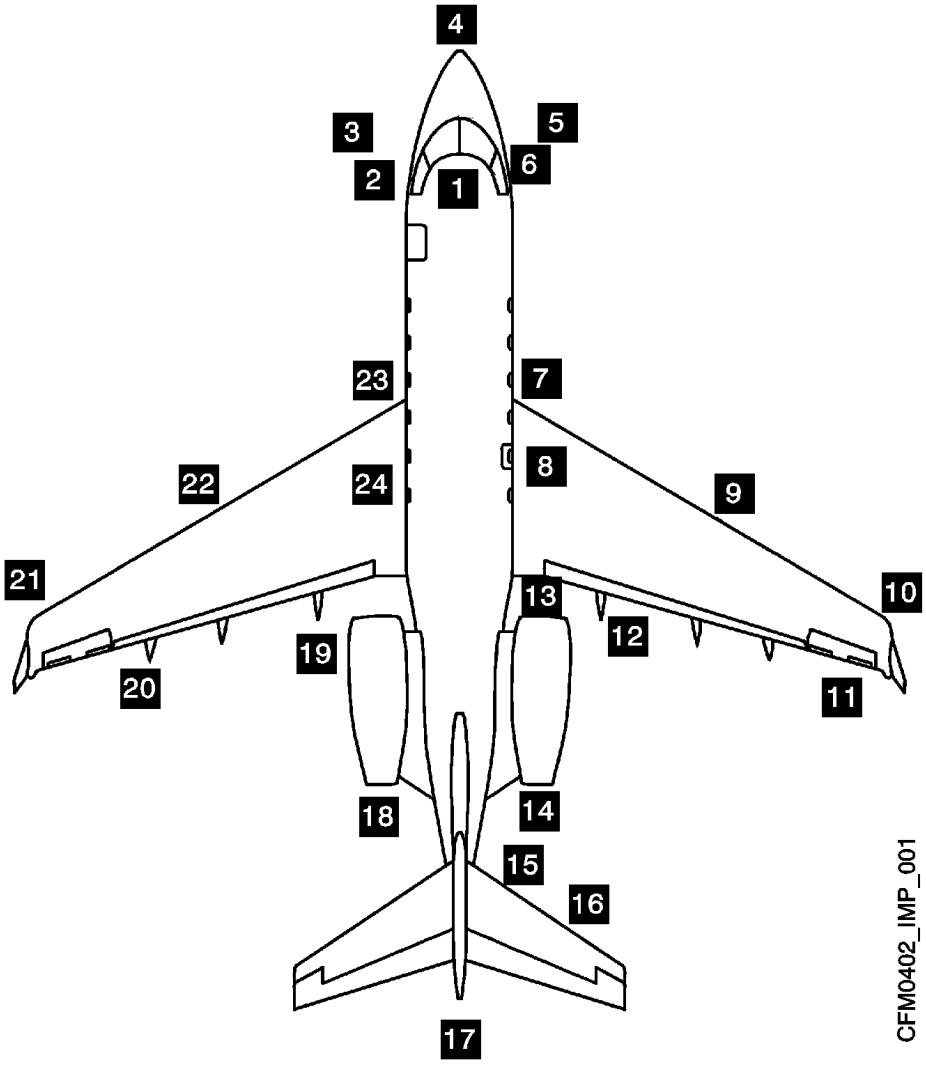
The Through–Flight Checklist may be used following an intermediate stop with both engines shut down, provided the following criteria have been satisfied during that stop:

- There has been no change in flight crew personnel.
- No maintenance has been performed on the aircraft. Routine line servicing is not considered maintenance.
- No more than three (3) hours have elapsed between engine shutdown and engine start.
- Extreme weather conditions (heavy precipitation, ice, snow, extreme cold, etc.) have not occurred which would change the preflight status of the aircraft.

For intermediate stops with no engine shut down, completion of the Quick Turn–Around procedure in this section provides the minimum preflight requirements.

EXTERIOR PREFLIGHT

Walk–Around Inspection



EXTERIOR PREFLIGHT (CONT)

EXTERIOR SAFETY CHECK/WALKAROUND

1. Exterior Safety Check/Walkaround ..... Accomplish

♦ During Exterior Preflight, check all vents clear, check access doors for security, and all aircraft surfaces for condition.

1

♦ a. LANDING GEAR switch ..... DN

♦ b. L, R, and AUX HYDRAULIC PUMP switches ..... OFF

c. R BATT switch ..... On

NOTE: R BATT switch is selected first to prevent uncommanded APU starts.

d. L BATT switch ..... On

e. Clock ..... Check

Set to correct local time.

f. Fuel quantities ..... Check

g. Oxygen quantity ..... Check

h. PARK/EMER BRAKE:

If PARK/EMER BRAKE not set:

(1) L and R HYDRAULIC PUMP switches ..... ON

Check hydraulic systems fully pressurized.

(2) Brake pedals ..... Depress fully

(3) PARK/EMER BRAKE handle ..... Set

(4) Brake pedals ..... Release

(5) L and R HYDRAULIC PUMP switches ..... OFF

If PARK/EMER BRAKE set:

(1) L HYDRAULIC PUMP switch ..... ON

Check left hydraulic system fully pressurized.

(2) L HYDRAULIC PUMP switch ..... OFF

i. If night flight is anticipated, check exterior lighting.

All exterior light switches ..... On

Check proper illumination, then all exterior light switches ..... Off

j. L and R BATT switches ..... OFF

k. GUST LOCK ..... OFF

2

a. Passenger door operating switch door ..... Closed

b. Left standby static port ..... Clear of obstructions

EXTERIOR PREFLIGHT (CONT)

c. Left stall warning vane ..... Freedom of movement

d. Left pitot–static probe ..... Cover removed, clear of obstructions

e. Standby pitot probe ..... Cover removed, clear of obstructions

f. Left ice detector ..... Check

g. Ground communication door ..... Closed

h. L windshield/window ..... Condition

3 ♦ a. Nose gear check:

(1) Wheel well and gear ..... Condition

(2) Doors ..... Condition

(3) Wheels and tires ..... Condition

(4) Gear pin and chocks ..... Removed

(5) N LDG/TAXI lights ..... Condition

4 a. Radome ..... Condition

b. Windshields/windows ..... Condition

5 a. Right ice detector ..... Check

b. Right pitot–static probe ..... Cover removed, clear of obstructions

6 a. R windshield/window ..... Condition

b. R stall warning vane ..... Freedom of movement

c. Total air temperature probe ..... Check

d. Right standby static port ..... Clear of obstructions

7 ♦ a. Outflow valve access door ..... Closed

b. L and R engine oil level ..... Check, green

c. Fuel access doors ..... Closed

8 a. Wing inspection and emergency exit lights and lenses ..... Condition

♦ b. Emergency exit ..... Closed

♦ c. Right engine inlet and fan ..... Clear of obstructions and condition

d. Upper fuselage antennas, and dorsal inlets ..... Condition

e. Lower fuselage antennas, landing light fairing and lens ..... Condition

[1] f. Fuel water drains ..... Drain

EXTERIOR PREFLIGHT (CONT)

NOTE: The fuel sump drains are low points in the fuel system. Fuel will drain from these when opened.

♦ g. Fuel and hydraulic drain masts ..... Check for leakage

9 a. Right wing check:

(1) Leading edge and vortilons ..... Condition

(2) Access panels ..... Fuel/Hydraulic leakage

(3) Fuel cap ..... Secure

CAUTION: The wing and flight control surfaces must be free of frost, snow, and ice. Ice can form on the surfaces of the wing even on very warm days if the fuel temperature will support it. The leading edge and lower surface of the flaps must be free of ice.

10 a. Right winglet navigation light/lens and static wicks ..... Condition

11 a. Right aileron ..... Check free motion, balance tab linkage, bent tab and brush seal condition

b. Right spoilers and flap ..... Condition

c. NACA scoop ..... Clear of obstructions

12 ♦ a. Right main gear check:

(1) Wheel well and gear ..... Hydraulic/fuel leakage and condition

(2) Doors ..... Condition

(3) Wheels, brakes and brake wear indicators, and tires ..... Condition

NOTE: The wear pins should be exposed with the PARKING BRAKE set.

(4) Gear pin and chocks ..... Removed

13 a. Oxygen overpressure relief indicator and service door ..... Check and close

b. Lav waste access door ..... Closed

c. Ground power supply access door ..... Closed

14 ♦ a. Right generator scoop ..... Clear

b. Right engine cowl latches ..... Closed

c. Right engine turbine exhaust area ..... Condition, clear of obstructions

EXTERIOR PREFLIGHT (CONT)

d. Right thrust reverser ..... Stowed

15 a. High pressure pneumatic supply door ..... Closed

16 a. APU inlet ..... Clear of obstructions

b. APU generator and compartment scoops .. Clear of obstructions

c. APU exhaust ..... Clear of obstructions

d. Vertical stabilizer and rudder ..... Condition

e. Horizontal stabilizer and elevator ..... Condition

WARNING: The vertical and horizontal stabilizer, and flight control surfaces must be free of frost, snow, and ice.

f. Static discharge wicks ..... Condition

g. PACK exhaust vent ..... Clear

17 a. Aft equipment bay door ..... Open, check for fluid leaks, security and condition of installed equipment, remote circuit breakers set.

b. Aft equipment bay door ..... Close

18 ♦ a. Left engine turbine exhaust area ..... Condition, clear of obstructions

b. Left thrust reverser ..... Stowed

19 ♦ a. Cargo door ..... Closed

♦ b. Battery bay door ..... Closed

c. Battery vents ..... Check

d. Left engine cowl latches ..... Closed

e. Left main gear check:

(1) Wheel well and gear ..... Hydraulic/fuel leakage and condition

(2) Doors ..... Condition

(3) Wheels, brakes and brake wear indicators, and tires ..... Condition

NOTE: The wear pins should be exposed with the PARKING BRAKE set.

(4) Gear pin and chocks ..... Removed

f. Left generator scoop ..... Clear

20 a. Left spoilers and flap ..... Condition

b. Left aileron ..... Check free motion, balance, bent tabs and trim tab linkage and brush seal condition

EXTERIOR PREFLIGHT (CONT)

c. NACA scoop ..... Clear of obstructions

21 a. Left winglet navigation light/lens and static wicks ..... Condition

22 a. Left wing check:

(1) Leading edge and vortilons ..... Condition

(2) Access panels ..... Fuel/hydraulic leakage

(3) Fuel cap ..... Secure

CAUTION: The wing and flight control surfaces must be free of frost, snow, and ice. Ice can form on the surfaces of the wing even on very warm days if the fuel temperature will support it. The leading edge and lower surface of the flaps must be free of ice.

23 [1] a. Fuel water drains ..... Drain

NOTE: The fuel sump drains are low points in the fuel system. Fuel will drain from these when opened.

24 ♦ a. Left engine inlet and fan ..... Clear of obstructions and condition

b. Upper fuselage ..... Condition

CABIN PREFLIGHT

♦ 1. Cabin furnishings ..... Secure

♦ 2. Emergency exit ..... Aisle clear and handle unobstructed.

Remove and stow aft emergency exit door security pin.

BEFORE STARTING ENGINES

NOTE: All flight deck switches will be extinguished, except as noted in the following procedures.

1. Circuit breakers (CB1 and CB2) ..... Set

♦ 2. Seats, safety harnesses ..... Secure

3. Crew oxygen masks and smoke goggles ..... Check

♦ 4. LANDING GEAR switch ..... DN

♦ 5. L, R, and AUX HYDRAULIC PUMP switches ..... OFF

♦ 6. AIR SOURCE switch ..... OFF

BEFORE STARTING ENGINES (CONT)

♦ 7. Electrical system:
   a. STBY INST switch ..... On
   b. EXT PWR switch (if connected) ..... Check AVAIL then select ON
   c. R BATT switch ..... On

   NOTE: R BATT switch is selected first to prevent uncommanded APU starts.

   d. L BATT switch ..... On

♦ 8. L and R PROBES ..... OFF

9. L and R COCKPIT LIGHTS ..... As desired

♦ 10. APU Start:
   a. CAS ..... Check, no APU or AIR COND FAULT messages
   b. L and R BLEED switches ..... OFF
   c. NAV lights ..... NAV
   d. R FUEL PUMP switch ..... AUTO
   e. APU switch ..... START, (hold for 3 seconds) and release
   f. EXT PWR switch (if applicable) ..... AVAIL and disconnect
   g. APU BLEED switch ..... ON
   h. XBLEED switch ..... Open
   i. AIR SOURCE switch ..... NORM

11. SYSTEMS TEST panel:
   a. ANNUN A ..... Test
   b. ANNUN B ..... Test
   c. PROBES ..... Test
      – PROBE HEAT TEST OK (S) CAS illuminates.
   d. STALL/RUD LIM ..... Test
      – The STALL icon on both PFDs illuminates.
      – Flashing AOA red illuminates briefly.
      – "STALL" voice sounds.
      – Left stick shaker activates.
      – Right stick shaker activates.
      – Pusher activates.
      – RUDDER LIMITER IN TEST (S) illuminates.

BEFORE STARTING ENGINES (CONT)

e. ICE DET ..... Test

– ICE DETECTED (C) and **ICE** icon on PFD illuminates.

12. L and R rudder pedals ..... Adjust

13. L and R audio panels ..... Set

♦ 14. Fuel quantity ..... Check

♦ 15. Standby Instrument ..... Check

16. Clock ..... Zero flight time

Effectivity:

On airplanes 20501 to 20758 incorporating SB 350–34–018 and airplanes 20759 and subsequent incorporating SB 350–34–017:

17. STEEP APPR ..... Off

Check ON light out.

18. NWS switch ..... OFF

♦ 19. L and R FUEL PUMP switches ..... AUTO

♦ 20. FMS ..... Program

21. REVERSION panel ..... NORM

22. AIR COND/BLEED panel ..... Check

[1] a. RAM AIR switch ..... ON

– RAM AIR ON (S) illuminates

b. RAM AIR switch ..... OFF

23. ANTI–ICE panel:

a. WING SOURCE switch ..... NORM

b. L and R PROBES switches ..... OFF

♦ c. L and R WSHLD/WINDOW switches ..... ON

♦ 24. PRESSURIZATION panel ..... Check

a. LNDG ALT ..... Set

25. LIGHTING panel ..... As desired

[1] a. Emergency lights ..... Check:

BEFORE STARTING ENGINES (CONT)

(1) EMER LTS switch ..... OFF
(EMER LIGHTS OFF (C) CAS)

(2) EMER LTS switch ..... ON
(EMER LIGHTS ON (C) CAS),
check emergency lights displayed

♦ (3) EMER LTS switch ..... ARM

26. GUST LOCK ..... OFF

♦ 27. HYDRAULIC panel:

a. L and R PUMP switches ..... ON
b. AUX pump switch ..... AUTO
c. PARK/EMER BRAKE handle ..... Confirm set
d. L and R PUMP and PTU switches ..... AUTO
e. R HYDRAULIC PRESS ..... Verify less than 1800 psi
f. AUX pump switch ..... OFF

28. Trim system:

a. STAB TRIM switch ..... SEC
b. Pilot's trim switch ..... NUP and NDN
Verify movement
c. Copilot's trim switch ..... NUP and NDN
Verify movement
d. STAB TRIM switch ..... PRI
e. Pilot's trim switch ..... NUP and NDN
Verify movement
f. Pilot's trim switch housing only ..... NUP or NDN
Verify no movement
g. Pilot's trim switch arm button only ..... Depress
Verify no movement
h. Pilot's trim switch ..... NUP or NDN & hold
Verify movement
i. Pilot's master disconnect switch ..... Depress
Verify movement stops
j. Pilot's trim switch and master disconnect switch ..... Release

BEFORE STARTING ENGINES (CONT)

k. Copilot's trim switch ..... NUP and NDN
Verify movement

l. Copilot's trim switch housing only ..... NUP or NDN
Verify no movement

m. Copilot's trim switch arm button only ..... Depress
Verify no movement

n. Copilot's trim switch ..... NUP or NDN & hold
Verify movement

o. Copilot's master disconnect switch ..... Depress
Verify movement stops

p. Copilot's trim switch and master disconnect switch ..... Release

WARNING: If any anomalies occur during the stab trim check below, the indicated stabilizer position may be grossly incorrect and the aircraft must not be flown until resolved.

q. Stab Trim ..... Set to 1.0

NOTE: Monitor STAB indicated position from 1.0 to 3.0 units. Trim digits and pointer should move continuously with no skips, hesitations or reversals.

r. Stab Trim ..... Set to 3.0

s. Stab Trim ..... Set for takeoff

t. AIL and RUD Trim ..... Check operation and set for takeoff

29. ELT ..... ARM

30. CABIN DC and AC PWR switches ..... On

31. PAX OXYGEN switch ..... AUTO

32. THERAPEUTIC OXYGEN switch ..... ON

(Only required for flights requiring a mission completion altitude above 10,000 ft following a pressurization failure.)

– Switch ON light illuminates

a. THERAPEUTIC OXYGEN switch ..... OFF

♦ 33. Altimeters (3) ..... Set

BEFORE STARTING ENGINES (CONT)

Effectivity:

On airplanes 20584 and subsequent, and airplanes incorporating SB 350−22−001:

CAUTION: Reduced vertical separation with terrain may be encountered in mountainous terrain if altimeter is incorrectly set and LNV is armed for departure.

♦ 34. Avionics ..... Set for departure

NOTE: For any SBAS covered airspace (US RNAV routes, SIDs, and STARs), it is not required to run a pre−flight prediction of RAIM availability along the intended route if no satellites are NOTAM'd as out of service over the intended route.

For non−SBAS covered airspace, certain operations may require that an appropriate prediction program be used prior to departure for RAIM availability along the intended route.

♦ 35. Takeoff data (V_1, V_R, V_2, and distance) ..... Computed, and speeds set .

Effectivity:

On airplanes 20578 and subsequent, and airplanes incorporating SB 350−34−013:

36. Takeoff data ..... Check displayed.

Crosscheck input data on PERF INIT 1/3, TAKEOFF REF 1/4 and 2/4 CDU pages:

RWY data, Wind, OAT, QNH, PALT, CG, T/O FLAPS, Weight, ENG BLEED, THRUST REV.

CAUTION: Ensure input data matches airplane configuration and environmental conditions.

37. CAS messages ..... Check

NOTE: 1. The IRS automatically aligns using GNSS position (normal IRS alignment time varies depending on location, typically not exceeding 10 minutes). If GNSS is not available, it will align using the position entered to initialize the FMS.

2. Following a successful initial alignment, do not manually re−enter the position in the FMS CDU either immediately before, or immediately after airplane motion. If this has occurred, a complete normal shutdown and restart of the airplane and IRSs must be completed. Failure to do so may lead to a total IRU loss during subsequent flight legs.

STARTING ENGINES

Engine starts may be made by using the APU, an external air source, or crossbleed from the other engine.

WARNING: Maintain a safe distance from the engine outlets at all times during engine operation. Airflow into the turbofan engine is sufficient to draw personnel and equipment into the engine inlet.

NOTE: Ensuring ITT is below 350 °C (cranking if necessary) will reduce the possibility of a hot start.

1. Passenger door ..... Closed
   a. Green flag ..... Check
2. PARK/EMER BRAKE handle ..... Confirm set
3. Thrust levers ..... IDLE
4. STROBE switch ..... BCN
5. Engine Start (APU bleed source)
   a. ENGINE RUN switch ..... RUN
   b. STARTER ..... START and release
   c. Engine Instruments ..... Check
   d. Start other engine by repeating steps 5 a through c. (Optional)

5. Engine Start (External bleed source)
   a. External air source ..... Verify connected
   b. Bleed pressure ..... 32 psi minimum
   c. ENGINE RUN switch ..... RUN
   d. STARTER ..... START and release
   e. Engine Instruments ..... Check
   f. Start other engine by repeating steps 5 c through f. (Optional)
   g. External air source ..... Disconnect
   h. XBLEED switch ..... Closed
   i. L and R BLEED switches ..... ON
   j. EXT PWR switch (if applicable) ..... AVAIL, Disconnect

5. Engine Start (Crossbleed source)
   a. APU BLEED switch ..... OFF
   b. Operating engine BLEED switch ..... On
   c. Operating engine thrust lever ..... Advance
   d. Bleed pressure ..... 32 psi minimum
   e. ENGINE RUN switch ..... RUN

   NOTE: Starting with a tailwind may require a higher bleed pressure than 32 psi.

STARTING ENGINES (CONT)

f. STARTER ..... START and release
g. Engine Instruments ..... Check normal
h. XBLEED switch ..... Closed
i. L and R BLEED switches ..... ON
j. EXT PWR switch (if applicable) ..... AVAIL, Disconnect

6. Generators ..... Check on line

BEFORE TAXI

NOTE: If anti–icing fluids have been applied to the aircraft, the anti–ice system checks in steps 1 and 9 below may be accomplished upon completion of the first flight of the day prior to engine shutdown.

[1] 1. WING ANTI–ICE switch ..... ON

– WING ANTI–ICE (S) illuminates.

2. FLAPS ..... 10 or 20
3. AUX PUMP switch ..... AUTO
4. Flight controls:
   a. Select FLIGHT CONTROLS synoptic page.
   b. Apply full range of motion to pitch, roll and yaw while checking for elevator, aileron, roll spoilers, and rudder motion.
5. FLIGHT SPOILERS lever ..... Check extension all positions 0–MAX and EMER.
6. GND SPOILERS:
   a. MANUAL ARM ..... Check extended
   b. AUTO ..... Check stowed
7. YD ..... On
8. EICAS ..... Check
9. Passenger brief/cabin check ..... Complete

[1] 10. ANTI–ICE panel:
   a. Wing anti–ice flow lines green after 2 minutes ON ..... Check
   b. WING SOURCE switch ..... FROM L

– WING SOURCE XBLEED (S) illuminates

   c. WING SOURCE switch ..... FROM R

– WING SOURCE XBLEED (S) illuminates

BEFORE TAXI (CONT)

NOTE: If L(R) WING A/I LOW TEMP (C) illuminates, it may be necessary to increase the thrust lever slightly.

d. WING SOURCE switch ..... NORM

e. WING ANTI–ICE switch ..... As required

11. Airplane lighting ..... As required

12. SMKG/BELTS switch ..... SMKG/BELTS

13. NWS switch ..... On

14. PARK/EMER BRAKE Release:

a. Brake pedals ..... Depress fully

b. PARK/EMER BRAKE handle ..... Stow

c. Brake pedals ..... Release

TAXI AND BEFORE TAKEOFF

1. XPDR/TCAS ..... Set

2. Brakes and nose wheel steering ..... Check

If conditions exist that could result in water saturated brakes, perform 7 consecutive brake applications from 20 kt to 5 kt. Perform the brake applications during the last mile/kilometer of taxi prior to and not including the final stop or snub before takeoff.

DO NOT DRAG THE BRAKES.

Warming of the brakes will preclude the chance of water saturated brakes freezing at altitude and being locked for landing touchdown.

3. Flight instruments ..... Check

4. Thrust reversers:

CAUTION: Use of reverse thrust on poorly cleaned or maintained runway, taxiway, or ramp surfaces may cause foreign object damage to engine fan blades.

a. Thrust levers ..... REV

(REV [white] EI, then REV [green] EI)

b. Thrust levers ..... IDLE

(REV [white] EI, then extinguishes)

5. Engine instruments and N_1 bugs ..... Check,

verify that the left and right bugs agree within 1%.

6. Takeoff data (V_1, V_R, V_2, and distance) ..... Check displayed

TAXI AND BEFORE TAKEOFF (CONT)

Effectivity:

On airplanes 20578 and subsequent, and airplanes incorporating SB 350–34–013:

7. Takeoff data (V_1, V_R, V_2, and distance) ..... Check displayed.

   Crosscheck input data on PERF INIT 1/3, TAKEOFF REF 1/4 and 2/4 CDU pages:

   RWY data, Wind, OAT, QNH, PALT, CG, T/O FLAPS, Weight, ENG BLEED, THRUST REV.

   CAUTION: Ensure input data matches airplane configuration and environmental conditions.

8. Nav equipment ..... Check
9. Crew takeoff briefing ..... Complete
10. Radar/terrain ..... As required

WARNING: **Do not** transmit radar energy if personnel are within 9 feet (3 meters) radially from the nose of the airplane, within 100 feet (30 meters) of large metallic objects including airplanes, or during refueling.

11. ANTI–ICE panel:
    a. WING switch ..... As required
    b. L and R ENG switch ..... As required

RUNWAY LINEUP

1. L and R PROBES switches ..... On
2. L and R LANDING, N LDG/TAXI light switches ..... As required
3. STROBE switch ..... STROBE
4. CAS ..... Checked and cleared

TAKEOFF

1. Thrust Levers ..... TO

At V_R:

2. Smoothly rotate toward flight director pitch guidance command. Adjust pitch as required to accelerate to a speed of not less than V_2 + 10 at 35 ft above the runway.

AFTER TAKEOFF

NOTE: If taxi and/or takeoff were on ice, snow, or slush, unless weather conditions or performance requirements prohibit, delay retraction of the landing gear until excess water, snow or slush is thrown off by wheel rotation and/or slipstream force.

1. LANDING GEAR ..... UP after positive rate of climb
2. FLAPS ..... 0 at V_2 + 15 (flaps 10); V_2 + 25 (flaps 20)
3. N LDG/TAXI light switch ..... OFF
4. ANTI–ICE panel ..... As required
5. L and R HYDRAULIC PUMP switches ..... AUTO

CLIMB

1. Thrust levers ..... CLB

10,000 ft Checks:

2. SMKG/BELTS switch ..... As required
3. APU and BLEEDS ..... Set
4. Pressurization ..... Check

Transition Altitude (or 18,000 ft) Checks:

5. Altimeters ..... Set
6. L and R LANDING light switches ..... As required

CRUISE

1. Fuel balance ..... Check
2. Engine power settings for cruise ..... Confirm

   Cruise tables are found in the Flight Planning and Cruise Control Manual.

NOTE: The VOR and FMS bearing pointers may differ by up to 7 degrees when the VOR is being used as a waypoint.

DESCENT

1. WING ANTI–ICE switch ..... As required
2. L and R ENG ANTI–ICE switches ..... As required
3. Pressurization ..... Check/Set

DESCENT (CONT)

Transition Level (or FL 180) Checks:

4. Altimeters ..... Set
5. L and R LANDING light switches ..... As required
6. Passenger Brief/Cabin Check ..... Complete
7. SMKG/BELTS switch ..... SMKG/BELTS
8. Fuel Quantities and Balance ..... Check

APPROACH

NOTE: Intermittent operation at idle when wing anti–ice and/or engine anti–ice is ON is acceptable during final approach provided the following CAS messages are not annunciated: L (R) WING ANTI–ICE FAIL (C) or L (R) WING A/I LOW TEMP (C) and/or L (R) ENG ANTI–ICE FAIL (C).

1. APU and BLEEDS ..... Set
2. Landing data (V_{REF}, V_{GA}, Distance) ..... Set

Effectivity:

On aircraft 20578 and subsequent, and aircraft incorporating SB 350–34–013:

3. Landing data (V_{REF}, V_{GA}, Distance) ..... Check displayed.

   Crosscheck input data on APPROACH REF 1/4 and 2/4 CDU pages:

   RWY data, Wind, OAT, QNH, PALT, LDG FACTOR (if applicable), Weight, ENG BLEED, THRUST REV, DELTA V_{REF} (if applicable).

   CAUTION: Ensure input data matches aircraft configuration and environmental conditions.

4. Approach setup and crew briefing ..... Complete
5. RA MIN or BARO MIN ..... Set
6. MIN ALERT ..... Set
7. ROAAS RCC 5 switch (if installed) ..... As required
8. L and R HYDRAULIC PUMP switches ..... AUTO

BEFORE LANDING

1. LANDING GEAR ..... DN
2. L LANDING, N LDG/TAXI and R LANDING light switches ..... On
3. FLAPS 30

GO–AROUND

CAUTION: If unreliable airspeed is suspected, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed.

1. Autopilot ..... Disengage with the TO/GA button
2. Thrust levers ..... TO
3. FLIGHT SPOILERS (if extended) ..... RETRACT
4. Pitch attitude ..... Increase

   rapidly but smoothly to initiate pitch attitude of 8 degrees at a speed of not less than V_{REF}, then adjust pitch attitude to maintain V_{2GA} speed.
5. FLAPS 10
6. LANDING GEAR ..... UP

   after positive rate of climb is established.
7. Climb at V_{2GA} or above.

NOTE: The flight director guidance only represents an initial target to rotate toward and does not guarantee that the climb speed will be achieved under all conditions.

8. When clear of obstacles, accelerate to V_{2GA} + 15 and retract flaps.
9. Pressurization ..... LNDG ALT set

LANDING

NOTE: Carry out a positive touchdown to ensure initial wheel spin up and breakout of frozen brakes if icing accumulation on the wheels and brakes is suspected.

1. Brakes ..... As required
2. Thrust reversers ..... As desired
   a. With nose wheel on runway, move both thrust levers to REV, a REV [white] EI will illuminate.
   b. The thrust reversers are deployed when the REV [green] EI illuminates. Smoothly pull thrust levers to the desired reverse thrust.

   WARNING: When landing on snow covered runways, apply reverse thrust with caution as visibility may be impaired.

   c. By 40 KIAS return the thrust levers to REV.

   CAUTION:
   - Do not use reverse thrust on poorly cleaned or poorly maintained surfaces. This may cause foreign object damage to engine fan blades.
   - If full reverse thrust is maintained below 40 KIAS, reingestion of exhaust gases in the engine and foreign object damage may occur.

   d. When reverse thrust is no longer required, return thrust levers to IDLE. The REV [green] EI will change to a REV [white] EI. Once the thrust reversers are stowed, the REV [white] EI will extinguish.

AFTER LANDING/CLEARING RUNWAY

1. L and R PROBES ..... OFF

NOTE: If anti–icing fluids have been applied to the airplane, the anti–ice system checks may be accomplished upon completion of the first flight of the day prior to engine shutdown. Refer to the first flight of the day anti–ice system checks in BEFORE TAXI, this chapter.

2. WING ANTI–ICE switch ..... As required
3. L and R ENG ANTI–ICE switches ..... As required
4. Lighting ..... As desired
   a. STROBE switch ..... BCN
5. FLAPS ..... As desired
6. XPDR/TCAS ..... As required

SHUTDOWN

1. PARK/EMER BRAKE Set:
   a. Brake pedals ..... Depress fully
   b. PARK/EMER BRAKE handle ..... Set
   c. Brake pedals ..... Release
2. Chocks ..... Insert

NOTE: Do not rely on parking brake for overnight or unattended use.

3. NWS switch ..... OFF
4. L and R WSHLD/WINDOW switches ..... OFF
5. EMER LTS switch ..... OFF
6. ENGINE RUN switches ..... OFF
7. XPDR ..... STBY
8. STROBE switch ..... OFF
9. Gear pins ..... Insert
10. HYDRAULIC panel:
    a. L, R PUMPS and PTU switches ..... OFF
    b. R HYDRAULIC PRESS ..... Verify less than 1,800 psi
    c. AUX switch ..... OFF
11. GUST LOCK ..... Set

NOTE: It may be required to move the control wheel left and right near the neutral position to ensure lock engagement.

12. L and R COCKPIT LIGHTS ..... As desired
13. CABIN DC and AC PWR switches ..... OFF
14. APU switch ..... OFF
15. NAV lights ..... OFF
16. STBY INST switch ..... OFF

Effectivity:

For airplanes incorporating SB 350–23–010.

17. ATN ..... log OFF

18. L and R BATT switches ..... OFF

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CL-350



CL-350 SUPPLEMENTAL MANUAL

LIMITATIONS 07

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GENERAL

Observance of the limitations in this Airplane Flight Manual is mandatory.

BASIC LIMITATIONS

KINDS OF OPERATION

This airplane is certificated to the applicable regulations in the transport category and is eligible for the following kinds of operations when the appropriate instruments and equipment required by the airworthiness and operating requirements are installed and approved and are operable.

This airplane is approved for:

- VMC (Visual Meteorological Conditions)
- IMC (Instrument Meteorological Conditions)
- Day
- Night
- Icing.

Effectivity:

On Argentinean registered airplanes:

The equipment necessary for the different kinds of operations must comply with the applicable Argentine Regulations.

APPROVAL STATUS

The approvals listed in the OPERATIONAL CAPABILITIES do not constitute operational approval. Some operations require additional crew qualification, communication and surveillance equipage in order to obtain operational approval from regulatory authorities.

OPERATION IN ICING CONDITIONS

Do not hold in icing conditions with flaps extended.

Super–Cooled Large Droplet Icing:

Flight in super–cooled large droplet icing (SLD) conditions may, but not necessarily be indicated by ice accretion on the side windows.

When side window icing is observed:

- Wing and engine anti–icing systems must be on.
- Leave icing conditions as soon as possible.

Engine Anti–Ice Systems:

Ground operations. The engine anti–icing system must be ON when the outside air temperature (OAT) on the ground and for takeoff is 10 °C (50 °F) or below and visible moisture in any form is present (such as fog with visibility of one mile (1,500 m) or less, rain, snow, sleet, or ice crystals).

BASIC LIMITATIONS (CONT)

The engine anti–icing system must also be ON when the OAT is 10 °C (50 °F) or below when operating on ramps, taxiways, or runways where surface snow, ice, standing water, or slush is present.

Flight operations. Icing conditions exist in flight at a total air temperature (TAT) of 10 °C (50 °F) or below and visible moisture in any form is encountered (such as clouds, rain, snow, sleet, or ice crystals), except when the static air temperature (SAT) is –40 °C (–40 °F) or below.

The engine anti–icing system must be ON when the ICE DETECTED CAS message is on, or in icing conditions.

Wing Anti–Ice System:

Ground operations. The wing anti–icing system must be ON for takeoff when the OAT is 5 °C (41 °F) or below and visible moisture in any form is present (such as fog with visibility of one mile (1,500 m) or less, rain, snow, sleet, or ice crystals).

The wing anti–icing system must also be ON when the OAT is 5 °C (41 °F) or below when operating on ramps, taxiways, or runways where surface snow, ice, standing water, or slush is present.

Flight operations. Icing conditions exist in flight at a total air temperature (TAT) of 10 °C (50 °F) or below and visible moisture in any form is encountered (such as clouds, rain, snow, sleet, or ice crystals), except when the static air temperature (SAT) is –40 °C (–40 °F) or below.

The wing anti–icing system must also be ON when:

- the ICE DETECTED CAS message is on, OR
- in icing conditions and the airspeed is less than 210 KIAS.

COLD WEATHER OPERATIONS

Airplane operations in cold weather conditions must be conducted in accordance with the Flight Crew Operating Manual – Volume 1, Supplement 1 – COLD WEATHER OPERATIONS .

DITCHING

This airplane is certified for ditching when the appropriate safety equipment is installed per applicable regulations.

BASIC LIMITATIONS (CONT)

APPROACHES

Operations with glidepath angles exceeding that shown in Figure 02–01–1 are prohibited unless they are accomplished in accordance with the supplement 10 – STEEP APPROACHES WITH PUBLISHED GLIDEPATH ANGLES FROM 4.5 TO 5.5 DEGREES.

APPROACH GLIDEPATH ANGLE OPERATING LIMITS

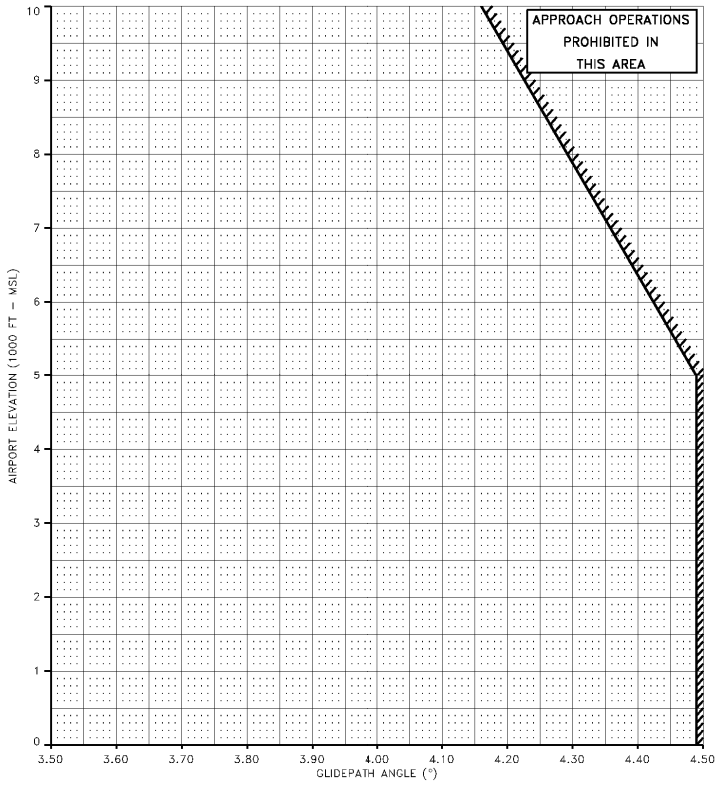


Figure 02–01–1

MINIMUM FLIGHT CREW

The minimum flight crew shall consist of a pilot and a copilot.

WEIGHT AND C.G. LIMITATIONS

MAXIMUM RAMP WEIGHT (MRW)

Maximum Ramp Weight ..... 40,750 lb (18,484 kg)

MAXIMUM TAKEOFF WEIGHT (MTOW)

Maximum Takeoff Weight ..... 40,600 lb (18,416 kg)

MAXIMUM ZERO FUEL WEIGHT (MZFW)

Maximum Zero Fuel Weight ..... 28,200 lb (12,791 kg)

MAXIMUM LANDING WEIGHT (MLW)

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

MINIMUM FLIGHT WEIGHT (MFW)

Minimum Flight Weight ..... 24,800 lb (11,249 kg)

All weights in excess of Maximum Zero Fuel Weight must consist of fuel.

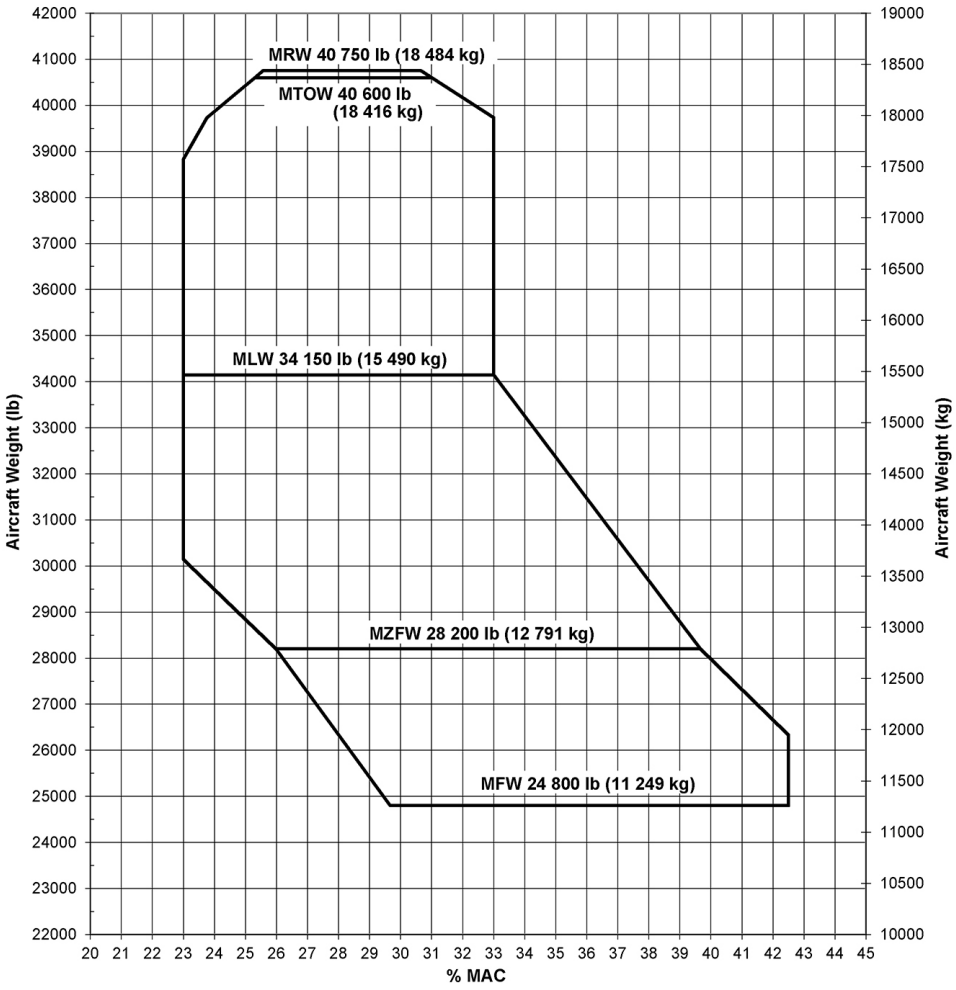
The Maximum Takeoff Weight (MTOW) and/or Maximum Landing Weight (MLW) may be further limited due to performance considerations.

CENTER–OF–GRAVITY

The center of gravity of the airplane for all flight conditions must be maintained within the applicable CENTER–OF–GRAVITY ENVELOPE below. For specific details on the Center of Gravity Envelope, refer to the Weight & Balance Manual CH 350 WBM.

NOTE: The airplane must be loaded in accordance with the loading instructions associated with the weight and balance manual CH 350 WBM. The effect of landing gear retraction on the CG position is negligible.

WEIGHT AND C.G. LIMITATIONS (CONT)



SPEED LIMITATIONS

MAXIMUM OPERATING SPEED (V_{MO}/M_{MO})

V_{MO} (up to 8,000 ft) ..... 300 KIAS

V_{MO} (8,001 to 29,475 ft) ..... 320 KIAS

M_{MO} (Above 29,475 ft) ..... 0.83 M_I

V_{MO}/M_{MO} may not be deliberately exceeded in any regime of flight (climb, cruise, or descent), unless a higher speed is specifically authorized for flight test or training operations.

NOTE: Overspeed alerting is based on baro–corrected altitude. This is applicable to both the primary flight displays and to the integrated standby instrument.

MANEUVERING SPEED (V_A)

V_A is the highest speed that full roll and yaw control can be applied without overstressing the aircraft. Full application of rudder and aileron controls as well as maneuvers that involve angles of attack near the stall, must be confined to speeds below V_A.

Refer to the applicable figure titled Airspeed/Mach Limitations in this section for V_A.

CAUTION: Rapid and large alternating control inputs, especially in combination with large changes in pitch, roll, or yaw (e.g. large sideslip angles) may result in structural failures at any speed, even including below V_A.

ROUGH AIR PENETRATION SPEED (V_{RA})

V_{RA} ..... 265 KIAS/0.75 M_I

MAXIMUM LANDING GEAR OPERATING SPEED – RETRACTION

$V_{LO\ RET}$ ..... 200 KIAS

MAXIMUM LANDING GEAR OPERATING SPEED – EXTENSION

$V_{LO\ EXT}$ ..... 250 KIAS

MAXIMUM LANDING GEAR EXTENDED SPEED (V_{LE})

V_{LE} ..... 250 KIAS

MAXIMUM FLAP EXTENDED SPEED (V_{FE})

V_{FE}:

Flaps 10 ..... 210 KIAS

Flaps 20 ..... 210 KIAS

Flaps 30 ..... 175 KIAS

SPEED LIMITATIONS (CONT)

MINIMUM OPERATING SPEED

Intentional speed reduction below the onset of stall warning, as defined by stick shaker operation, is prohibited unless a lower speed is specifically authorized for flight test or training operations.

TIRE SPEED

Maximum tire speed (ground speed) ..... 182 kts

SPEED LIMITATIONS (CONT)

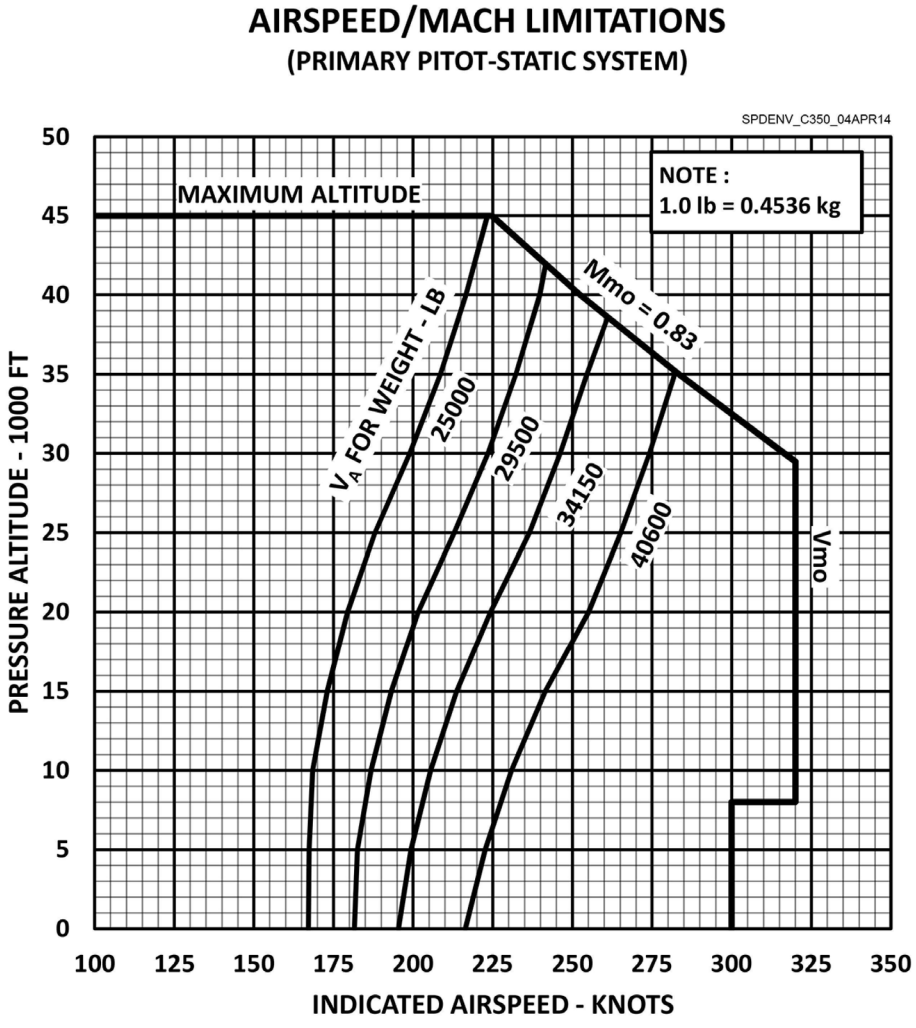


Figure 02–03–1

NOTE: Overspeed alerting is based on baro–corrected altitude. This is applicable to both the primary flight displays and to the integrated standby instrument.

OPERATIONAL LIMITATIONS

TAKEOFF AND LANDING

Maximum takeoff and landing pressure altitude ..... 10,000 ft

Maximum tailwind component ..... 10 kts

Takeoffs and Landings are limited to paved runways.

The maximum runway slopes approved for takeoff and landing are +2% uphill and –2% downhill.

Effectivity:

For aircraft on the State Aviation Administration of Ukraine (SAAU) registry:

MAXIMUM CROSSWIND COMPONENT – DRY RUNWAYS

The maximum crosswind component for takeoff is 28 knots (14 meters/sec).

The maximum crosswind component for landing is 24 knots (12 meters/sec).

MAXIMUM CROSSWIND COMPONENT – WET RUNWAYS

The maximum crosswind component for takeoff and landing on a wet runway with water depth no more than 3.00 mm (0.125 inch) is defined in the following table for different values of the coefficient of friction:

REPORTED RUNWAY COEFFICIENT OF FRICTION	MAXIMUM CROSSWIND COMPONENT
0.3 (poor braking)	10 knots (5 meters/sec)
0.4 (average braking)	15 knots (8 meters/sec)
0.5 (good braking, equivalent to dry)	Takeoff – 28 knots (14 meters/sec) Landing – 24 knots (12 meters/sec)

1. Operation on runways with a coefficient of friction less than 0.3 is prohibited.

MAXIMUM CROSSWIND COMPONENT – CONTAMINATED RUNWAYS

1. The maximum crosswind component for takeoff and landing on a contaminated runway is 10 knots (5 meters/sec).
2. Operation on runways with a coefficient of friction less than 0.3 is prohibited.

OPERATIONAL LIMITATIONS (CONT)

Effectivity:

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

MAXIMUM CROSSWIND COMPONENT – DRY RUNWAYS

The maximum crosswind component for takeoff is 28 knots (14 meters/sec).

The maximum crosswind component for landing is 24 knots (12 meters/sec).

MAXIMUM CROSSWIND COMPONENT – WET RUNWAYS

The maximum crosswind component for takeoff and landing on a wet runway with water depth no more than 3.00 mm (0.125 inch) is defined in the following table for different values of the coefficient of friction:

REPORTED RUNWAY COEFFICIENT OF FRICTION	MAXIMUM CROSSWIND COMPONENT
0.3 – 0.35 (Poor braking)	10 knots (5 meters/sec)
0.35 – 0.5 (Medium braking)	15 knots (8 meters/sec)
0.5 – 0.6 (Good braking, equivalent to dry)	Takeoff – 28 knots (14 meters/sec) Landing – 24 knots (12 meters/sec)

1. Operation on runways with a coefficient of friction less than 0.3 is prohibited.

MAXIMUM CROSSWIND COMPONENT – CONTAMINATED RUNWAYS

1. The maximum crosswind component for takeoff and landing on a contaminated runway is 10 knots (5 meters/sec).
2. Operation on runways with a coefficient of friction less than 0.3 is prohibited.

OPERATIONAL LIMITATIONS (CONT)

COLD WEATHER OPERATIONS

WARNING: Even small amounts of frost, ice, snow, or slush on the wing leading edges and forward upper wing surface may adversely change the stall speeds, stall characteristics, and the protection provided by the stall protection system, which may result in loss of control on takeoff.

Takeoff is prohibited with frost, ice, snow, or slush adhering to any critical surface (wings, horizontal stabilizer, vertical stabilizer, control surfaces or engine inlets).

Although the upper fuselage is not defined as a critical surface, it must nonetheless be deiced to remove contamination, other than allowable frost, anytime the wing and tail surfaces require deicing.

NOTE: 1. Takeoff is permitted with frost adhering to:

- the underside of the wing that is caused by cold soaked fuel; or
- the upper surface of the fuselage,

in accordance with the instructions provided in the Flight Crew Operating Manual, Supplement 1 – Cold Weather Operations.

2. Comprehensive procedures for operating in cold weather are provided in the Flight Crew Operating Manual – Volume 1, Supplement 1 – COLD WEATHER OPERATIONS.

EN ROUTE

Maximum Pressure Altitude ..... 45,000 ft

MANEUVERING LOAD FACTORS

Flaps Up ..... +2.6 g to −1.0 g

Flaps Extended ..... +2.0 g to 0.0 g

OPERATION WITH TYPE II, III & IV ANTI–ICING FLUIDS

When Type II, III & IV anti–icing fluids have been applied:

The wing anti–ice system must only be selected ON, if required, just prior to thrust increase for takeoff.

MANEUVERS

Aerobatic maneuvers and spins are prohibited.

OPERATIONAL LIMITATIONS (CONT)

ALTITUDE/TEMPERATURE LIMITATIONS

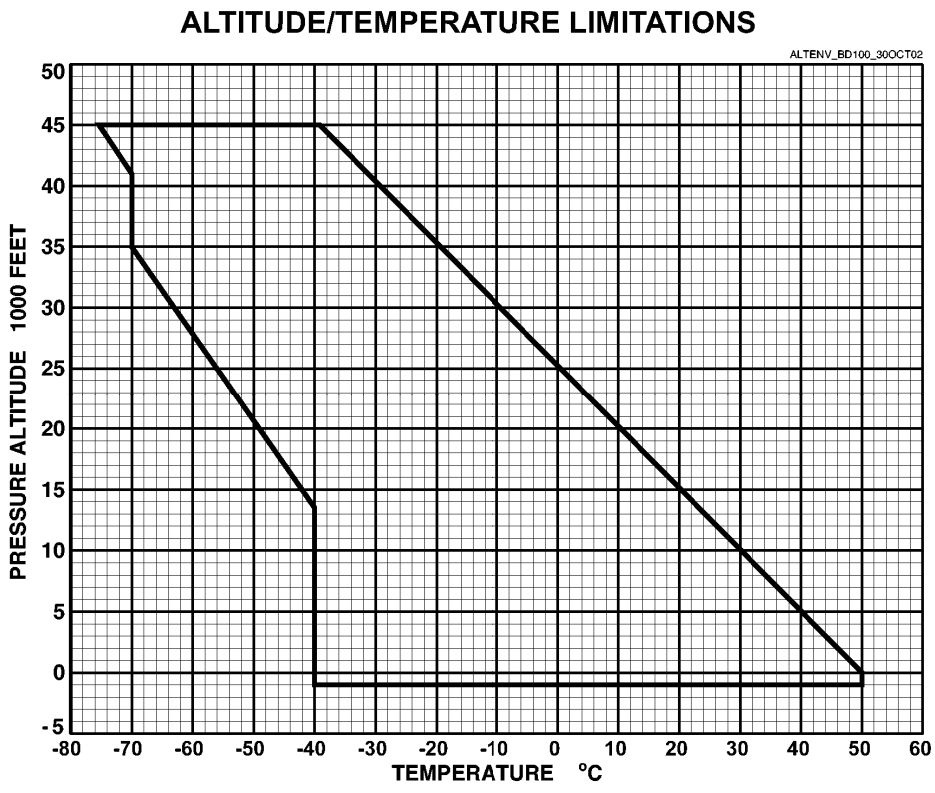


Figure 02–03–2

PERFORMANCE CALCULATIONS

Performance Calculations may be based exclusively from either the CAFM output or Quick Reference Handbook (QRH) Volume 1 tables and charts, but not both. Once the pilot has decided to use either the CAFM or QRH he/she must continue with that source and use only the performance data generated from that source.

The performance tables and charts contained in Quick Reference Handbook (QRH) Volume 1 may be used to calculate aircraft performance and are considered approved data ONLY for the following revision level:

Challenger 350 Quick Reference Handbook Volume 1, Publication No. CH 350 QRH–1, Initial Issue, dated Jun 11, 2014.

SYSTEMS LIMITATIONS

AIR CONDITIONING AND PRESSURIZATION

AIR CONDITIONING

Do not select the AIR SOURCE switch to TRIM AIR ONLY while the airplane is on the ground.

The pack must be operating (APU or engine running and AIR SOURCE switch – NORM or PACK ONLY) when the airplane electrical power is on (BATTs or EXT PWR – On) for more than 30 minutes and the OAT is above 40 °C (104 °F).

OXYGEN

The following airplane certification requirements are in addition to the requirements of applicable operating rules. The most restrictive requirements (certification or operating) must be observed.

Crew and passenger oxygen masks are not approved for use above 40,000 feet cabin altitude. Prolonged operation of passenger masks above 25,000 feet cabin altitude is not recommended.

PRESSURIZATION

The maximum differential pressure on the ground (during taxi) must not exceed 0.1 psi.

The maximum differential pressure during landing must not exceed 1.0 psi.

Effectivity:

For aircraft 20501 to 20886:

The maximum positive differential pressure is 9.4 psi. The maximum negative differential pressure is –0.5 psi.

Effectivity:

For aircraft 20887 to 22999:

The maximum positive differential pressure is 10.1 psi. The maximum negative differential pressure is –0.5 psi.

SYSTEMS LIMITATIONS (CONT)

AUTOFLIGHT

WARNING: If an engine failure occurs during a climb while in, or just below (V) ALTS CAP or (V) ALTV CAP vertical FD modes, the FD/autopilot may not maintain the selected airspeed. Further, the Autothrottle (if installed) may have already begun to command a thrust reduction. Crew intervention may be required to ensure that the aircraft maintains a safe operating speed and avoid loss of control.

AUTOPILOT

Do not intentionally overpower the autopilot.

Autopilot Minimum Engage Height:

Climb, En Route, or Descent ..... 700 feet AGL

Autopilot Minimum Use Height:

Approach

Precision with glidepath angle of 3.5 degrees or less ..... 80 feet AGL

Precision with glidepath angle between 3.5 and 4.5 degrees ..... 160 feet AGL

Visual and non−precision ..... 200 feet AGL

The maximum altitude with yaw damper off is 31,000 ft.

It is prohibited to select the XFR button on the flight guidance panel while simultaneously making inputs on an FMS CDU.

AUTOTHROTTLE (IF INSTALLED)

For an Autothrottle engaged takeoff, the Autothrottle must be verified engaged, TLA in the takeoff detent, takeoff N1 verified and HOLD mode active prior to 80 KIAS.

It is prohibited to engage the Autothrottle following an engine failure on takeoff until flaps are retracted and the aircraft has accelerated to en route climb speed.

Autothrottle must be disengaged prior to 200 feet AGL for any abnormal procedure landing with flaps less than 30°.

The radio altimeter must be valid for Autothrottle retard mode operation. If radio altitude is unavailable or invalid, the Autothrottle must be disengaged prior to reaching 200 feet AGL.

It is prohibited to have the Autothrottle engaged during a single engine go−around until flaps are retracted and the aircraft has accelerated to en route climb speed.

Use of Autothrottle during touch and go landings is prohibited.

SYSTEMS LIMITATIONS (CONT)

AVIONICS

DATA LINK

All weather products data linked to the airplane are advisory.

Effectivity:

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

NOTE: Use of DATALINK is not permitted for ATC purposes.

Crew actions based on messages such as digital automatic terminal information service, weight and balance, take−off data (speeds, trim settings, runway distances) are prohibited unless the approved operational procedures are used to verify that the message is received by the intended recipient, that the message is valid, and that the content is not corrupted.

Effectivity:

On EASA registered airplanes:

ATN CPDLC shall only be used for routine datalink exchanges during en−route operations in upper airspace.

FANS CPDLC must be operated in accordance with ATN and FANS Interlocked CPDLC Applications Operators Guide (part number 5230822435 at the latest applicable revision).

The crew must ensure that the FMS is updated with the proposed flight plan and its associated constraints and procedures when receiving a route clearance via CPDLC.

Before executing any flight plan modification received via CPDLC, the crew must ensure that the entire content of the flight plan has been inserted.

Use of FANS INSERT MOD is prohibited within 5 NM of sequencing a waypoint.

It is prohibited to use the WX DEV TO from the FANS ROUTE REQ 1/2 page.

It is prohibited to use the DIVERT TO from the EMERGENCY MSG 1/2 page using the FANS REQUEST page.

Inmarsat L band satellite communication systems (SwiftBoardBand, Swift64 and Classical) interfere with Iridium systems. If both Inmarsat L band and Iridium systems are installed and the Iridium is capable of providing cockpit datalink services (including FANS 1/A+, and CDU datalink), then the Inmarsat L band system must be depowered and considered inoperative for the entire flight where cockpit datalink services are intended to be used.

SYSTEMS LIMITATIONS (CONT)

FLIGHT MANAGEMENT SYSTEM (FMS)

The FMS must be operated in accordance with the latest revision of the following:

- Airplane Flight Manual, and
- Rockwell Collins Operators Guide – Bombardier Challenger 300/350 Pro Line 21 Advance Flight Management System (publication 523–0820888 at the latest applicable revision).

If a difference exists between the AFM and the Rockwell Collins FMS Pilot's Guide, the AFM shall take precedence. The Rockwell Collins FMS Pilot's Guide (Part number 523–0820888 at the latest applicable revision) must be immediately available to the flight crew whenever navigation is predicated on the use of the FMS.

The FMS is approved for use with software version [HSCD CPN 946–2720–101, or later applicable revision].

Effectivity:

On airplanes 20664 and subsequent, and airplanes incorporating SB 350–34–012:

The FMS is approved for use with software version [HSCD CPN 946–2720–130, or later applicable revision].

Effectivity:

On airplanes 20578 and subsequent, and airplanes incorporating SB 350–34–013:

The performance database part number must be verified to be 096 –5327–001.

FMS performance data, ETE/ETA and Fuel Remaining information is advisory only. Airplane operation must not be predicated upon FMS performance data.

NOTE: Measured mode or manual entry fuel predictions will not be updated while a flight plan modification is open.

Effectivity:

On airplanes 20501–20663 not incorporating SB 350–34–012:

The V–speed database part number must be verified to be 096 –5016–001.

NOTE: The FMS V–speed database (version 096–5016–001) does not permit calculation of Actual Landing Distances (ALD) on contaminated runways (ice, compacted snow, dry snow or water/slush). Use the CAFM or the QRH, as appropriate, to determine the ALD on a contaminated runway.

SYSTEMS LIMITATIONS (CONT)

Effectivity:

On airplanes 20664 and subsequent, and airplanes incorporating SB 350–34–012:

The V–speed database part number must be verified to be 096 –5016–002.

– The FMS V–speed data does not need to be verified with the AFM, provided both Flight Management Computers are available.

For some high airport altitude conditions, the CAFM TOFL can be longer than the corresponding FMS V–speed TOFL. This results in a lower weight limited by runway length. For airport pressure altitudes of 8000 ft and above, the FMS V–speed TOFL must be compared to the corresponding CAFM result. If the CAFM TOFL is longer than the FMS value, then the CAFM TOFL and takeoff speeds (V_1, V_R, V_2 and V_{FTO}) must be used for operation.

Effectivity:

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

– The FMS V–speed data does not need to be verified with the AFM, provided both Flight Management Computers are available.

Effectivity:

On airplanes 20501–20663 not incorporating SB 350–34–012:

– V–speed database part number must be verified to be: 096–5016–001.

NOTE: The FMS V–speed database (version 096–5016–001) does not permit calculation of Actual Landing Distances (ALD) on contaminated runways (ice, compacted snow, dry snow or water/slush). Use the CAFM or the QRH, as appropriate, to determine the ALD on a contaminated runway.

Effectivity:

On airplanes 20664 and subsequent, and airplanes incorporating SB 350–34–012:

– The V–speed database part number must be verified to be 096–5016–002.

It is prohibited to load pilot routes from the PILOT ROUTE LIST during flight.

It is prohibited to upload flight plans from ROUTE MENU (FPLN RECALL) during flight.

It is prohibited to select FPLN WIND UPDATE from the ROUTE MENU.

SYSTEMS LIMITATIONS (CONT)

It is prohibited to tune a localizer on the TUNE page using the identifier only.

It is prohibited to initiate a NAV RADIO SELF TEST from either the NAV radio tuning page on the FMS CDU or the MFD nav radio menu during flight.

Effectivity:

On airplanes 20664 and subsequent, and airplanes incorporating SB 350–34–012:

It is prohibited to use the FMS as a navigation source when it is not receiving suitable navigation information from the following:

- One GNSS; or
- Two DMEs; or
- One VOR / DME; or
- One IRS.

Effectivity:

On airplanes 20501–20663 not incorporating SB 350–34–012:

It is prohibited to use the FMS as a navigation source when it is not receiving suitable navigation information from the following:

- Two GNSSs.

Use of the FMS Secondary Flight Plan function is prohibited.

FMS navigation (FMS selected as NAV Source) and display of magnetic heading is prohibited in Canadian Northern Domestic Airspace and at the following locations:

- All latitudes greater than N82°.
- Latitudes greater than N73° if between W080° and W170° longitude.
- At latitude greater than S82°.
- Latitude greater than S60° if between E120° and E160° longitude.

It is prohibited to load FMS procedures that are referenced to True Heading into the flightplan.

It is prohibited to use the FMS as the primary source of navigation during periods of dead reckoning (indicated by the FMS DR message).

IFR navigation is prohibited unless the pilot verifies the currency of the database or verifies the waypoints for accuracy by reference to current publications.

When conducting RNP operations the pilot must verify the PFD CDI scale annunciation is appropriate for the RNP leg as follows:

- RNP APCH CDI Scale 0.3 nm
- BASIC RNP–1 CDI Scale 1.0 nm

SYSTEMS LIMITATIONS (CONT)

- RNP–2 CDI Scale 2.0 nm
- RNP–4 CDI Scale 4.0 nm (selected by pilot)
- RNP–10 CDI Scale 4.0 nm (selected by pilot).

When conducting BASIC RNP–1 operations, the length of each individual flight plan leg or between the airplane position and the TO waypoint must not exceed 200 NM.

When conducting RNP–2 operations, the length of each individual flight plan leg or between the airplane position and the TO waypoint must not exceed 400 NM.

When conducting RNP–4 or RNP–10 operations, the length of each individual flight plan leg or between the airplane position and the TO waypoint must not exceed 500 NM.

Pilot defined waypoints (e.g. along track offset) must not be used to create individual legs shorter than the limiting length.

When conducting non–AR RNP operations, pilots should maintain CDI lateral deviation less than +/–1 dot deviation except brief deviation in excess of +/–1 dot deviation during waypoint sequencing is permitted.

Effectivity:

On airplanes 20501–20663 not incorporating SB 350–34–012:

Performing any departure, arrival, approach or missed approach procedure that contains any radius–to–fix (RF) leg(s) is prohibited.

RNAV operations per AC 90–100A or AC 90–96A in RNAV 1, RNAV 2 or RNAV 5 are prohibited with any of the following FMS messages annunciated:

- FMS DR (PFD, MFD or CDU)
- IRS ONLY (PFD, MFD or CDU)
- VOR/DME ONLY (CDU) or V/D ONLY (PFD)
- VOR/DME DIST > 40.0 NM (CDU)
- CHK POS (PFD or CDU).

RNP operations with any of the following FMS messages annunciated, are prohibited:

- NO APPR (PFD)
- UNABLE RNP (PFD).

PERFORMANCE

The FMS will automatically display the displaced thresholds of runways provided that they are identified in the loaded active cycle FMS navigation database. If RUNWAY LENGTH is manually entered then the FMS will not compute headwind/crosswind; these must be manually entered.

SYSTEMS LIMITATIONS (CONT)

VERTICAL NAVIGATION

Vertical guidance deviation information is an aid to assist pilots to comply with altitude restrictions and plan descent profiles. When using vertical guidance the pilot must use the primary barometric altimeter to ensure compliance with altitude restrictions, particularly during instrument approach operations.

Use of VNAV vertical guidance is prohibited when the barometric altitude is corrected to the landing field elevation (QFE).

Use of VFLC (FLC with VNAV) is prohibited during climb when the airspeed reference is displayed as Mach.

It is prohibited to select MCRZ from the FMS VNAV CRUISE page.

It is prohibited to select VNAV following a go–around during the missed approach procedure.

The flight crew must verify any altitude/speed constraints on the last waypoint of any entered STAR procedure and/or the first waypoint of any entered approach procedure. The flight crew may correct any such altitude/speed constraint(s) as required to agree with current chart procedures.

Effectivity:

On airplanes 20501–20663 not incorporating SB 350–34–012:

Use of barometric VNAV vertical guidance is prohibited.

CAUTION: Errors to VNAV defined paths may occur because of coding errors in the navigation data base and because of altimetry errors. The actual VNAV path may deviate significantly below the intended VNAV path in very cold temperatures; the temperature compensation function is used to correct for non–standard temperatures. Flight crew must coordinate use of temperature compensation with ATC prior to employing this function.

Database coding of VNAV altitudes for approach waypoints may result in VNAV paths continuing below Minimum Descent Altitude (MDA), Decision Altitude (DA), or Decision Height (DH), or ending at an altitude too high to continue a safe descent to landing. VNAV paths (often called pseudo glide paths) are not equivalent to an ILS glideslope.

Position along an approach must be verified prior to commencement of VNAV descent as displayed by the FMS. The required visual reference must be obtained prior to commencing descent below published MDAs, DAs, or DHs.

SYSTEMS LIMITATIONS (CONT)

APPROACH

Instrument approaches must be accomplished only in accordance with instrument approach procedures that are contained in the FMS database.

NOTE: Vectored ILS approaches are exempt from this limitation as they do not require nor do they rely on FMS guidance. ILS back course approaches also are exempt if they are vectored.

It is prohibited to conduct LPV Approach operations with FMS2 as pilot navigation source and FMS1 as copilot navigation source.

Use of FMS instrument approaches is prohibited unless RNP APPR or LPV APPR is annunciated on the PFD.

RNP operations down to LPV minimum when any of the following messages are present, are prohibited:

- Red boxed “VNV” flag (vertical deviation scale on PFD)
- NO APPR (on PFD)
- EFIS MISCOMPARE (CAS message)
- EFIS COMPARATOR INOP (CAS message)
- LPV NOT AVAIL (on CDU)

RNP operations down to LPV minimum must not be commenced or continued unless all required airborne equipment are operating satisfactorily.

The following airborne equipment must be installed and operational:

- Dual PFD
- Two GNSS/SBAS sensors must be available to commence an approach and one GNSS/SBAS sensor is required to continue an approach.
- Dual FMS.

LPV approach operations are prohibited in the area defined by A, B, C and D in Fig. 02–04–1.

SYSTEMS LIMITATIONS (CONT)

Effectivity:

For airplanes NOT incorporating Service Bulletins SB350–34–025 or SB350–34–033:

POINT	LAT	LONG
A	N75	W175
B	N75	W130
C	N50	W175
D	N50	W155

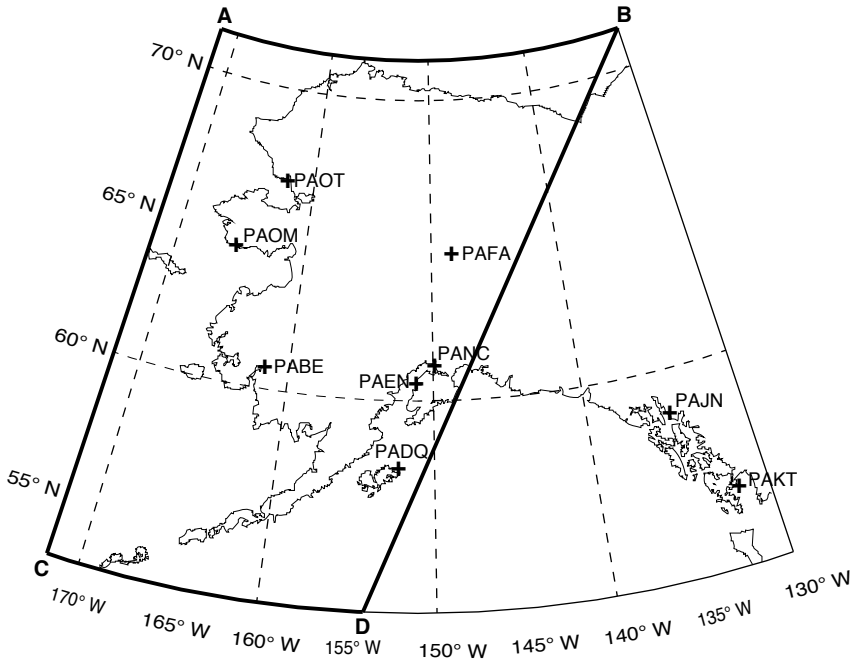


Figure 02–04–1

Use of VNAV vertical guidance for VMDA type approach between the final approach fix and the missed approach fix is prohibited.

FMS as a primary navigation source beyond the FAF is prohibited for ILS, LOC and LOCBC approaches.

SYSTEMS LIMITATIONS (CONT)

FMS as a supplementary navigation source beyond the FAF is permitted when APPR or REF APPR is annunciated on the PFD if the navigation aid referenced in the approach procedure is displayed and monitored by the flight crew during the approach.

NOTE: For the FMS approaches for which GNSS is not authorized as a primary navigation source (i.e. GNSS does not appear in the approach title), APPR will be annunciated on the PFD if the GNSS sensors are deselected; otherwise, REF APPR will be annunciated.

The FMS with inputs from GNSS may only be used for approach guidance if the reference coordinate data system for the instrument approach is WGS84 or NAD83.

GNSS sensors must be deselected when on approach in airspace not referenced to WGS84 or NAD83.

When conducting an instrument approach with a T–Transition and utilizing VNAV for descent guidance, indicated airspeed at the initial approach fix must be 210 KIAS or less.

Other than automatic FMS temperature compensation, changes to altitudes in the final approach segment (including FAF and step–down fixes) for any FMS approach procedures are prohibited.

SYNTHETIC VISION SYSTEM (SVS)

- TAWS alerts must take priority over the image depicted on SVS.
- Use of the SVS for airplane navigation is prohibited.
- Use of the SVS is prohibited when the barometric altitude is corrected to the landing field elevation (QFE).
- When conducting an approach in airspace not referenced to WGS–84 or NAD–83, the SVS shall be deselected prior to passing the FAF.
- When conducting an approach to a runway not entered in the FMS flight plan, the SVS shall be deselected.
- The SVS Airport/Runway database must incorporate the current update cycle. If not, the SVS shall be deselected prior takeoff and prior to passing the FAF.
- The SVS does not render a video image above latitude 85N and below latitude 85S. The SVS shall be deselected prior reaching these latitudes.

The Synthetic Vision System is intended as a situational awareness enhancement feature and shall not be the sole source of reference by the pilot for any of the following:

- Continuation of an approach, landing or takeoff below the minima published for that approach
- Execution of an approach, landing or takeoff in low visibility conditions

SYSTEMS LIMITATIONS (CONT)

- As a replacement for natural vision where there are specific visual requirements to be achieved
- As a replacement for the basic attitude, flight guidance or navigation displays and information
- The performance of any specific flight related task
- The flight crew making any judgment, decision or action that is solely based on the synthetic vision display
- The application of any operational credit.

NAVIGATION RECEIVER

It is prohibited to conduct ILS Approach operations with LOC2 as pilot navigation source and LOC1 as copilot navigation source.

It is prohibited to navigate using VOR or LOC as Nav source when displaying true heading mode.

STANDBY INSTRUMENT

Use of the standby instrument localizer deviation guidance is prohibited during localizer backcourse approaches.

STANDBY COMPASS

L and R WSHLD/WINDOW switches must be temporarily selected OFF while the standby compass is being read.

INTEGRATED FLIGHT INFORMATION SYSTEM

- Incorporation of Dual IFIS does not constitute operational approval to dispatch without adequate backup documentation.
- The IFIS related databases utilized (i.e. charts, airspace, airways, geographic, political, graphical weather) must incorporate the current update cycle.
- The IFIS does not include enroute charts.
- The airplane symbol on the electronic charts is advisory and is presented for increased situational awareness. It is not to be used for navigation.
- The display of geo–political boundaries, airspace and airways on the MFD (Enhanced Map overlays) is for enhanced situational awareness only, and use for navigation is prohibited.
- All weather products data linked to the airplane are advisory.
- For a single IFIS, adequate backup documentation must be immediately available to the flight crew.

SYSTEMS LIMITATIONS (CONT)

- The airplane symbol displayed on airport diagram charts during ground operations is advisory and is presented for increased situational awareness. It is not to be used for precision maneuvering on the ground.
- It is not possible to display landscape formatted approach charts in split view.

Effectivity:

For ANAC (Brazilian) registered airplanes:

VHF SYSTEM

Use of the VHF selected for 8.33 kHz channel spacing in airspace where 25 kHz channel spacing is used, is prohibited.

Effectivity:

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

NAVIGATION

During normal flight, reversion of ATT, HDG and ADC is **not** permitted.

TERRAIN AWARENESS AND WARNING SYSTEM (TAWS)

Navigation must not be predicated upon the use of the terrain awareness display.

TAWS TERRAIN OFF must be selected when using QFE operations, and GPS is not available.

RUNWAY OVERRUN AWARENESS AND ALERTING SYSTEM (ROAAS) (IF INSTALLED)

The use of ROAAS for approach and landings to runways with the departure end of runway (far end) temporarily displaced is prohibited.

With ROAAS on, to avoid ROAAS alerts, the landing distance available must be equal to or greater than FOLD (Factored Operational Landing Distance). See Flight Crew Operating Manual – Volume 1, Chapter 6 – PERFORMANCE DATA for FOLD information.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

Maneuvers must not be based solely on information presented on the traffic map overlay.

SYSTEMS LIMITATIONS (CONT)

Effectivity:

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

Flight is not permitted along routes where ATC service provided is not in RBS mode.

TCAS II TA/RA mode is not recommended on routes where ATC modes not limited to RBS are provided. On these routes, while in TA mode, the pilot action shall be coordinated with ATC.

WEATHER RADAR

Weather Radar information must be displayed continuously on at least one (1) PFD or MFD during the entire flight.

Following a TAWS terrain caution or terrain warning, the Weather Radar information must be reinstated on at least one (1) PFD or MFD, after the encounter has been resolved.

Effectivity:

On Argentinean registered airplanes:

GLOBAL POSITIONING SYSTEM (GPS)

Pilot is not authorized to use the GPS for precision approach and landing.

EMERGENCY LOCATOR TRANSMITTER (ELT)

The ELT must comply with RAAC 91.207.

ELECTRICAL

GROUND OR FLIGHT OPERATIONS

Continuous:

Two or three generators operating	400 amps
One generator operating (on the ground)	400 amps
One generator operating (in flight)	500 amps

Transient (5 minutes) ..... 600 amps

NOTE: Refer to APU LIMITATIONS in this chapter for APU generator altitude limits.

It is prohibited to take off if battery temperatures are below −20 °C (−4 °F).

SYSTEMS LIMITATIONS (CONT)

FLIGHT CONTROLS

FLAPS

It is prohibited to extend the flaps above 18,000 ft.

SPOILERS

It is prohibited to select Flight Spoilers to EMER except during emergency conditions or as required by procedure.

Flight spoilers must not be extended in flight at airspeeds below approach speed + 8 KIAS.

Flight spoilers must not be extended in flight below 500 ft AGL.

HYDRAULICS

Hydraulic fluid of type Phosphate Ester Fire–Resistant per BAMS 564–003 Type IV, Skydrol LD–4, Hyjet IV–a Plus is approved for use.

LANDING GEAR, WHEELS & BRAKES

It is prohibited to extend the gear above 18,000 ft.

Brake cooling times (established in accordance with the procedures in Chapter 6 – PERFORMANCE DATA) must be observed between a landing or a rejected takeoff (RTO) and a subsequent takeoff, to ensure that a sufficient brake energy is available to bring the airplane to a complete stop, if the subsequent takeoff is rejected.

FUEL LIMITATIONS

APPROVED FUELS

Fuels conforming to any of the following specifications are approved for use. Mixing of fuel types is permitted.

CANADIAN	AMERICAN	BRITISH	RUSSIAN/ UKRAINIAN	CHINESE
KEROSENE TYPE				
CAN/CGSB 3.23–97	ASTM D1655 JET A	Def–Stan 91–91/3	–	–
CAN/CGSB 3.23–97	ASTM D1655 JET A–1	Def–Stan 91–91/3	–	GB 6537–2006 No. 3 JET
3–GP–24c	MIL–DTL–5624 JP–5	Def–Stan 91–86/2	–	–
–	MIL–DTL–83133 JP–8	Def–Stan 91–87	–	–
–	–	–	TS–1 & RT	–
WIDE–CUT TYPE ††				
CAN/CGSB 3.22–97	ASTM D1655 JET B	Def–Stan 91–88/1	–	–
CAN/CGSB 3.22–97	MIL–DTL–5624 JP–4	Def–Stan 91–88/1	–	–
† When Russian/Ukrainian RT & TS–1 fuels are used, the maximum altitude is limited to 37,000 ft if the bulk fuel temperature is greater than 30°C (86°F).				
†† When JP–4 or JET B is used, the maximum altitude is limited to 16,000 ft.				

NOTE: ASTM D1655, Def. Std. 91–91 and CAN/CGSB–3–23 Jet fuels whose origin is ASTM D7566 (Aviation Turbine Fuel Containing Synthesized Hydrocarbons) and are re–identified as Jet A, A–1 fuels are considered equivalent to fossil based fuels.

FUEL LIMITATIONS (CONT)

APPROVED FUEL ADDITIVES

Fuel additives:

- Anti–icing additives MIL–DTL–27686 (0.1 to 0.15% by volume), or MIL–DTL–85470 (0.1 to 0.15% by volume), also referred to as Prist.

  CAUTION: DO NOT add unblended Prist directly into the fuel tank. Unblended Prist may damage fuel tank components.

- Methyl cellosolve
- Biobor JF biocide (270 ppm)
- Shell ASA–3 anti–static additive
- Corrosion inhibitors: Appollo PRI–19 (0.0227 g/l), Dupont DCI–4A (0.0227 g/l), Dupont DCI–6A (0.0227 g/l), Hitec E–515 (0.0457 g/l), Hitec E–580 (0.0227 g/l), Nalco 5403 (0.0227 g/l), Nalco 5405 (0.0227 g/l), Tolad 245 (0.0340 g/l).
- Anti–static additive: STADIS 450 (a), (b), (e), Sigbol (cis), TU–38101741 (0.0005 wt% max.).
- Anti–icing additives for Russian and Ukrainian fuels:

  I (per GOST 8313–88), 0.10 to 0.30% max.*

  I–M (per GOST TU–6–10–1458–79), 0.10 to 0.30% max.*

  TGF (per GOST 17477–86), 0.10 to 0.30% max.*

  TGF–M (per GOST TU–6–10–1457–79), 0.10 to 0.30% max.*

  *Standard concentration 0.10 to 0.20% by volume except for extreme cold conditions (below −40 °F).

FUELING

Single–point pressure refueling is limited to 55 psig (3792 hPa) and defueling is limited to −8 psig (−552 hPa).

FUEL TRANSFER SYSTEMS

The Power and Gravity shut–off valves shall be selected off for takeoff.

FUEL LIMITATIONS (CONT)

USABLE FUEL LOAD

The maximum usable fuel load for each fuel tank is given below:

PRESSURE REFUEL		
FUEL TANK	**FUEL MASS †**	
Right	7,075 lb	3,210 kg
Left	7,075 lb	3,210 kg
Left & Right	14,150 lb	6,420 kg
† Based on a fuel density of 6.75 lb/USG (0.809 kg/litre), rounded to the nearest 5 lb or 5 kg.		

GRAVITY REFUEL (AIRPLANE LEVEL)		
FUEL TANK	**FUEL MASS †**	
Right	6,500 lb	2,950 kg
Left	6,500 lb	2,950 kg
Left & Right	13,000 lb	5,900 kg
† Based on a fuel density of 6.75 lb/USG (0.809 kg/litre), rounded to the nearest 50 lb or 25 kg.		

MINIMUM FUEL QUANTITY FOR GO–AROUND

The minimum fuel quantity for go–around is 500 lb (227 kg) per side.

MAXIMUM FUEL IMBALANCE

The maximum allowable fuel imbalance values are detailed in the Flight Crew Operating Manual, Volume 1.

FUEL LIMITATIONS (CONT)

TEMPERATURE LIMITATIONS

Takeoff with Bulk Fuel Temperature indications above 50 °C (122 °F) is prohibited.

With wing bulk fuel temperature indications at 45 °C (113 °F) or above:

- The minimum fuel load for takeoff is 2,800 lbs.
- With less than 1,000 lbs of fuel per side, do not operate engine for more than 30 minutes.

Takeoff with Bulk Fuel Temperature indications below the limits stated in the following table is prohibited:

FUEL TYPE	MINIMUM BULK FUEL TEMPERATURE @ TAKEOFF
Jet A	−30 °C (−22 °F)
Jet A−1	−35 °C (−31 °F)
JP−5	−35 °C (−31 °F)
JP−8	−35 °C (−31 °F)
Jet B	−40 °C (−40 °F)
JP−4	−40 °C (−40 °F)
Russian TS−1	−35 °C (−31 °F)
Russian RT	−40 °C (−40 °F)
Ukrainian TS−1 & RT	−40 °C (−40 °F)
GB 6537−2006 No. 3 JET	−37 °C (−34.6 °F)

POWERPLANT LIMITATIONS

ENGINE TYPE

AS907–2–1A turbofan propulsion engines.

ENGINE OPERATION

The engine indicating system is designed to show system status with specified colors. The limits are indicated in red .

ENGINE OPERATING LIMITS

LIMIT	GROUND START	AIR START ⑦	IDLE	MAX REVERSE	MAXIMUM CONTINUOUS (CLB) ①	NORMAL TAKEOFF (TO) ②	APR (MAX POWER) ③
N1	––	––	––	70.7% ④	96.5%	96.8%	96.8%
N2	––	––	46.0% min.	––	98.0%	98.0%	98.6%
ITT	650 °C	800 °C ⑤	––	955 °C	950 °C	955 °C	955 °C
OIL TEMP	–40 °C min.	––	⑨	––	138 °C max.	138 °C max. 27 °C min. ⑥	138 °C max.
OIL PRESS	––	––	28 psi min.	⑧	⑧	⑧	⑧

① Climb (CLB) equals maximum continuous thrust (MCT).
② Normal Takeoff power is limited to 5 minutes.
③ APR power (one engine inoperative) is limited to 10 minutes.
④ Maximum reverse thrust is automatically reduced (ramped) commencing at 85 KIAS.
⑤ Maximum ITT limit varies with N2 speed (400 °C when N2 <18% and ITT at start initiation <250 °C).
⑥ Minimum oil temperature must be achieved before commencing takeoff. Below –30 °C (–22 °F) the minimum oil temperature limit is 15 °C provided a fuel system icing inhibitor is used and the Cold Weather Operations procedures in FCOM, Vol. 1 are followed.
⑦ The in flight re–start envelope is defined in figure in chapter 05–32 of this manual.
⑧ Minimum oil pressure varies with engine speed. Maximum allowable oil pressure increases with engine speed and with low oil temperature.
⑨ A minimum oil temperature of 5 °C is required to operate engines above ground idle power. Between 5 and 14 °C, the engines may be operated from idle up to but not including CLB power.

Figure 02–06–1

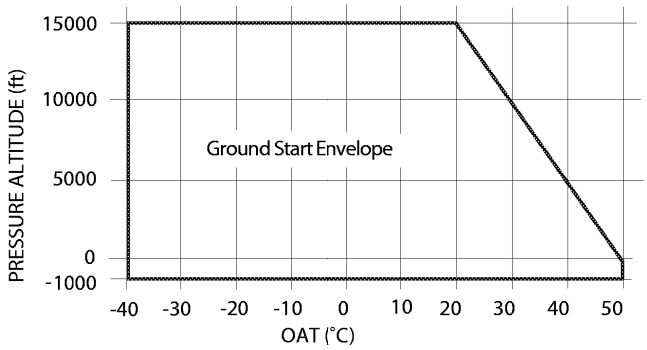
POWERPLANT LIMITATIONS (CONT)

ENGINE START:

Three consecutive engine start cycles may be conducted, followed by a cooling period of 15 minutes, prior to additional starts and motoring.

The engine must be motored for 30 seconds after an aborted start.

For engine ground starting altitude and temperature limits, refer to the following chart:



Ground Start Envelope

Figure 02–06–2

Fuel system icing inhibitor must be used when fuel temperature is below −20 °C (−4 °F) (for takeoff only), unless cold weather procedures are followed.

ENGINE CRANKING:

The engine can be motored (cranked) for up to 5 minutes, followed by a cooling period of 15 minutes prior to additional starts or motoring.

OIL

Oils conforming to Honeywell specification EMS 53110, Type II are approved.

THRUST REVERSERS

Limit thrust reverser system use to ground operations on paved surfaces.

Do not attempt to deploy thrust reversers in flight.

Do not use thrust reversers to back up the aircraft.

Do not use thrust reversers for touch–and–go landings.

Reverse thrust above idle reverse is prohibited below 40 KIAS.

AUXILIARY POWER UNIT (APU) LIMITATIONS

APU TYPE

Honeywell 36–150BD auxiliary power unit.

MAXIMUM ALTITUDE

APU Operation ..... 37,000 ft

APU GEN ..... 30,000 ft

Bleed air for Engine Start ..... 20,000 ft

Bleed air for ECS ..... 20,000 ft

Do not use the APU to start the left engine on the ground above 9,000 ft.

Operation of the APU during fluid de–icing/anti–icing is prohibited.

APU START

The APU may be started up to an altitude of 30,000 ft (14,000 ft on the ground).

The crew must monitor the APU start and abort the start if the APU RPM is less than 30% after 30 seconds (hung start).

On Ground:

Three start attempts may be made, each followed by a one–minute cooling period. After a third start attempt, there must be a 20–minute cooling period. Two more start attempts may then be made. No further attempts may be made for at least 40 minutes. Six successive starts may be made at 10 minute intervals with a one hour waiting period prior to additional start attempts.

In Flight:

Do not start the APU above 285 KIAS.

Following an unsuccessful start or a hung start, do not attempt another start until after landing.

APU OPERATION

The EICAS system is designed to show system status with specified colors.

The maximum and minimum limits are indicated in red.

The maximum APU RPM is 108%.

The maximum APU EGT is:

973 °C for start

718 °C for normal operations.

APPROVED FUELS/OILS

Fuels approved for the main aircraft engines are also approved for the APU.

Refer to appropriate maintenance or servicing manual for approved oils.

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CL-350



CL-350 SUPPLEMENTAL MANUAL

NORMAL PROCEDURES 08

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GENERAL

The procedures in this section of the manual have been developed by Bombardier Inc. for the certification of this aircraft. This section contains those procedures which may be considered routine in day–to–day operations. The presentation includes, but is not limited to, detailed checklist procedures by flight phase.

FIRST FLIGHT OF THE DAY

The " [1] " symbol in the procedure means that the associated procedure is accomplished only on the first flight of the day.

THROUGH–FLIGHT PROCEDURES (BOTH ENGINES SHUT DOWN)

Normal preflight procedures (all checklist line items) must be accomplished prior to takeoff at the original departure point of a flight. At each intermediate stop of flight where both engines are shut down, the Through–Flight Checklist may be used for preflight, provided certain criteria are met. In the following procedures (Exterior Preflight, Cabin Preflight, and Before Starting Engines), steps marked with this symbol (♦) denote Through–Flight Checklist items. When permitted, accomplishment of all Through–Flight Checklist items fulfills a minimum preflight requirement.

The Through–Flight Checklist may be used following an intermediate stop with both engines shut down, provided the following criteria have been satisfied during that stop:

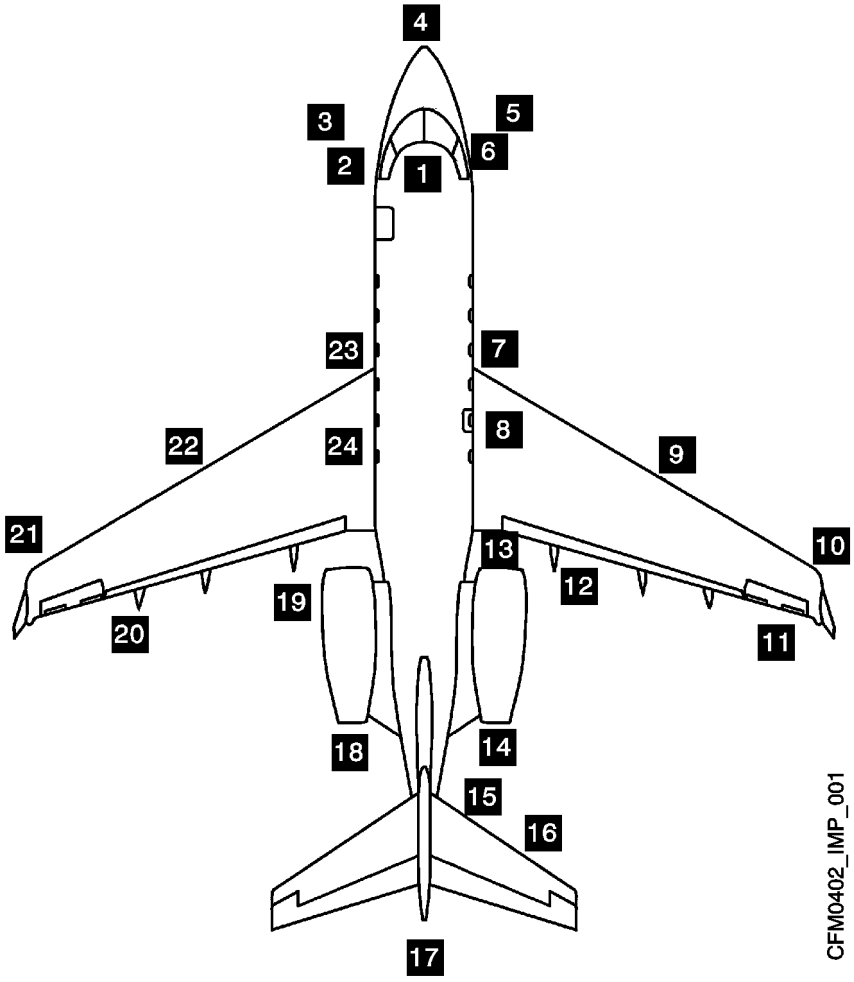
- There has been no change in flight crew personnel.
- No maintenance has been performed on the aircraft. Routine line servicing is not considered maintenance.
- No more than three (3) hours have elapsed between engine shutdown and engine start.
- Extreme weather conditions (heavy precipitation, ice, snow, extreme cold, etc.) have not occurred which would change the preflight status of the aircraft.

For intermediate stops with no engine shut down, completion of the Quick Turn–Around procedure in this section provides the minimum preflight requirements.

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EXTERIOR PREFLIGHT

Walk–Around Inspection



BEFORE STARTING ENGINES (CONT)

k. Copilot's trim switch ..... NUP and NDN
Verify movement

l. Copilot's trim switch housing only ..... NUP or NDN
Verify no movement

m. Copilot's trim switch arm button only ..... Depress
Verify no movement

n. Copilot's trim switch ..... NUP or NDN & hold
Verify movement

o. Copilot's master disconnect switch ..... Depress
Verify movement stops

p. Copilot's trim switch and master disconnect switch ..... Release

WARNING: If any anomalies occur during the stab trim check below, the indicated stabilizer position may be grossly incorrect and the aircraft must not be flown until resolved.

q. Stab Trim ..... Set to 1.0

NOTE: Monitor STAB indicated position from 1.0 to 3.0 units. Trim digits and pointer should move continuously with no skips, hesitations or reversals.

r. Stab Trim ..... Set to 3.0

s. Stab Trim ..... Set for takeoff

t. AIL and RUD Trim ..... Check operation and set for takeoff

29. ELT ..... ARM

30. CABIN DC and AC PWR switches ..... On

31. PAX OXYGEN switch ..... AUTO

32. THERAPEUTIC OXYGEN switch ..... ON

(Only required for flights requiring a mission completion altitude above 10,000 ft following a pressurization failure.)

– Switch ON light illuminates

a. THERAPEUTIC OXYGEN switch ..... OFF

♦ 33. Altimeters (3) ..... Set

BEFORE STARTING ENGINES (CONT)

Effectivity:

On airplanes 20584 and subsequent, and airplanes incorporating SB 350–22–001:

CAUTION: Reduced vertical separation with terrain may be encountered in mountainous terrain if altimeter is incorrectly set and LNV is armed for departure.

♦ 34. Avionics ..... Set for departure

NOTE: For any SBAS covered airspace (US RNAV routes, SIDs, and STARs), it is not required to run a pre–flight prediction of RAIM availability along the intended route if no satellites are NOTAM'd as out of service over the intended route.

For non–SBAS covered airspace, certain operations may require that an appropriate prediction program be used prior to departure for RAIM availability along the intended route.

♦ 35. Takeoff data (V_1, V_R, V_2, and distance) ..... Computed, and speeds set .

Effectivity:

On airplanes 20578 and subsequent, and airplanes incorporating SB 350–34–013:

36. Takeoff data ..... Check displayed.

Crosscheck input data on PERF INIT 1/3, TAKEOFF REF 1/4 and 2/4 CDU pages:

RWY data, Wind, OAT, QNH, PALT, CG, T/O FLAPS, Weight, ENG BLEED, THRUST REV.

CAUTION: Ensure input data matches airplane configuration and environmental conditions.

37. CAS messages ..... Check

NOTE: 1. The IRS automatically aligns using GNSS position (normal IRS alignment time varies depending on location, typically not exceeding 10 minutes). If GNSS is not available, it will align using the position entered to initialize the FMS.

2. Following a successful initial alignment, do not manually re–enter the position in the FMS CDU either immediately before, or immediately after airplane motion. If this has occurred, a complete normal shutdown and restart of the airplane and IRSs must be completed. Failure to do so may lead to a total IRU loss during subsequent flight legs.

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EXTERIOR PREFLIGHT (CONT)

EXTERIOR SAFETY CHECK/WALKAROUND

1. Exterior Safety Check/Walkaround ..... Accomplish

♦ During Exterior Preflight, check all vents clear, check access doors for security, and all aircraft surfaces for condition.

1 ♦ a. LANDING GEAR switch ..... DN

♦ b. L, R, and AUX HYDRAULIC PUMP switches ..... OFF

c. R BATT switch ..... On

NOTE: R BATT switch is selected first to prevent uncommanded APU starts.

d. L BATT switch ..... On

e. Clock ..... Check

Set to correct local time.

f. Fuel quantities ..... Check

g. Oxygen quantity ..... Check

h. PARK/EMER BRAKE:

If PARK/EMER BRAKE not set:

(1) L and R HYDRAULIC PUMP switches ..... ON

Check hydraulic systems fully pressurized.

(2) Brake pedals ..... Depress fully

(3) PARK/EMER BRAKE handle ..... Set

(4) Brake pedals ..... Release

(5) L and R HYDRAULIC PUMP switches ..... OFF

If PARK/EMER BRAKE set:

(1) L HYDRAULIC PUMP switch ..... ON

Check left hydraulic system fully pressurized.

(2) L HYDRAULIC PUMP switch ..... OFF

i. If night flight is anticipated, check exterior lighting.

All exterior light switches ..... On

Check proper illumination, then all exterior light switches ..... Off

j. L and R BATT switches ..... OFF

k. GUST LOCK ..... OFF

2 a. Passenger door operating switch door ..... Closed

b. Left standby static port ..... Clear of obstructions

EXTERIOR PREFLIGHT (CONT)

c. Left stall warning vane ..... Freedom of movement

d. Left pitot–static probe ..... Cover removed, clear of obstructions

e. Standby pitot probe ..... Cover removed, clear of obstructions

f. Left ice detector ..... Check

g. Ground communication door ..... Closed

h. L windshield/window ..... Condition

3 ♦ a. Nose gear check:

(1) Wheel well and gear ..... Condition

(2) Doors ..... Condition

(3) Wheels and tires ..... Condition

(4) Gear pin and chocks ..... Removed

(5) N LDG/TAXI lights ..... Condition

4 a. Radome ..... Condition

b. Windshields/windows ..... Condition

5 a. Right ice detector ..... Check

b. Right pitot–static probe ..... Cover removed, clear of obstructions

6 a. R windshield/window ..... Condition

b. R stall warning vane ..... Freedom of movement

c. Total air temperature probe ..... Check

d. Right standby static port ..... Clear of obstructions

7 ♦ a. Outflow valve access door ..... Closed

b. L and R engine oil level ..... Check, green

c. Fuel access doors ..... Closed

8 a. Wing inspection and emergency exit lights and lenses ..... Condition

♦ b. Emergency exit ..... Closed

♦ c. Right engine inlet and fan ..... Clear of obstructions and condition

d. Upper fuselage antennas, and dorsal inlets ..... Condition

e. Lower fuselage antennas, landing light fairing and lens ..... Condition

[1] f. Fuel water drains ..... Drain

▼

EXTERIOR PREFLIGHT (CONT)

NOTE: The fuel sump drains are low points in the fuel system. Fuel will drain from these when opened.

♦ g. Fuel and hydraulic drain masts ..... Check for leakage

9 a. Right wing check:

(1) Leading edge and vortilons ..... Condition

(2) Access panels ..... Fuel/Hydraulic leakage

(3) Fuel cap ..... Secure

CAUTION: The wing and flight control surfaces must be free of frost, snow, and ice. Ice can form on the surfaces of the wing even on very warm days if the fuel temperature will support it. The leading edge and lower surface of the flaps must be free of ice.

10 a. Right winglet navigation light/lens and static wicks ..... Condition

11 a. Right aileron ..... Check free motion, balance tab linkage, bent tab and brush seal condition

b. Right spoilers and flap ..... Condition

c. NACA scoop ..... Clear of obstructions

12 ♦ a. Right main gear check:

(1) Wheel well and gear ..... Hydraulic/fuel leakage and condition

(2) Doors ..... Condition

(3) Wheels, brakes and brake wear indicators, and tires ..... Condition

NOTE: The wear pins should be exposed with the PARKING BRAKE set.

(4) Gear pin and chocks ..... Removed

13 a. Oxygen overpressure relief indicator and service door ..... Check and close

b. Lav waste access door ..... Closed

c. Ground power supply access door ..... Closed

14 ♦ a. Right generator scoop ..... Clear

b. Right engine cowl latches ..... Closed

c. Right engine turbine exhaust area ..... Condition, clear of obstructions

▼

EXTERIOR PREFLIGHT (CONT)

d. Right thrust reverser ..... Stowed

15 a. High pressure pneumatic supply door ..... Closed

16 a. APU inlet ..... Clear of obstructions

b. APU generator and compartment scoops .. Clear of obstructions

c. APU exhaust ..... Clear of obstructions

d. Vertical stabilizer and rudder ..... Condition

e. Horizontal stabilizer and elevator ..... Condition

WARNING: The vertical and horizontal stabilizer, and flight control surfaces must be free of frost, snow, and ice.

f. Static discharge wicks ..... Condition

g. PACK exhaust vent ..... Clear

17 a. Aft equipment bay door ..... Open,

check for fluid leaks, security and condition of installed equipment, remote circuit breakers set.

b. Aft equipment bay door ..... Close

18 ♦ a. Left engine turbine exhaust area ..... Condition,

clear of obstructions

b. Left thrust reverser ..... Stowed

19 ♦ a. Cargo door ..... Closed

♦ b. Battery bay door ..... Closed

c. Battery vents ..... Check

d. Left engine cowl latches ..... Closed

e. Left main gear check:

(1) Wheel well and gear ..... Hydraulic/fuel leakage and condition

(2) Doors ..... Condition

(3) Wheels, brakes and brake wear indicators, and tires ..... Condition

NOTE: The wear pins should be exposed with the PARKING BRAKE set.

(4) Gear pin and chocks ..... Removed

f. Left generator scoop ..... Clear

20 a. Left spoilers and flap ..... Condition

b. Left aileron ..... Check free motion,

balance, bent tabs and trim tab linkage and brush seal condition

▼

EXTERIOR PREFLIGHT (CONT)

c. NACA scoop ..... Clear of obstructions

21 a. Left winglet navigation light/lens and static wicks ..... Condition

22 a. Left wing check:

(1) Leading edge and vortilons ..... Condition

(2) Access panels ..... Fuel/hydraulic leakage

(3) Fuel cap ..... Secure

CAUTION: The wing and flight control surfaces must be free of frost, snow, and ice. Ice can form on the surfaces of the wing even on very warm days if the fuel temperature will support it. The leading edge and lower surface of the flaps must be free of ice.

23 [1] a. Fuel water drains ..... Drain

NOTE: The fuel sump drains are low points in the fuel system. Fuel will drain from these when opened.

24 ♦ a. Left engine inlet and fan ..... Clear of obstructions and condition

b. Upper fuselage ..... Condition

CABIN PREFLIGHT

♦ 1. Cabin furnishings ..... Secure

♦ 2. Emergency exit ..... Aisle clear and handle unobstructed.

Remove and stow aft emergency exit door security pin.

BEFORE STARTING ENGINES

NOTE: All flight deck switches will be extinguished, except as noted in the following procedures.

1. Circuit breakers (CB1 and CB2) ..... Set

♦ 2. Seats, safety harnesses ..... Secure

3. Crew oxygen masks and smoke goggles ..... Check

♦ 4. LANDING GEAR switch ..... DN

♦ 5. L, R, and AUX HYDRAULIC PUMP switches ..... OFF

♦ 6. AIR SOURCE switch ..... OFF

BEFORE STARTING ENGINES (CONT)

♦ 7. Electrical system:
   a. STBY INST switch ..... On
   b. EXT PWR switch (if connected) ..... Check AVAIL then select ON
   c. R BATT switch ..... On

   NOTE: R BATT switch is selected first to prevent uncommanded APU starts.

   d. L BATT switch ..... On

♦ 8. L and R PROBES ..... OFF

9. L and R COCKPIT LIGHTS ..... As desired

♦ 10. APU Start:
   a. CAS ..... Check, no APU or AIR COND FAULT messages
   b. L and R BLEED switches ..... OFF
   c. NAV lights ..... NAV
   d. R FUEL PUMP switch ..... AUTO
   e. APU switch ..... START, (hold for 3 seconds) and release
   f. EXT PWR switch (if applicable) ..... AVAIL and disconnect
   g. APU BLEED switch ..... ON
   h. XBLEED switch ..... Open
   i. AIR SOURCE switch ..... NORM

11. SYSTEMS TEST panel:
   a. ANNUN A ..... Test
   b. ANNUN B ..... Test
   c. PROBES ..... Test
      – PROBE HEAT TEST OK (S) CAS illuminates.
   d. STALL/RUD LIM ..... Test
      – The STALL icon on both PFDs illuminates.
      – Flashing AOA red illuminates briefly.
      – "STALL" voice sounds.
      – Left stick shaker activates.
      – Right stick shaker activates.
      – Pusher activates.
      – RUDDER LIMITER IN TEST (S) illuminates.

▼

BEFORE STARTING ENGINES (CONT)

e. ICE DET ..... Test

– ICE DETECTED (C) and **ICE** icon on PFD illuminates.

12. L and R rudder pedals ..... Adjust

13. L and R audio panels ..... Set

♦ 14. Fuel quantity ..... Check

♦ 15. Standby Instrument ..... Check

16. Clock ..... Zero flight time

Effectivity:

On airplanes 20501 to 20758 incorporating SB 350–34–018 and airplanes 20759 and subsequent incorporating SB 350–34–017:

17. STEEP APPR ..... Off

Check ON light out.

18. NWS switch ..... OFF

♦ 19. L and R FUEL PUMP switches ..... AUTO

♦ 20. FMS ..... Program

21. REVERSION panel ..... NORM

22. AIR COND/BLEED panel ..... Check

[1] a. RAM AIR switch ..... ON

– RAM AIR ON (S) illuminates

b. RAM AIR switch ..... OFF

23. ANTI–ICE panel:

a. WING SOURCE switch ..... NORM

b. L and R PROBES switches ..... OFF

♦ c. L and R WSHLD/WINDOW switches ..... ON

♦ 24. PRESSURIZATION panel ..... Check

a. LNDG ALT ..... Set

25. LIGHTING panel ..... As desired

[1] a. Emergency lights ..... Check:

BEFORE STARTING ENGINES (CONT)

(1) EMER LTS switch ..... OFF
(EMER LIGHTS OFF (C) CAS)

(2) EMER LTS switch ..... ON
(EMER LIGHTS ON (C) CAS),
check emergency lights displayed

♦ (3) EMER LTS switch ..... ARM

26. GUST LOCK ..... OFF

♦ 27. HYDRAULIC panel:

a. L and R PUMP switches ..... ON
b. AUX pump switch ..... AUTO
c. PARK/EMER BRAKE handle ..... Confirm set
d. L and R PUMP and PTU switches ..... AUTO
e. R HYDRAULIC PRESS ..... Verify less than 1800 psi
f. AUX pump switch ..... OFF

28. Trim system:

a. STAB TRIM switch ..... SEC
b. Pilot's trim switch ..... NUP and NDN
Verify movement
c. Copilot's trim switch ..... NUP and NDN
Verify movement
d. STAB TRIM switch ..... PRI
e. Pilot's trim switch ..... NUP and NDN
Verify movement
f. Pilot's trim switch housing only ..... NUP or NDN
Verify no movement
g. Pilot's trim switch arm button only ..... Depress
Verify no movement
h. Pilot's trim switch ..... NUP or NDN & hold
Verify movement
i. Pilot's master disconnect switch ..... Depress
Verify movement stops
j. Pilot's trim switch and master disconnect switch ..... Release

STARTING ENGINES

Engine starts may be made by using the APU, an external air source, or crossbleed from the other engine.

WARNING: Maintain a safe distance from the engine outlets at all times during engine operation. Airflow into the turbofan engine is sufficient to draw personnel and equipment into the engine inlet.

NOTE: Ensuring ITT is below 350 °C (cranking if necessary) will reduce the possibility of a hot start.

1. Passenger door ..... Closed
   a. Green flag ..... Check
2. PARK/EMER BRAKE handle ..... Confirm set
3. Thrust levers ..... IDLE
4. STROBE switch ..... BCN
5. Engine Start (APU bleed source)
   a. ENGINE RUN switch ..... RUN
   b. STARTER ..... START and release
   c. Engine Instruments ..... Check
   d. Start other engine by repeating steps 5 a through c. (Optional)

5. Engine Start (External bleed source)
   a. External air source ..... Verify connected
   b. Bleed pressure ..... 32 psi minimum
   c. ENGINE RUN switch ..... RUN
   d. STARTER ..... START and release
   e. Engine Instruments ..... Check
   f. Start other engine by repeating steps 5 c through f. (Optional)
   g. External air source ..... Disconnect
   h. XBLEED switch ..... Closed
   i. L and R BLEED switches ..... ON
   j. EXT PWR switch (if applicable) ..... AVAIL, Disconnect

5. Engine Start (Crossbleed source)
   a. APU BLEED switch ..... OFF
   b. Operating engine BLEED switch ..... On
   c. Operating engine thrust lever ..... Advance
   d. Bleed pressure ..... 32 psi minimum
   e. ENGINE RUN switch ..... RUN

NOTE: Starting with a tailwind may require a higher bleed pressure than 32 psi.

STARTING ENGINES (CONT)

f. STARTER ..... START and release
g. Engine Instruments ..... Check normal
h. XBLEED switch ..... Closed
i. L and R BLEED switches ..... ON
j. EXT PWR switch (if applicable) ..... AVAIL, Disconnect

6. Generators ..... Check on line

BEFORE TAXI

NOTE: If anti–icing fluids have been applied to the aircraft, the anti–ice system checks in steps 1 and 9 below may be accomplished upon completion of the first flight of the day prior to engine shutdown.

[1] 1. WING ANTI–ICE switch ..... ON

– WING ANTI–ICE (S) illuminates.

2. FLAPS ..... 10 or 20
3. AUX PUMP switch ..... AUTO
4. Flight controls:
   a. Select FLIGHT CONTROLS synoptic page.
   b. Apply full range of motion to pitch, roll and yaw while checking for elevator, aileron, roll spoilers, and rudder motion.
5. FLIGHT SPOILERS lever ..... Check extension all positions 0–MAX and EMER.
6. GND SPOILERS:
   a. MANUAL ARM ..... Check extended
   b. AUTO ..... Check stowed
7. YD ..... On
8. EICAS ..... Check
9. Passenger brief/cabin check ..... Complete

[1] 10. ANTI–ICE panel:
   a. Wing anti–ice flow lines green after 2 minutes ON ..... Check
   b. WING SOURCE switch ..... FROM L

– WING SOURCE XBLEED (S) illuminates

   c. WING SOURCE switch ..... FROM R

– WING SOURCE XBLEED (S) illuminates

BEFORE TAXI (CONT)

NOTE: If L(R) WING A/I LOW TEMP (C) illuminates, it may be necessary to increase the thrust lever slightly.

d. WING SOURCE switch ..... NORM

e. WING ANTI–ICE switch ..... As required

11. Airplane lighting ..... As required

12. SMKG/BELTS switch ..... SMKG/BELTS

13. NWS switch ..... On

14. PARK/EMER BRAKE Release:

a. Brake pedals ..... Depress fully

b. PARK/EMER BRAKE handle ..... Stow

c. Brake pedals ..... Release

TAXI AND BEFORE TAKEOFF

1. XPDR/TCAS ..... Set

2. Brakes and nose wheel steering ..... Check

If conditions exist that could result in water saturated brakes, perform 7 consecutive brake applications from 20 kt to 5 kt. Perform the brake applications during the last mile/kilometer of taxi prior to and not including the final stop or snub before takeoff.

DO NOT DRAG THE BRAKES.

Warming of the brakes will preclude the chance of water saturated brakes freezing at altitude and being locked for landing touchdown.

3. Flight instruments ..... Check

4. Thrust reversers:

CAUTION: Use of reverse thrust on poorly cleaned or maintained runway, taxiway, or ramp surfaces may cause foreign object damage to engine fan blades.

a. Thrust levers ..... REV

(REV [white] EI, then REV [green] EI)

b. Thrust levers ..... IDLE

(REV [white] EI, then extinguishes)

5. Engine instruments and N_1 bugs ..... Check,

verify that the left and right bugs agree within 1%.

6. Takeoff data (V_1, V_R, V_2, and distance) ..... Check displayed

▼

TAXI AND BEFORE TAKEOFF (CONT)

Effectivity:

On airplanes 20578 and subsequent, and airplanes incorporating SB 350–34–013:

7. Takeoff data (V_1, V_R, V_2, and distance) ..... Check displayed.

   Crosscheck input data on PERF INIT 1/3, TAKEOFF REF 1/4 and 2/4 CDU pages:

   RWY data, Wind, OAT, QNH, PALT, CG, T/O FLAPS, Weight, ENG BLEED, THRUST REV.

   CAUTION: Ensure input data matches airplane configuration and environmental conditions.

8. Nav equipment ..... Check
9. Crew takeoff briefing ..... Complete
10. Radar/terrain ..... As required

WARNING: **Do not** transmit radar energy if personnel are within 9 feet (3 meters) radially from the nose of the airplane, within 100 feet (30 meters) of large metallic objects including airplanes, or during refueling.

11. ANTI–ICE panel:
    a. WING switch ..... As required
    b. L and R ENG switch ..... As required

RUNWAY LINEUP

1. L and R PROBES switches ..... On
2. L and R LANDING, N LDG/TAXI light switches ..... As required
3. STROBE switch ..... STROBE
4. CAS ..... Checked and cleared

TAKEOFF

1. Thrust Levers ..... TO

At V_R:

2. Smoothly rotate toward flight director pitch guidance command. Adjust pitch as required to accelerate to a speed of not less than V_2 + 10 at 35 ft above the runway.

AFTER TAKEOFF

NOTE: If taxi and/or takeoff were on ice, snow, or slush, unless weather conditions or performance requirements prohibit, delay retraction of the landing gear until excess water, snow or slush is thrown off by wheel rotation and/or slipstream force.

1. LANDING GEAR ..... UP after positive rate of climb
2. FLAPS ..... 0 at V_2 + 15 (flaps 10); V_2 + 25 (flaps 20)
3. N LDG/TAXI light switch ..... OFF
4. ANTI–ICE panel ..... As required
5. L and R HYDRAULIC PUMP switches ..... AUTO

CLIMB

1. Thrust levers ..... CLB

10,000 ft Checks:

2. SMKG/BELTS switch ..... As required
3. APU and BLEEDS ..... Set
4. Pressurization ..... Check

Transition Altitude (or 18,000 ft) Checks:

5. Altimeters ..... Set
6. L and R LANDING light switches ..... As required

CRUISE

1. Fuel balance ..... Check
2. Engine power settings for cruise ..... Confirm

   Cruise tables are found in the Flight Planning and Cruise Control Manual.

NOTE: The VOR and FMS bearing pointers may differ by up to 7 degrees when the VOR is being used as a waypoint.

DESCENT

1. WING ANTI–ICE switch ..... As required
2. L and R ENG ANTI–ICE switches ..... As required
3. Pressurization ..... Check/Set

DESCENT (CONT)

Transition Level (or FL 180) Checks:

4. Altimeters ..... Set
5. L and R LANDING light switches ..... As required
6. Passenger Brief/Cabin Check ..... Complete
7. SMKG/BELTS switch ..... SMKG/BELTS
8. Fuel Quantities and Balance ..... Check

APPROACH

NOTE: Intermittent operation at idle when wing anti–ice and/or engine anti–ice is ON is acceptable during final approach provided the following CAS messages are not annunciated: L (R) WING ANTI–ICE FAIL (C) or L (R) WING A/I LOW TEMP (C) and/or L (R) ENG ANTI–ICE FAIL (C).

1. APU and BLEEDS ..... Set
2. Landing data (V_{REF}, V_{GA}, Distance) ..... Set

Effectivity:

On aircraft 20578 and subsequent, and aircraft incorporating SB 350–34–013:

3. Landing data (V_{REF}, V_{GA}, Distance) ..... Check displayed.

   Crosscheck input data on APPROACH REF 1/4 and 2/4 CDU pages:

   RWY data, Wind, OAT, QNH, PALT, LDG FACTOR (if applicable), Weight, ENG BLEED, THRUST REV, DELTA V_{REF} (if applicable).

   CAUTION: Ensure input data matches aircraft configuration and environmental conditions.

4. Approach setup and crew briefing ..... Complete
5. RA MIN or BARO MIN ..... Set
6. MIN ALERT ..... Set
7. ROAAS RCC 5 switch (if installed) ..... As required
8. L and R HYDRAULIC PUMP switches ..... AUTO

BEFORE LANDING

1. LANDING GEAR ..... DN
2. L LANDING, N LDG/TAXI and R LANDING light switches ..... On
3. FLAPS 30

GO–AROUND

CAUTION: If unreliable airspeed is suspected, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed.

1. Autopilot ..... Disengage with the TO/GA button
2. Thrust levers ..... TO
3. FLIGHT SPOILERS (if extended) ..... RETRACT
4. Pitch attitude ..... Increase

   rapidly but smoothly to initiate pitch attitude of 8 degrees at a speed of not less than V_{REF}, then adjust pitch attitude to maintain V_{2GA} speed.
5. FLAPS 10
6. LANDING GEAR ..... UP

   after positive rate of climb is established.
7. Climb at V_{2GA} or above.

NOTE: The flight director guidance only represents an initial target to rotate toward and does not guarantee that the climb speed will be achieved under all conditions.

8. When clear of obstacles, accelerate to V_{2GA} + 15 and retract flaps.
9. Pressurization ..... LNDG ALT set

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LANDING

NOTE: Carry out a positive touchdown to ensure initial wheel spin up and breakout of frozen brakes if icing accumulation on the wheels and brakes is suspected.

1. Brakes ..... As required
2. Thrust reversers ..... As desired
   a. With nose wheel on runway, move both thrust levers to REV, a REV [white] EI will illuminate.
   b. The thrust reversers are deployed when the REV [green] EI illuminates. Smoothly pull thrust levers to the desired reverse thrust.

   WARNING: When landing on snow covered runways, apply reverse thrust with caution as visibility may be impaired.

   c. By 40 KIAS return the thrust levers to REV.

   CAUTION:
   - Do not use reverse thrust on poorly cleaned or poorly maintained surfaces. This may cause foreign object damage to engine fan blades.
   - If full reverse thrust is maintained below 40 KIAS, reingestion of exhaust gases in the engine and foreign object damage may occur.

   d. When reverse thrust is no longer required, return thrust levers to IDLE. The REV [green] EI will change to a REV [white] EI. Once the thrust reversers are stowed, the REV [white] EI will extinguish.

AFTER LANDING/CLEARING RUNWAY

1. L and R PROBES ..... OFF

NOTE: If anti–icing fluids have been applied to the airplane, the anti–ice system checks may be accomplished upon completion of the first flight of the day prior to engine shutdown. Refer to the first flight of the day anti–ice system checks in BEFORE TAXI, this chapter.

2. WING ANTI–ICE switch ..... As required
3. L and R ENG ANTI–ICE switches ..... As required
4. Lighting ..... As desired
   a. STROBE switch ..... BCN
5. FLAPS ..... As desired
6. XPDR/TCAS ..... As required

SHUTDOWN

1. PARK/EMER BRAKE Set:
   a. Brake pedals ..... Depress fully
   b. PARK/EMER BRAKE handle ..... Set
   c. Brake pedals ..... Release
2. Chocks ..... Insert

NOTE: Do not rely on parking brake for overnight or unattended use.

3. NWS switch ..... OFF
4. L and R WSHLD/WINDOW switches ..... OFF
5. EMER LTS switch ..... OFF
6. ENGINE RUN switches ..... OFF
7. XPDR ..... STBY
8. STROBE switch ..... OFF
9. Gear pins ..... Insert
10. HYDRAULIC panel:
    a. L, R PUMPS and PTU switches ..... OFF
    b. R HYDRAULIC PRESS ..... Verify less than 1,800 psi
    c. AUX switch ..... OFF
11. GUST LOCK ..... Set

NOTE: It may be required to move the control wheel left and right near the neutral position to ensure lock engagement.

12. L and R COCKPIT LIGHTS ..... As desired
13. CABIN DC and AC PWR switches ..... OFF
14. APU switch ..... OFF
15. NAV lights ..... OFF
16. STBY INST switch ..... OFF

Effectivity:

For airplanes incorporating SB 350–23–010.

17. ATN ..... log OFF

18. L and R BATT switches ..... OFF

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NON-NORMAL PROCEDURES 09

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GENERAL

The Advisory part of this section addresses minor failure conditions or loss of redundancy with an associated crew action. A listing of all Advisory messages is included in FCOM vol 1 and QRH vol 2.

AIR CONDITIONING & PRESSURIZATION

L (R) PYLON LOOP FAIL (A)

1. Do not takeoff.

END

Effectivity:

The following BLEED LOOP FAULT (A) procedure applies to aircraft 20501 thru 20906 not incorporating Service Bulletin SB350–36–003:

BLEED LOOP FAULT (A)

If message posted on ground only, after AIR SOURCE switch selected to NORM and AIR COND/BLEED from any source (external, APU, engine bleed) or engine running.

1. Do not takeoff.

END

AUTO FLIGHT

FD 1 FAIL (A)
FD 2 FAIL (A)

1. Autopilot ..... Disconnect
2. Autothrottle (if installed) ..... Disengage
3. Flight Guidance Panel XFR button ..... Select operative FD
4. Autopilot ..... As desired

END

AUXILIARY POWER UNIT

APU FAULT (A)

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... Off
4. R BLEED switch ..... ON
5. APU switch ..... OFF

END

APU SHUTDOWN (A)

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... Off
4. R BLEED switch ..... ON
5. APU switch ..... OFF

END

AVIONICS

FDR FAULT (A)

1. With the PARK/EMER BRAKE set, push ENGINE EVENT button for two seconds.

END

MFD X–TALK FAIL (A)

If cross–side tuning is desired:

1. TUNE REVERSION switch ..... CDU ONLY

END

Effectivity:

For aircraft 20595–22999 and aircraft incorporating SB 350–34–011.

XPDR 1 (2) FAIL (A)

The not–selected transponder has failed.

END

XPDR 1 (2) FAIL (A)

1. Select cross–side transponder.

END

Effectivity:

For aircraft 20595–22999 and aircraft incorporating SB 350–34–011.

TSS FAN FAIL (A)

1. No crew action required.

END

Effectivity:

For aircraft 20595–22999 and aircraft incorporating SB 350–34–011.

XPDR IN STBY (S)

The selected transponder is in STBY and operational.

END

SVS RWY INOP on PFD

(This advisory is white in color)

1. SVS ..... Select OFF prior to passing the FAF

END

AVIONICS

SVS INOP on PFD

(This advisory is white in color)

1. SVS ..... Select OFF

END

CHART FAULT on MFD

If left (right) MFD shows CHART FAULT message on CHART MAIN INDEX after a chart has been selected and the MFD becomes inoperative (locked up):

1. Affected LEFT (RIGHT) DISPLAYS REVERSION switch ..... Select from NORM to PFD REV and back to NORM

END

FIRE PROTECTION

FIREX BTL 2 LOW (A)

APU Shutdown:

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... Off
4. R BLEED switch ..... ON
5. APU switch ..... OFF

END

FLIGHT CONTROLS

STAB TRIM FAULT (A)

A minor failure has occurred causing a loss of redundancy in the horizontal stabilizer trim system. The stabilizer trim will continue to function in most cases.

NOTE: If STAB TRIM FAULT (A) posts and autopilot is engaged, consider leaving engaged as long as practical.

Prior to disengaging the autopilot and operating in manual flight, refer to Chapter 5, CAUTIONS PROCEDURES, FLIGHT CONTROLS, Stabilizer Trim Malfunction.

END

FUEL

FUEL GRAV XFLOW FAIL (A)

1. Fuel Quantities ..... Check
2. GRAVITY XFLOW switch ..... Cycle

GRAVITY XFLOW valve fails to open:

Yes

If fuel is not balanced:

3. FUEL XFER switch ..... Open
4. L or R FUEL PUMP switch (heavy wing) ..... ON
5. Wing fuel quantity ..... Monitor

When fuel is balanced:

6. L or R FUEL PUMP switch ..... OFF
7. FUEL XFER switch ..... Close

– END –

No

GRAVITY XFLOW valve fails to close:

3. Sideslip ..... Minimize
4. Wing fuel quantity ..... Monitor

END

FUEL

FUEL XFER FAIL (A)

1. Fuel quantities ..... Check
2. FUEL XFER switch ..... Cycle

FUEL XFER valve fails to open:

Yes

If fuel is not balanced:

3. GRAVITY XFLOW switch ..... OPEN

NOTE: It may be necessary to use a sideslip to transfer fuel.

– END –

No

FUEL XFER valve fails to close:

3. L and R FUEL PUMPS ..... **Both** OFF or **Both** ON as required

END

HYDRAULICS

AUX HYD PUMP FAIL ON (A)

1. AUX HYDRAULIC PUMP switch ..... OFF

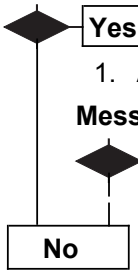
Before landing

2. AUX HYDRAULIC PUMP switch ..... AUTO

END

AUX HYD SYS FAIL (A)

Fluid quantity digits are green:



1. AUX HYDRAULIC PUMP switch ..... AUTO

Message goes out:

– END –

1. AUX HYDRAULIC PUMP switch ..... OFF

END

L (R) HYD DC PUMP FAIL (A)

1. Affected HYDRAULIC PUMP switch ..... ON

If L (R) HYD DC PUMP FAIL persists:

2. Affected HYDRAULIC PUMP switch ..... OFF

The engine driven pump will provide sufficient pressure.

END

ICE & RAIN PROTECTION

ICE DETECTOR FAULT (A)

If in visible moisture or at night and TAT is 10 °C or below except when SAT is –40 °C or below:

1. WING ANTI–ICE switch ..... ON
2. L and R ENG ANTI–ICE switches ..... ON

END

L (R) ENG A/ICE FAIL ON (A)

1. Anti–Ice synoptic ..... Check

An amber T_2 is displayed:

Yes

2. No action required.

– END –

No

2. Use Engine Anti–Ice On performance data in the PERFORMANCE DATA Chapter.

END

WING A/ICE LOOP FAIL (A)

1. Do not takeoff.

END

LANDING GEAR, WHEEL AND BRAKE SYSTEM

NWS FAULT (A)

1. NWS switch ..... **Do Not** turn OFF

END

PROX SYS FAULT (A)

1. LANDING GEAR switch ..... Ensure firmly in “DN” or “UP” position.

If all landing gear indications display “DN”, “UP” or “in transit” and no further crew action is required.

If landing gear indication displays “––” (magenta) :

2. GEAR SYS FAIL procedure in the NON–NORMAL Procedures Chapter ..... Perform

   Refer to GEAR SYS FAIL procedure.

3. WOW FAIL procedure in the NON–NORMAL Procedures Chapter ..... Perform

   Refer to WOW FAIL procedure.

END

POWERPLANT

Effectivity:

If Autothrottle installed:

AT FAIL (A)

1. Autothrottle ..... Disengage
2. Thrust levers ..... Position manually

END

ENGINE SYNC FAIL (A)

1. SYNC switch ..... OFF

END

Effectivity:

Applicable to aircraft without Autothrottle.

ENGINE MACH–HOLD FAIL (A)

1. MACH HOLD switch ..... Off

END

L (R) ENG FUEL TEMP LOW (A)

1. Descend to a warmer altitude.
2. Monitor the affected engine(s).

END

L (R) ENGINE FUEL BYPASS (A)

1. Affected FUEL PUMP switch ..... ON
2. Engine and fuel synoptic pages ..... Monitor

END

L (R) ENGINE OIL BYPASS (A)

1. Affected engine indications ..... Monitor

END

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GENERAL

The CAUTION part of this section addresses foreseeable but abnormal situations, usually involving a failure condition. While not requiring immediate action, Caution messages must still be actioned expeditiously to maintain safe operation.

AIR CONDITIONING & PRESSURIZATION

AIR COND TEMP FAIL (C)

1. MAN TEMP switch ..... ON
2. COCKPIT and CABIN COLD–HOT knobs ..... As desired

END

AIR COND TEMP HIGH (C)

1. AIR SOURCE switch ..... PACK ONLY

Airflow into Cockpit/Cabin stops:

Yes

2. AIR SOURCE switch ..... TRIM AIR ONLY
3. Altitude ..... 35,000 ft maximum
4. COCKPIT COLD–HOT knob (for cockpit & cabin) ..... As desired

On approach below 9000 ft but not below minimum safe altitude:

5. AIR SOURCE switch ..... OFF
6. EMER DEPRESS switch ..... ON
7. RAM AIR switch ..... ON

– END –

No

AIR COND TEMP HIGH CAS remains displayed:

Yes

2. Descend to an altitude that will safely allow unpressurized flight.
3. AIR SOURCE switch ..... OFF
4. EMER DEPRESS switch ..... ON
5. RAM AIR switch ..... ON

– END –

No

On approach below 9000 ft but not below minimum safe altitude:

2. AIR SOURCE switch ..... OFF
3. EMER DEPRESS switch ..... ON
4. RAM AIR switch ..... ON

END

AUTO PRESS FAIL (C)

1. MANUAL PRESSURIZATION switch ..... ON
2. MAN RATE control ..... As required

   Refer to the applicable Pressurization schedule in this section:

   – For aircraft 20501 to 20886

   – For aircraft 20887 to 22999

END

Unpressurized Flight

1. Airplane altitude ..... 9000 ft maximum
2. AIR SOURCE switch ..... OFF
3. RAM AIR switch ..... ON

   Check RAM AIR ON (S) message is displayed.
4. EMER DEPRESS switch ..... ON

   Check EMER DEPRESS ON (S) message is displayed.

END

Manual Cabin Pressurization Control

1. MAN RATE control ..... Set to mid position/center
2. MANUAL PRESSURIZATION switch ..... ON

   Adjust cabin altitude and cabin differential pressure as required. The Pressurization Schedule presents the normal values during operation in AUTO mode.

Effectivity:

For aircraft 20501 to 20886:

CAUTION: Do not exceed the maximum normal cabin differential pressure of 8.8 PSID.

Effectivity:

For aircraft 20887 to 22999:

CAUTION: Do not exceed the maximum normal cabin differential pressure of 9.7 PSID.

To increase cabin altitude:

3. MAN RATE control ..... UP

To decrease cabin altitude:

4. MAN RATE control ..... DN

To maintain cabin altitude:

5. MAN RATE control ..... Mid position/center

AIR CONDITIONING & PRESSURIZATION

Manual Cabin Pressurization Control (Cont)

Before landing:

6. Cabin altitude ..... Adjust to the landing field elevation

After Landing:

7. MAN RATE control ..... UP until field elevation is attained

END

L (R) BLEED FAIL (C)

1. Autothrottle (if installed) ..... Disengage
2. Affected thrust lever ..... Increase

CAUTION: If conditions persists, do not engage Autothrottle.

BLEED FAIL (C) remains displayed:

Yes

3. Affected BLEED switch ..... OFF
4. XBLEED switch ..... CLOSED

If R BLEED FAIL is displayed:

5. APU BLEED switch ..... OFF

– END –

No

END

L (R) BLEED LOOP FAIL (C)

1. Affected BLEED switch ..... OFF

END

CABIN ALTITUDE (C)

1. Crew oxygen masks ..... Don
2. AIR SOURCE switch ..... Check NORM
3. L and R BLEED switches ..... Check On
4. CAB ALT ..... Check

Cabin altitude continues to climb:

Yes

5. MANUAL PRESSURIZATION switch ..... ON
6. MAN RATE control ..... DN, as required to maintain satisfactory pressurization.

   Refer to the applicable Pressurization schedule in this section:

   – For aircraft 20501 to 20886
   – For aircraft 20887 to 22999
7. Descend as necessary to control cabin altitude.

– END –

No

Cabin altitude stabilizes at a safe altitude:

5. Continue flight.

END

AIR CONDITIONING & PRESSURIZATION

Effectivity:

For aircraft 20501 to 20886:

PRESSURIZATION SCHEDULE — CLIMB AND CRUISE

Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)
-1500	-1786	0.2	15 000	1379	5.7	33 000	4955	8.5
-1000	-1273	0.2	16 000	1504	6.0	34 000	5272	8.5
0	-245	0.1	17 000	1637	6.2	35 000	5612	8.5
1000	-135	0.6	18 000	1778	6.4	36 000	5877	8.5
1500	-81	0.8	19 000	1926	6.7	37 000	6076	8.6
2000	-26	1.0	20 000	2091	6.9	38 000	6331	8.6
3000	81	1.5	21 000	2258	7.1	39 000	6586	8.7
4000	187	1.9	22 000	2429	7.2	40 000	6827	8.7
5000	294	2.3	23 000	2608	7.4	41 000	7056	8.7
6000	399	2.7	24 000	2795	7.6	42 000	7272	8.8
7000	504	3.1	25 000	2984	7.7	43 000	7476	8.8
8000	610	3.5	26 000	3189	7.9	44 000	7669	8.8
9000	716	3.8	27 000	3404	8.0	45 000	7850	8.8
10 000	816	4.2	28 000	3628	8.1	-	-	-
11 000	925	4.5	29 000	3864	8.2	-	-	-
12 000	1036	4.8	30 000	4111	8.3	-	-	-
13 000	1150	5.1	31 000	4375	8.4	-	-	-
14 000	1268	5.4	32 000	4653	8.4	-	-	-

PRESSURIZATION SCHEDULE — DESCENT AND HOLD (<25 000 FT)

Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)
-1500	-1786	0.2	15 000	1118	5.8	33 000	4699	8.6
-1000	-1291	0.2	16 000	1229	6.1	34 000	5098	8.6
0	-299	0.2	17 000	1347	6.3	35 000	5487	8.6
1000	-202	0.6	18 000	1473	6.6	36 000	5782	8.6
1500	-155	0.9	19 000	1606	6.8	37 000	6064	8.6
2000	-107	1.1	20 000	1756	7.0	38 000	6332	8.6
3000	-13	1.5	21 000	1907	7.2	39 000	6587	8.7
4000	80	2.0	22 000	2063	7.4	40 000	6828	8.7
5000	173	2.4	23 000	2226	7.6	41 000	7057	8.7
6000	264	2.8	24 000	2396	7.8	42 000	7273	8.8
7000	356	3.2	25 000	2569	7.9	43 000	7477	8.8
8000	448	3.5	26 000	2754	8.1	44 000	7670	8.8
9000	540	3.9	27 000	2948	8.2	45 000	7850	8.8
10 000	626	4.3	28 000	3151	8.3	-	-	-
11 000	721	4.6	29 000	3366	8.4	-	-	-
12 000	818	4.9	30 000	3591	8.5	-	-	-
13 000	918	5.2	31 000	3873	8.6	-	-	-
14 000	1022	5.5	32 000	4291	8.6	-	-	-

AIR CONDITIONING & PRESSURIZATION

Effectivity:

For aircraft 20887 to 22999:

PRESSURIZATION SCHEDULE – CLIMB AND CRUISE

Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)
–1,500	–1,786	0.2	15,000	756	6.0	33,000	3,300	9.2
–1,000	–1,273	0.1	16,000	845	6.3	34,000	3,525	9.3
0	–245	0.1	17,000	933	6.6	35,000	3,742	9.3
1,000	–180	0.6	18,000	1,022	6.8	36,000	3,926	9.4
1,500	–148	0.9	19,000	1,111	7.1	37,000	4,111	9.5
2,000	–116	1.1	20,000	1,201	7.3	38,000	4,295	9.5
3,000	–53	1.6	21,000	1,311	7.5	39,000	4,479	9.6
4,000	11	2.0	22,000	1,422	7.7	40,000	4,650	9.7
5,000	75	2.4	23,000	1,534	7.9	41,000	4,848	9.7
6,000	139	2.8	24,000	1,646	8.1	42,000	5,114	9.7
7,000	203	3.2	25,000	1,775	8.3	43,000	5,369	9.7
8,000	268	3.6	26,000	1,920	8.5	44,000	5,614	9.7
9,000	333	4.0	27,000	2,099	8.6	45,000	5,850	9.7
10,000	397	4.4	28,000	2,271	8.7	–	–	–
11,000	469	4.7	29,000	2,443	8.9	–	–	–
12,000	540	5.1	30,000	2,625	9.0	–	–	–
13,000	612	5.4	31,000	2,830	9.1	–	–	–
14,000	684	5.7	32,000	3,050	9.2	–	–	–

PRESSURIZATION SCHEDULE – DESCENT AND HOLD

Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)	Aircraft Altitude (ft)	Cabin Altitude (ft)	Cabin Delta P (PSID)
–1,500	–1,786	0.2	15,000	712	6.0	33,000	2,989	9.4
–1,000	–1,290	0.2	16,000	801	6.3	34,000	3,206	9.4
0	–299	0.2	17,000	891	6.6	35,000	3,423	9.5
1,000	–235	0.6	18,000	980	6.8	36,000	3,629	9.6
1,500	–202	0.9	19,000	1,070	7.1	37,000	3,837	9.6
2,000	–170	1.1	20,000	1,161	7.3	38,000	4,064	9.7
3,000	–106	1.6	21,000	1,273	7.6	39,000	4,294	9.7
4,000	–42	2.0	22,000	1,385	7.8	40,000	4,572	9.7
5,000	23	2.5	23,000	1,498	8.0	41,000	4,848	9.7
6,000	88	2.9	24,000	1,611	8.2	42,000	5,114	9.7
7,000	153	3.3	25,000	1,726	8.3	43,000	5,369	9.7
8,000	218	3.7	26,000	1,867	8.5	44,000	5,614	9.7
9,000	283	4.0	27,000	2,011	8.7	45,000	5,850	9.7
10,000	349	4.4	28,000	2,155	8.8	–	–	–
11,000	421	4.8	29,000	2,299	8.9	–	–	–
12,000	494	5.1	30,000	2,445	9.1	–	–	–
13,000	566	5.4	31,000	2,625	9.2	–	–	–
14,000	639	5.7	32,000	2,807	9.3	–	–	–

AIR CONDITIONING & PRESSURIZATION

CABIN PRESS FAULT (C)

1. Altitude ..... 31,000 ft maximum

END

DITCHING NOT AVAIL (C)

1. DITCHING switch ..... Off

MANUAL DITCHING (Aircraft below 15,000 ft and time permitting):

2. AIR SOURCE switch ..... OFF
3. MANUAL PRESSURIZATION switch ..... Check ON
4. EMER DEPRESS switch ..... ON

When CABIN DELTA P is indicated less than 0.15 psid:

5. EMER DEPRESS switch ..... OFF
6. MAN RATE control ..... Full down

END

EQPT RACK TEMP HIGH (C)

1. AIR SOURCE switch ..... NORM
2. COCKPIT COLD/HOT control ..... Full COLD
3. Land as soon as practical.

END

OXYGEN QUANTITY LOW (C)

1. Altitude ..... 25,000 ft maximum

END

OXYGEN VALVE CLOSED (C)

On the ground:

1. Oxygen bottle valve ..... Open

In flight:

1. Altitude ..... 25,000 ft maximum

NOTE: This CAS will occur in flight with the OXYGEN QUANTITY LOW (C), when the bottle(s) are depleted.

END

AIR CONDITIONING & PRESSURIZATION

PACK FAIL (C)

On the ground:

1. AIR SOURCE switch ..... OFF

In flight:

1. AIR SOURCE switch ..... TRIM AIR ONLY
2. Altitude ..... 35,000 ft maximum
3. COCKPIT COLD–HOT knob (for cockpit & cabin) ..... As desired

On approach below 9000 ft but not below minimum safe altitude:

4. AIR SOURCE switch ..... OFF
5. EMER DEPRESS switch ..... ON
6. RAM AIR switch ..... ON

END

PACK LOOP FAIL (C)

1. AIR SOURCE switch ..... TRIM AIR ONLY
2. Altitude ..... 35,000 ft maximum
3. COCKPIT COLD–HOT knob (for cockpit & cabin) ..... As desired

On approach below 9000 ft but not below minimum safe altitude:

4. AIR SOURCE switch ..... OFF
5. EMER DEPRESS switch ..... ON
6. RAM AIR switch ..... ON

END

PACK TEMP HIGH (C)

On the ground:

1. AIR SOURCE switch ..... OFF

In flight:

1. AIR SOURCE switch ..... TRIM AIR ONLY
2. Altitude ..... 35,000 ft maximum
3. COCKPIT COLD–HOT knob (for cockpit & cabin) ..... As desired

AIR CONDITIONING & PRESSURIZATION

PACK TEMP HIGH (C) (Cont)

PACK TEMP HIGH remains on:

Yes

4. Descend to an altitude that will safely allow unpressurized flight.
5. AIR SOURCE switch ..... OFF
6. EMER DEPRESS switch ..... ON
7. RAM AIR switch ..... ON

– END –

No

On approach below 9000 ft but not below minimum safe altitude:

4. AIR SOURCE switch ..... OFF
5. EMER DEPRESS switch ..... ON
6. RAM AIR switch ..... ON

END

PAX OXYGEN AUTO FAIL (C)

1. PAX OXYGEN switch ..... DEPLOY

END

TRIM AIR FAIL (C)

1. AIR SOURCE switch ..... PACK ONLY
2. COCKPIT COLD–HOT knob (for cockpit & cabin) ..... As desired

END

TRIM AIR LOOP FAIL (C)

1. AIR SOURCE switch ..... PACK ONLY
2. COCKPIT COLD–HOT knob (for cockpit & cabin) ..... As desired

END

AIR CONDITIONING & PRESSURIZATION

XBLEED FAIL (C)

1. XBLEED switch ..... CYCLE

XBLEED valve is failed closed:

Yes

2. Crossbleed engine starts will not be possible. If necessary, conduct a windmilling start on the left engine, and a windmilling or APU assisted start on the right engine.

– END –

No

XBLEED valve is failed open:

2. L or R BLEED switch ..... OFF

END

AUTO FLIGHT

AFCS MESSAGES FAIL (C)

1. Autopilot ..... Disconnect and do not re–engage

END

AP HOLDING LWD (C)
AP HOLDING RWD (C)
AP HOLDING NOSE DOWN (C)
AP HOLDING NOSE UP (C)

WARNING: An abrupt change in control force, or an out of trim situation may be experienced when disconnecting the autopilot.

SMKG/BELTS should be selected on.

CAUTION: Minimize changes to airspeed and configuration to minimize control forces and out of trim situation.

1. Flight controls ..... Hold firmly
2. Autopilot ..... Use control wheel MSW switch to disconnect
3. Retrim aircraft if necessary.
4. Autopilot ..... As desired

END

AP STAB TRIM FAIL (C)

1. AP STAB TRIM FAIL PROCEDURE ..... Accomplish

   Refer to Chapter 3, EMERGENCY PROCEDURES, Auto Flight, AP STAB TRIM FAIL

END

FD MODE CHANGE (C)

1. Autothrottle (if installed) ..... Disengage
2. Flight director ..... Select the desired mode

END

AUTO FLIGHT

FD Failure

1. Flight Guidance Panel XFR switch ..... Select operative side

NOTE: Autothrottle (if installed) will disengage if coupled to the failed Flight Director. It can be re–engaged after XFR to the operative side.

2. If failure occurred on approach, select TO/GA and Go–Around if required.
3. Verify flight director modes are appropriate on XFR side.

NOTE: If a subsequent approach is an ILS, the failed side will not perform a NAV to NAV transfer. It is necessary to manually select the LOC as NAV source.

END

YAW DAMPER FAIL (C)

1. YD ..... Re–engage

If YAW DAMPER FAIL remains on:

2. Autopilot ..... Disconnect
3. **Do not** re–engage yaw damper.
4. Altitude ..... 31,000 ft maximum

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

END

AUTOPILOT DISCONNECT



Cavalry Charge

1. Control wheel MSW switch ..... Press to silence tone
2. Autopilot ..... Re–engage

If condition recurs:

3. Control wheel MSW switch ..... Press to silence tone
4. **Do not** re–engage autopilot.

END

AUXILIARY POWER UNIT

APU BLEED ALT LIMIT (C)

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... Off
4. R BLEED switch ..... ON

END

APU FUEL SOV FAIL (C)

If APU fuel SOV has failed to close when commanded closed:

APU is supplying bleed air for air conditioning

Yes

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... OFF
4. R BLEED switch ..... ON
5. APU switch ..... OFF

– END –

No

1. APU switch ..... OFF

END

APU OIL PRESS LOW (C)

APU is supplying bleed air for air conditioning

Yes

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... OFF
4. R BLEED switch ..... ON
5. APU switch ..... OFF

– END –

No

1. APU switch ..... OFF

END

AUXILIARY POWER UNIT

APU OIL TEMP HIGH (C)

APU is supplying bleed air for air conditioning

Yes

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... OFF
4. R BLEED switch ..... ON
5. APU switch ..... OFF

– END –

No

1. APU switch ..... OFF

END

APU OVERSPEED (C)

APU is supplying bleed air for air conditioning

Yes

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... OFF
4. R BLEED switch ..... ON
5. APU switch ..... OFF

– END –

No

1. APU switch ..... OFF

END

APU STARTER FAIL ON (C)

1. APU ..... Leave operating until after landing SHUTDOWN checks in the NORMAL PROCEDURES Chapter are performed.

END

AVIONICS

AIR DATA 1 (2) FAULT (C)

The airplane is above 29,000 ft.

Yes

1. AIR DATA REVERSION switch ..... Select operative side

NOTE: FLAPS FAULT (A), STAB TRIM FAULT (A), and L (R) ENG THRUST FAULT (A) CAS messages will be displayed due to loss of one ADC input.

2. Flight Guidance Panel XFR switch ..... Select same side as air data reversion

– END –

No

1. AIR DATA REVERSION switch ..... NORM

END

EFIS COMPARATOR INOP (C)

1. Affected flight instruments ..... Monitor
2. Integrated Standby Instrument ..... Use to cross–check

NOTE: If any of the following occurs, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed:

- Pitch attitude, thrust setting or external noise not consistent with indicated airspeed,
- Large airspeed differences between PFDs and/or ISI,
- Loss of multiple airspeed indications.

NOTE: If message is displayed during an LPV approach with indications of an air data or attitude/heading failure, refer to EMERGENCY PROCEDURES for IAS or ATT/HDG failure.

END

AVIONICS

EFIS MISCOMPARE (C)

If accompanied by ALT or IAS:

1. Altitude and airspeed ..... Cross check
2. AIR DATA REVERSION switch ..... Select operative side
3. Flight Guidance Panel XFR switch ..... Select same side as air data reversion

NOTE: If any of the following occurs, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed:

- Pitch attitude, thrust setting or external noise not consistent with indicated airspeed,
- Large airspeed differences between PFDs and/or ISI,
- Loss of multiple airspeed indications.

If accompanied by HDG, ROL or PIT, or ATT:

1. Autopilot ..... Disconnect

Accompanied by ROL or PIT, or ATT

Yes

2. Flight instruments and Integrated Standby Instrument ..... Cross check
3. Reversionary panel, ATT/HDG switch ..... Select to reliable alternate source

– END –

No

Accompanied by HDG

IRS 1(2) IN ATT status message displayed

Yes

2. FMS ..... Enter present airplane heading on the IRS CDU Control page

– END –

No

2. Flight instruments and Integrated Standby Instrument ..... Cross check
3. Reversionary panel, ATT/HDG switch ..... Select to reliable alternate source

– END –

If accompanied by LOC or GS:

1. Autopilot ..... Disconnect

AVIONICS

EFIS MISCOMPARE (C) (Cont)

2. Localizer and glideslope ..... Cross check
3. NAV SRC button ..... Select operative side

If accompanied by RA:

1. Autopilot ..... Disconnect

Effectivity:

If Autothrottle installed:

CAUTION: For an intermittent or undetected radio altimeter error or if the unreliable side is selected, arming of RETARD mode and retarding of thrust levers may occur early, late or not occur.

2. Autothrottle (if installed) ..... Disengage prior to 200 feet AGL
3. ROAAS (if installed) ..... OFF
4. Radio altitude ..... Cross check with barometric altimeter
5. Radio altimeter ..... Use reliable side

If accompanied by FD:

1. Autopilot ..... Disconnect
2. Autothrottle (if installed) ..... Disengage
3. Flight directors ..... Cross check
4. Flight Guidance Panel XFR switch ..... Select operative side

END

Inertial Reference System (IRS) Failure

NOTE: 1. If an IRS is in attitude mode, a heading drift rate of up to 15 deg/hr can occur. The FMS heading on the IRS CONTROL page should be updated periodically from the best available alternate navigation source.

2. Autothrottle (if installed) will disengage if coupled to the failed IRS. It can be re−engaged after XFR to the operative side.

1. ATT/HDG Reversion switch ..... Select operative side
2. Flight Guidance Panel XFR switch ..... Select same side as ATT/HDG reversion

CAUTION: PFD Flight Director Modes may not remain synchronized on some approaches.

3. If failure occurred on approach, select TO/GA and Go−Around if required.
4. Verify flight director modes are appropriate on XFR side.
5. Failed side FD ..... Off

AVIONICS

Inertial Reference System (IRS) Failure (Cont)

NOTE: 1. If a subsequent approach is an ILS, the failed side will not perform a NAV to NAV transfer. It is necessary to manually select the LOC as NAV source.

2. Selecting TO/GA will re–engage the flight director on both sides. If this occurs, it will be necessary to select the failed side FD off again.

END

Effectivity:

For airplanes 20595–22999 and airplanes incorporating SB 350–34–011.

XPDR 1 & 2 FAIL (C)

1. Contact ATC on radio.

END

Effectivity:

For airplanes 20501–20594 not incorporating SB 350–34–011.

XPDR 1 FAIL (C) and
XPDR 2 FAIL (C)

1. Contact ATC on radio.

END

Effectivity:

For airplanes 20595–22999 and airplanes incorporating SB 350–34–011.

XPDR 1(2) FAIL (C)

1. Select the alternate transponder.

NOTE: TCAS and ADS–B OUT will stop functioning until the alternate transponder is activated.

END

Effectivity:

For airplanes 20595–22999 and airplanes incorporating SB 350–34–011.

ADS–B OUT FAIL (C)

1. Contact ATC on radio.

END

AVIONICS

Effectivity:

For airplanes 20595–22999 and airplanes incorporating SB 350–34–011.

ADS–B OUT FAULT (C)

1. Select the alternate transponder.

END

L IAPS FAIL (C)

1. Autopilot ..... Check disconnected
2. Flight Guidance Panel XFR switch ..... Select FD2
3. TUNE REVERSION switch ..... CDU ONLY
4. LNDG ALT SOURCE SELECT FMS2

END

R IAPS FAIL (C)

1. Autopilot ..... Check disconnected
2. Flight Guidance Panel XFR switch ..... Select FD1
3. TUNE REVERSION switch ..... CDU ONLY
4. LNDG ALT SOURCE SELECT FMS1

END

PFD X–TALK FAIL (C)

1. Instruments ..... Cross check
2. Verify that the information is set (entered) on both display control panels.

END

AVIONICS

Air Data Computer (ADC) Failure – Single

1. AIR DATA Reversion switch ..... Select operative side
2. Flight Guidance Panel XFR switch ..... Select same side as air data reversion

CAUTION: PFD Flight Director Modes may not remain synchronized on some approaches.

NOTE: Autothrottle (if installed) will disengage if coupled to the failed ADC. It can be re–engaged after XFR to the operative side.

3. If failure occurred on approach, select TO/GA and Go–Around if required.
4. Verify flight director modes are appropriate on XFR side.
5. Failed side FD ..... Off

NOTE: 1. If a subsequent approach is an ILS, the failed side will not perform a NAV to NAV transfer. It is necessary to manually select the LOC as NAV source.

2. Selecting TO/GA will re–engage the flight director on both sides. If this occurs, it will be necessary to select the failed side FD off again.

NOTE: If any of the following occurs, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed:

- Pitch attitude, thrust setting or external noise not consistent with indicated airspeed,
- Large airspeed differences between PFDs and/or ISI,
- Loss of multiple airspeed indications.

END

Air Data Computer (ADC) Failure – Dual

1. Autothrottle (if installed) ..... Disengage
2. Maintain airplane control by reference to the standby airspeed/Mach and altitude.
3. Operative flight director modes will be PIT and ROL only.

NOTE: If any of the following occurs, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed:

- Pitch attitude, thrust setting or external noise not consistent with indicated airspeed,
- Large airspeed differences between PFDs and/or ISI,
- Loss of multiple airspeed indications.

END

AVIONICS

Audio System Failure

1. Affected audio NORM/EMER switch ..... EMER
2. Affected crew member ..... Use headset

END

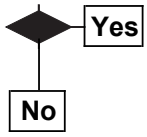
CDU Failure

1. TUNE REVERSION switch ..... MFD ONLY

END

Cursor Control Panel Failure

Is EICAS displayed on failed CCP side?



– END –

1. EICAS REVERSION switch ..... BOTH PFDs

END

DCU A and DCU B Failure

1. Autopilot ..... Disconnect
2. L and R HYDRAULIC PUMP switches ..... ON
3. Land as soon as practical.

END

Loss of EICAS

1. EICAS REVERSION switch ..... BOTH PFDs

END

MFD Failure

If a MFD fails (blank display, erratic display, or display of stale information), any information entered on the opposite MFD could be lost if the failed MFD comes back up.

1. Affected DISPLAYS REVERSION switch ..... PFD REV

or

1. TUNE REVERSION switch ..... CDU ONLY

NOTE: If more than one display has failed, it will be necessary to select TUNE REVERSION switch to CDU ONLY to regain tuning capability through the CDUs.

2. EICAS REVERSION switch ..... BOTH PFDs

END

AVIONICS

PFD Failure

1. Affected DISPLAYS REVERSION switch ..... MFD REV

NOTE: 1. If more than one display has failed, it will be necessary to select TUNE REVERSION switch to CDU ONLY to regain tuning capability through the CDUs.

2. Autothrottle (if installed) will disengage if coupled to the failed PFD. It can be re−engaged after MFD REV selected.

2. EICAS REVERSION switch ..... BOTH PFDs

END

Radio Tuning Failure

NOTE: 1. Note all frequencies being used prior to starting procedure.

2. During all steps of procedure, continue tuning and attempting communication even if the frequency is displayed in amber.

1. TUNE REVERSION switch ..... CDU ONLY
2. Use CDUs to retune radios as needed.

Radio tuning is restored:

Yes

No

– END –

3. TUNE REVERSION switch ..... MFD ONLY
4. Use DCP 1 and/or DCP 2 to retune radios as needed.

Radio tuning is restored:

Yes

No

– END –

5. LEFT DISPLAYS REVERSION switch ..... PFD REV
6. Use DCP 2 to retune radios as needed.

Radio tuning is restored:

Yes

No

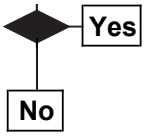
– END –

7. TUNE REVERSION switch ..... CDU ONLY
8. EICAS REVERSION switch ..... BOTH PFDs
9. RIGHT DISPLAYS REVERSION switch ..... PFD REV
10. Use CDUs to retune radios as needed.

AVIONICS

Radio Tuning Failure (Cont)

Radio tuning is restored:



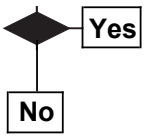
– END –

11. TUNE REVERSION switch ..... MFD ONLY

NOTE: Autothrottle (if installed) will disengage when DISPLAY REVERSION switch is selected back to NORM, but can be re–engaged after display is repowered.

12. LEFT DISPLAYS REVERSION switch ..... NORM
13. Use DCP 1 to retune radios as needed.

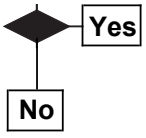
Radio tuning is restored:



– END –

14. LEFT DISPLAYS REVERSION switch ..... PFD REV
15. TUNE REVERSION switch ..... CDU ONLY
16. CB2–A4 (CDU 2) ..... Pull
17. Use CDU 1 to retune left hand radios as needed.

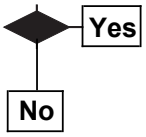
Radio tuning is restored:



– END –

18. CB2–A4 (CDU 2) ..... Reset
19. CB1–A4 (CDU 1) ..... Pull
20. Use CDU 2 to retune right hand radios as needed.

Radio tuning is restored:



– END –

21. CB1–A4 (CDU 1) ..... Reset

NOTE: Autothrottle (if installed) will disengage when DISPLAY REVERSION switch is selected back to NORM, but can be re–engaged after display is repowered.

22. LEFT DISPLAYS REVERSION switch ..... NORM
23. RIGHT DISPLAYS REVERSION switch ..... NORM

AVIONICS

Radio Tuning Failure (Cont)

24. EICAS REVERSION switch ..... LEFT MFD
25. TUNE REVERSION switch 121.50

NOTE: If 8.33 KHz channel spacing was previously tuned on VHF1, the emergency frequency (121.50) may be displayed in amber. The amber display does not prevent VHF from operating normally on this frequency.

END

FSU INOP on MFD

Airplanes equipped with Dual IFIS:

Is EICAS displayed on failed FSU side?

Yes

– END –

No

1. EICAS REVERSION switch ..... BOTH PFDs

END

TAWS Aurals



TAWS Aurals

"SINK RATE, SINK RATE"

1. Descent rate ..... Reduce

– END –

"TERRAIN, TERRAIN" or
"DON'T SINK, DON'T SINK" or
"TOO LOW, TERRAIN" or
"CAUTION TERRAIN, CAUTION TERRAIN" or
"CAUTION OBSTACLE, CAUTION OBSTACLE"

1. Establish a positive rate of climb.

– END –

"TOO LOW GEAR"

There is adequate time to extend gear:

Yes

1. GEAR switch ..... DN

– END –

No

AVIONICS

TAWS Aurals (Cont)

1. Execute a go–around.

– END –

"TOO LOW FLAPS"

1. FLAPS lever 30

– END –

"GLIDESLOPE"

1. Fly airplane up to glideslope.

– END –

"CAUTION WINDSHEAR"

During final approach:

1. Add wind and gust allowances to the approach speed. Increase thrust as necessary.
2. Avoid getting low on the approach glidepath or letting the thrust levers remain at idle for extended periods of time.

– END –

During takeoff:

1. Thrust levers ..... TO
2. Airspeed ..... V_2 + 10, until safe climbout is assured.

END

ROAAS (If Installed)

RWY LENGTH (Amber annunciation on PFD)  **"RUNWAY LENGTH"**

Can occur during final approach between 450 and 200 feet above runway elevation:

1. Current predicted landing distance exceeds runway length available.
2. Consider a go–around.
3. If condition persists at 200 feet above runway elevation, a ROAAS warning will be issued

– END –

AVIONICS

RWY LENGTH (Amber annunciation on PFD) (Cont)

DECELERATE (Amber annunciation on PFD)  **"DECELERATE"**

Can occur during landing rollout:

1. Current predicted stopping point is approaching the end of the runway.
2. Increase deceleration to avoid a ROAAS Warning.

END

Loss of Navigation Mode – Remote / Oceanic Airspace

If GNSS is used as sole means of navigation

and

following messages are shown on the PFD:

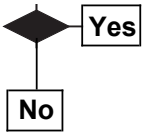
FMS DR

or

DR EXCEEDS 5 MIN

1. Pull and reset GPS circuit breakers (CB1–A3 & CB2–A3).

Within approximately 60 seconds, following messages are not shown on the PFD: FMS DR and DR EXCEEDS 5 MIN



– END –

After approximately 60 seconds, following messages remain shown on the PFD: FMS DR or DR EXCEEDS 5 MIN

2. Notify the controlling agency.

END

DOORS

AFT EQPT BAY DOOR (C)

1. Avoid slips or skids that could open the door.

END

BATTERY BAY DOOR (C)

1. Avoid slips or skids that could open the door.

END

CARGO DOOR (C)

1. SMKG/BELTS switch ..... BELTS
2. Cabin Altitude ..... Monitor

WARNING: **Do not approach door.** Door failure may be indicated by a loud noise, pressurization leak, or rumble emanating from the hatch area.

END

EMERGENCY EXIT (C)

1. SMKG/BELTS switch ..... BELTS
2. Cabin Altitude ..... Monitor

WARNING: **Do not approach exit.** Exit failure may be indicated by a loud noise, pressurization leak, or rumble emanating from the hatch area.

END

PASSENGER DOOR (C)

WARNING: **Do not approach door.** Door failure may be indicated by a loud noise, pressurization leak, or rumble emanating from the door area.

1. SMKG/BELTS switch ..... SMKG/BELTS
2. EMER DEPRESS switch ..... ON
   The cabin altitude will climb to approximately 15,000 feet and stabilize.
3. Airspeed ..... 250 KIAS maximum
4. Establish descent to reduce cabin delta pressure, but not lower than the minimum safe altitude.
5. Land as soon as possible.

END

ELECTRICAL

APU GEN FAIL (C)

NOTE: Should electrical system indication be flickering, cycling intermittently or behaving unexpectedly, accomplish the "Unexpected electrical indications" procedure at page 05–19–6.

1. APU GEN switch ..... ON

If APU GEN FAIL CAS remains on:

2. Do not attempt a second reset of the APU GEN switch.

END

APU GEN OVERLOAD (C)

1. Electrical load ..... Reduce

END

L (R) BATT FAIL (C)

NOTE: Should electrical system indication be flickering, cycling intermittently or behaving unexpectedly, accomplish the "Unexpected electrical indications" procedure at page 05–19–6.

If L (R) ESS BUS FAIL (C) is also displayed:

Yes

1. Affected BATT switch ..... OFF

– END –

No

1. Affected BATT switch ..... Verify OFF
2. Affected BATT temperature ..... Monitor

If BATT TEMP decreases below 60 °C:

3. Applicable BATT switch ..... On

END

ELEC HYD GEN FAIL (C)

The hydraulic generator has failed to come on–line:

1. HYD GEN ..... OFF

END

ELECTRICAL FAULT (C)

NOTE: Should electrical system indication be flickering, cycling intermittently or behaving unexpectedly, accomplish the "Unexpected electrical indications" procedure at page 05–19–6.

1. Land as soon as practical.

END

ELECTRICAL

L (R) ESS BUS FAIL (C)

1. Land as soon as practical.

If L ESS BUS FAIL CAS is displayed:

Yes

2. LEFT DISPLAYS REVERSION switch ..... PFD REV
3. ATT/HDG REVERSION switch 2
4. AIR DATA REVERSION switch 2
5. Autopilot ..... Disconnect
6. Flight Guidance Panel XFR switch ..... Select FD2
7. AIR SOURCE switch ..... TRIM AIR ONLY
8. L BLEED switch ..... OFF
9. XBLEED switch ..... Closed
10. WING SOURCE switch ..... FROM R
11. Leave icing conditions as soon as possible.
12. Altitude ..... 31,000 ft maximum
13. If less than 60 minutes has elapsed from takeoff ..... Operate with landing gear extended for 15 minutes prior to landing (to ensure cool brakes).
14. Final Approach Speed ..... V_{REF} + 10
15. Normal actual landing distance ..... Multiply by 1.75

NOTE: – The STBY probe will not be anti–iced.

– The applicable procedures for the following CAS messages are consolidated within this procedure and do not need to be conducted separately:

L WING ANTI–ICE FAIL (C), STALL PROTECT FAIL (C), INBD BRAKES FAIL (C)

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW or when landing at an airport pressure altitude of 4000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

CAUTION: Reducing weight below MLW or landing at an alternate airport shall only be attempted at pilot discretion and only if this can be achieved in a safe manner and within a reasonable time period.

16. ROAAS (if installed) ..... As required

ELECTRICAL

L (R) ESS BUS FAIL (C) (Cont)

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

– END –

No

If R ESS BUS FAIL CAS is displayed:

2. WING SOURCE switch ..... FROM L
3. Flight Guidance Panel XFR switch ..... Select FD1
4. Autopilot ..... Disconnect
5. Altitude ..... 31,000 ft maximum
6. If less than 60 minutes has elapsed from takeoff ..... Operate with landing gear extended for 15 minutes prior to landing (to ensure cool brakes).
7. Final Approach Speed ..... V_{REF} +10
8. Normal actual landing distance ..... Multiply by 1.75

NOTE: The applicable procedures for the following CAS messages are consolidated within this procedure and do not need to be conducted separately:

OUTBD BRAKES FAIL (C), STBY PITOT HEAT FAIL (C), *STALL PUSHER OFF (C) – *Not applicable to EASA registered aircraft.

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW or when landing at an airport pressure altitude of 4000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

CAUTION: Reducing weight below MLW or landing at an alternate airport shall only be attempted at pilot discretion and only if this can be achieved in a safe manner and within a reasonable time period.

9. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

ELECTRICAL

L (R) GEN FAIL (C)

NOTE: Should electrical system indication be flickering, cycling intermittently or behaving unexpectedly, accomplish the "Unexpected electrical indications" procedure at page 05–19–6.

If L (R) MAIN BUS FAIL (C) is also displayed:

Yes

1. Affected GEN switch ..... OFF

– END –

No

1. Affected GEN switch ..... On

If GEN FAIL CAS remains on:

2. Do not attempt a second reset of the GEN switch.

END

L (R) GEN OVERLOAD (C)

1. Affected electrical load ..... Reduce

END

L (R) MAIN BUS FAIL (C)

1. Land as soon as practical.

If L MAIN BUS FAIL CAS is displayed:

Yes

2. LEFT DISPLAYS REVERSION switch ..... MFD REV

NOTE: MFD control panel will not control the MFD when reverted. Use display control panel.

3. AIR DATA REVERSION switch 2
4. Autopilot ..... Disconnect
5. Airspeed ..... 0.75 M_I/250 KIAS maximum
6. STAB TRIM switch ..... SEC

NOTE: The autopilot, MACH trim, and configuration trim will be inoperative with SEC STAB TRIM selected.

7. Altitude ..... 31,000 ft maximum
8. Leave icing conditions as soon as possible.
9. Final Approach Speed ..... V_{REF} + 10
10. Normal actual landing distance ..... Multiply by:
    1.40 without thrust reversers
    1.30 with thrust reversers

ELECTRICAL

L (R) MAIN BUS FAIL (C) (Cont)

NOTE: The applicable procedures for the following CAS messages are consolidated within this procedure and do not need to be conducted separately:

STALL PROTECT FAIL (C), L PITOT HEAT FAIL (C), L (R) AUX BUS OFF (A).

11. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

– END –

No

If R MAIN BUS FAIL CAS is displayed:

2. Autopilot ..... Disconnect
3. Autothrottle (if installed) ..... Disengage
4. AIR SOURCE switch ..... PACK ONLY
5. R BLEED switch ..... OFF
6. XBLEED switch ..... Closed
7. WING SOURCE switch ..... FROM L
8. EMER LTS switch ..... OFF
9. Altitude ..... 31,000 ft maximum
10. Leave icing conditions as soon as possible.
11. Final Approach Speed ..... V_{REF} + 10
12. Normal actual landing distance ..... Multiply by:
    1.40 without thrust reversers
    1.30 with thrust reversers
13. EMER LTS switch ..... ON, when on final approach

NOTE: The applicable procedures for the following CAS messages are consolidated within this procedure and do not need to be conducted separately:

R WING ANTI–ICE FAIL (C), STALL PROTECT FAIL (C), R PITOT HEAT FAIL (C), L (R) AUX BUS OFF (A).

END

ELECTRICAL

Unexpected Electrical Indications

CAUTION: Any reset action may turn the affected source off–line, possibly worsening the situation.

NOTE: Indications may include flickering or incorrect switch annunciations, unexpected or multiple electrical system CAS messages (GEN FAIL, BATT FAIL, ELECTRICAL FAULT, GEN OFF, BATT OFF), partial loss of displays.

Apparent loss of electrical power

Yes

1. Electrical synoptic ..... Check generator digital indications

L(R) GEN indicates 0 amps

Yes

2. L(R) GEN ..... ON
3. Land as soon as practical.

– END –

No

At 30,000 ft and below:

2. APU switch ..... START and release
3. APU GEN ..... Check amps greater than 0
4. Land as soon as practical.

– END –

No

1. Land as soon as practical.

END

FIRE PROTECTION

APU FIRE DET FAIL (C)

APU Shutdown:

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... Off
4. R BLEED switch ..... ON
5. APU switch ..... OFF

END

CARGO SMOKE DET FAIL (C)

1. Doors between the cabin and the baggage compartment ..... Open

END

L (R) FIRE DET FAIL (C)

1. Associated engine indications ..... Monitor

END

FIRE SYS FAULT (C)

1. FIRE DET ..... TEST

NOTE: Release the FIRE DET press–to–test after 3 seconds maximum or when the FIRE SYS IN TEST (S) message illuminates.

All of the following CAS messages come on:

L (R) ENG FIRE, APU FIRE, GEAR BAY OVHT, CARGO SMOKE

Yes

2. Continue flight.

– END –

No

One of the following CAS messages comes on:

APU FIRE DET FAIL (C), CARGO SMOKE DET FAIL (C), L (R) FIRE DET FAIL (C), FIREX APU SQUIB FAIL (C), GEAR BAY DET FAIL (C), FIREX BTL 1 (2) FAULT (A).

2. Refer to the appropriate displayed CAS message.

END

FIRE PROTECTION

FIREX APU SQUIB FAIL (C)

APU Shutdown:

1. XBLEED switch ..... Closed
2. L BLEED switch ..... ON
3. APU BLEED switch ..... Off
4. R BLEED switch ..... ON
5. APU switch ..... OFF

END

GEAR BAY DET FAIL (C)

The CAS displays within 5 minutes of takeoff:

Yes

1. Airspeed ..... 250 KIAS maximum
2. LANDING GEAR switch ..... DN

After 5 minutes:

3. LANDING GEAR switch ..... UP

– END –

No

1. Continue flight.

END

FLIGHT CONTROLS

ELEVATOR SPLIT (C)

1. Airspeed ..... Reduce to speed at which message clears, or 200 kts maximum, whichever is greater.

NOTE:
- Avoid excessive elevator input.
- Use pitch trim as necessary to minimize elevator deflection.
- Use aileron control as necessary to stabilize the aircraft.

END

FLAPS FAIL (C)

CAUTION: If a STALL PROTECT FAULT (A) message is displayed in conjunction with a FLAPS FAIL (C), and flaps are not at 30, the Low Speed Awareness Cue will indicate too high. This is an indication error only. Using the final approach speed per step 10 of this procedure will provide adequate stall warning margin.

If flaps fail at any angle other than 30, divert to a suitable landing field with a glidepath angle of 3.5 degrees or less.

Descent checks:

1. Pressurization ..... LNDG ALT set
2. WING ANTI–ICE switch ..... As required
3. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) checks:

4. Altimeters ..... Set
5. L and R LANDING light switches ..... On
6. Passenger Brief/Cabin Check ..... Complete
7. SMKG/BELTS switch ..... SMKG/BELTS
8. Fuel quantities and balance ..... Check

Approach checks:

9. APU and Bleeds ..... Set
10. Final approach speed ..... As listed for flaps attained:
    - Flaps 0 ..... V_{REF} + 20
    - Flaps 10 ..... V_{REF} + 15
    - Flaps 20 ..... V_{REF} + 5
    - Flaps 30 ..... V_{REF}

FLIGHT CONTROLS

FLAPS FAIL (C) (Cont)

When combined with SPOILERS FAIL (C):

Flaps 0 ..... V_{REF} + 25
Flaps 10 ..... V_{REF} + 20
Flaps 20 ..... V_{REF} + 10
Flaps 30 ..... V_{REF} + 5

NOTE: Use the lesser flap deflection V_{REF} speed increment and distance factor for flap settings between the detent values.

11. Normal actual landing distance ..... Multiply by:

FLAPS	WITH TR	WITHOUT TR
0	1.40	1.45
10	1.30	1.35
20	1.20	1.25

When combined with SPOILERS FAIL (C):

FLAPS	WITH TR	WITHOUT TR
0	1.65	1.85
10	1.60	1.85
20	1.50	1.75
30	1.45	1.65

12. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL if FLAPS are not at 30 degrees. AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

FLIGHT CONTROLS

FLAPS FAIL (C) (Cont)

13. FLAPS TAWS WARN ..... OFF
14. Approach setup and crew briefing ..... Complete
15. RA MIN or BARO MIN ..... Set
16. MIN ALERT ..... Set
17. L and R HYDRAULIC PUMP switches ..... ON

Before Landing checks:

18. LANDING GEAR switch ..... DN
19. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
20. Autothrottle (if installed) ..... Disengage prior to 200 feet AGL

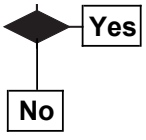
END

FLAPS FAULT (C)

1. Airspeed ..... Decrease
2. FLAPS ..... Select the previous detent, then select a detent to agree with the closest flap position.

NOTE: Trying to reset the flaps with the flap handle three times will result in a FLAPS FAIL (C) if the condition has not cleared. Ensure that all hydraulics are operating prior to resetting the flaps the third time.

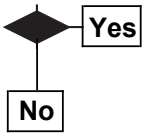
FLAPS FAULT (C) message clears:



– END –

3. ALTN FLAPS switch ..... ON
4. FLAPS selector ..... Select the previous detent, then select a detent to agree with the closest flap position.

FLAPS FAULT (C) message clears:



– END –

5. Refer to Flaps Fail procedure, this section.

END

FLIGHT CONTROLS

FLAPS NORM PRESS LOW (C)

1. ALTN FLAPS switch ..... ON
2. FLAPS ..... As desired

END

FLT SPOILERS DEPLOY (C)

1. FLIGHT SPOILERS lever ..... RET

END

FLT SPOILERS FAIL (C)

1. Altitude ..... 41,000 ft maximum
2. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.15 with thrust reversers
3. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

FLT SPOILERS FAULT (C)

1. Altitude ..... 41,000 ft maximum
2. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.15 with thrust reversers
3. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

FLIGHT CONTROLS

GND SPLRS NOT ARMED (C)

1. GROUND SPOILERS switch ..... MANUAL ARM

If GND SPLRS NOT ARMED (C) remains on:

2. Normal actual landing distance ..... Multiply by:
   1.60 without thrust reversers
   1.50 with thrust reversers
3. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

After touchdown:

4. FLIGHT SPOILERS lever ..... EMER

END

GND SPOILERS FAIL (C)

1. GROUND SPOILERS switch ..... OFF
2. Normal actual landing distance ..... Multiply by:
   1.60 without thrust reversers
   1.50 with thrust reversers
3. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

After touchdown:

4. FLIGHT SPOILERS lever ..... EMER

END

MACH TRIM FAIL (C)

1. Airspeed:

   with AP engaged ..... M_{MO}/V_{MO} maximum

   with AP disengaged ..... 0.75 M_I/250 KIAS maximum

END

FLIGHT CONTROLS

PRI STAB TRIM FAIL (C)

WARNING:
- If autopilot is engaged, an abrupt change in control force up to approximately 50 lbs, or an out of trim situation may be experienced when disconnecting the autopilot, or when selecting STAB TRIM switch to SEC.
- SMKG/BELTS should be selected on.
- Minimize changes to airspeed and configuration to minimize control forces and out of trim situation.

1. Flight Controls ..... Hold firmly
2. STAB TRIM switch ..... SEC

NOTE: The autopilot, MACH trim, and configuration trim will be inoperative with SEC STAB TRIM selected.

3. Control Wheel Trim switch ..... Operate as required to maintain trim
4. Airspeed ..... 0.75 M_I/250 KIAS maximum

Stab trim is operative in both directions:

Yes

5. Control Wheel Trim switch ..... Operate as required to maintain trim

– END –

No

5. STAB TRIM switch ..... OFF

If elevator PULL force is encountered and / or stabilizer jams during a high speed condition:

Yes

6. Delay further reduction of airspeed as long as possible to minimize the time out of trim.
7. Move C.G. aft if possible.

– END –

No

If Elevator PUSH force is encountered and / or stabilizer jams during a low speed condition:

6. Do not increase airspeed to minimize the out of trim conditions.
7. Move C.G. forward if possible.
8. Land as soon as possible to minimize aft C.G. movement.

Descent checks:

9. Pressurization ..... LNDG ALT set
10. WING ANTI–ICE switch ..... As required

FLIGHT CONTROLS

PRI STAB TRIM FAIL (C) (Cont)

11. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

12. Altimeters ..... Set
13. L and R LANDING light switches ..... On
14. Passenger brief/cabin check ..... Complete
15. SMKG/BELTS switch ..... SMKG/BELTS
16. Fuel quantities and balance ..... Check

Approach checks:

17. APU and BLEEDS ..... Set
18. Final approach speed ..... V_{REF}
19. Normal actual landing distance ..... Multiply by:
    1.15 without thrust reversers
    1.10 with thrust reversers
20. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

21. Approach setup and crew briefing ..... Complete
22. RA MIN or BARO MIN ..... Set
23. MIN ALERT ..... Set
24. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks:

25. LANDING GEAR switch ..... DN
26. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
27. FLAPS 30

END

FLIGHT CONTROLS

ROLL SPOILERS FAIL (C)

NOTE: The presence of SPOILERS FAULT (C) in addition to ROLL SPOILERS FAIL (C) may indicate a jammed spoiler surface. Disregard the SPOILERS FAULT (C) message.

Is any spoiler panel jammed in an extended position?

Yes

1. Autopilot ..... Disconnect
2. Aileron Trim ..... As required to minimize roll force
3. Altitude ..... 41,000 ft maximum
4. Land as soon as possible.
5. FLAPS 20
6. Final approach speed ..... V_{REF} + 18
7. Normal actual landing distance ..... Multiply by:
   1.65 without thrust reversers
   1.50 with thrust reversers

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL if FLAPS are not at 30 degrees, AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

8. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

9. Autothrottle (if installed) ..... Disengage Prior to 200 feet AGL
10. FLAPS TAWS WARN ..... OFF

– END –

No

1. FLAPS 30
2. Final approach speed ..... V_{REF} + 5

FLIGHT CONTROLS

ROLL SPOILERS FAIL (C) (Cont)

3. Normal actual landing distance ..... Multiply by:
   1.20 without thrust reversers
   1.15 with thrust reversers

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

4. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

ROLL SPOILERS FAULT (C)

1. Normal actual landing distance ..... Multiply by:
   1.15 without thrust reversers
   1.10 with thrust reversers

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

2. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

ROLL SPOILERS OFF (C)

1. ROLL SPOILERS switch ..... On

END

RUDDER LIMITER FAIL (C)

1. Avoid excessive rudder inputs.
2. Airspeed ..... 185 KIAS maximum

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

END

FLIGHT CONTROLS

SEC STAB TRIM FAIL (C)

PRI STAB TRIM FAIL is displayed:

Yes

1. Refer to Pri Stab Trim Fail procedure, this section.

– END –

No

1. STAB TRIM switch ..... PRI

END

SPOILERS FAIL (C)

1. FLIGHT SPOILERS lever ..... RET
2. Altitude ..... 41,000 ft maximum

Is any spoiler panel jammed in an extended position?

Yes

3. Autopilot ..... Disconnect
4. Aileron Trim ..... As required to minimize roll force
5. Land as soon as possible.
6. FLAPS 20
7. Final approach speed ..... V_{REF} + 18
8. Normal actual landing distance ..... Multiply by:
   2.0 without thrust reversers
   1.65 with thrust reversers

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL if FLAPS are not at 30 degrees, AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

9. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

FLIGHT CONTROLS

SPOILERS FAIL (C) (Cont)

10. Autothrottle (if installed) ..... Disengage
    Prior to 200 feet AGL
11. FLAPS TAWS WARN ..... OFF

– END –

No

3. FLAPS 30
4. Final approach speed ..... V_{REF} + 5
5. Normal actual landing distance ..... Multiply by:
   1.65 without thrust reversers
   1.45 with thrust reversers

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

6. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

SPOILERS FAULT (C)

CAUTION: If SPOILERS FAULT (C) is displayed intermittently, conduct the procedure in its entirety. The SPOILERS FAULT (C) may be displayed in conjunction with SPOILERS FAULT (A) and STAB TRIM FAULT (A).

NOTE: Monitor CAS messages for any potential new CAUTION/ADVISORY messages.

1. Altitude ..... 41,000 ft maximum

Is any spoiler panel jammed in an extended position?

Yes

2. Autopilot ..... Disconnect
3. Aileron Trim ..... As required to minimize roll force
4. Land as soon as possible.
5. FLAPS 20
6. Final approach speed ..... V_{REF} + 13

FLIGHT CONTROLS

SPOILERS FAULT (C) (Cont)

7. Normal actual landing distance ..... Multiply by:
   1.55 without thrust reversers
   1.40 with thrust reversers

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL if FLAPS are not at 30 degrees, AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

8. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

9. Autothrottle (if installed) ..... Disengage
   Prior to 200 feet AGL
10. FLAPS TAWS WARN ..... OFF

– END –

No

2. FLAPS 30
3. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.15 with thrust reversers

NOTE: Landing on a wide runway of sufficient length with minimum turbulence and crosswind is recommended.

4. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

FLIGHT CONTROLS

STALL PROTECT FAIL (C)

1. STALL PUSHER switch ..... OFF
2. Final approach speed ..... V_{REF} + 10
3. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.20 with thrust reversers
4. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

* STALL PUSHER OFF (C)

* (Not applicable to EASA registered aircraft)

1. MSW disconnect button ..... Release

STALL PUSHER OFF remains on:

Yes

2. Final approach speed ..... V_{REF} + 10
3. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.20 with thrust reversers
4. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

– END –

No

END

FLIGHT CONTROLS

Flight Spoiler Lever Jam

1. Altitude ..... 41,000 ft maximum

If the spoiler lever is jammed in an extended position:

1. Final approach apeed ..... V_{REF} + 8
2. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.20 with thrust reversers
3. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

Roll Trim Malfunction

Roll trim unresponsive in one or both directions, trim moving slower than normal or inconsistently, trim moving opposite to command.

CAUTION:
1. Use caution in trimming and be aware that with a failed pilot trim switch, copilot trim inputs regardless of direction may cause the trim to move opposite to the desired direction, worsening the situation.
2. If uncommanded trim motion occurs with no trim switch operation, refer immediately to Chapter 3, EMERGENCY PROCEDURES, FLIGHT CONTROLS, Roll and Yaw Axis Uncommanded Motion.

1. Retrim airplane ..... Monitor closely the direction of trim movement

If movement is not in the desired direction:

Problem identified when using pilot trim switch

Yes

2. Pilot's master disconnect switch ..... Depress
3. Master disconnect switch and Pilot's trim switch ..... Release
4. **Do not** use pilot trim switch in either pitch or roll.
5. Use copilot's trim switch to trim the aircraft.

FLIGHT CONTROLS

Roll Trim Malfunction (Cont)

6. If roll trim operation is or becomes unsatisfactory, discontinue trimming, and pull AIL TRIM CB2 B15; hold out of trim forces and land as soon as practical.

– END –

No

(Copilot's trim switch malfunction)

2. Copilot's master disconnect switch ..... Depress
3. Master disconnect switch and Copilot's trim switch ..... Release
4. **Do not** use copilot trim switch in either pitch or roll.
5. Use pilot's trim switch to trim the aircraft.
6. If roll trim operation is or becomes unsatisfactory, discontinue trimming, and pull AIL TRIM CB2 B15; hold out of trim forces and land as soon as practical.

END

Stabilizer Trim Malfunction

Stabilizer trim unresponsive to pilot or copilot trim commands in one or both directions, trim moving slower than normal or inconsistently, trim moving opposite to command.

May be accompanied by STAB TRIM FAULT (A)

WARNING:
1. Use caution in trimming and be aware that with a failed pilot trim switch, copilot trim inputs regardless of direction may cause the trim to move opposite to the desired direction, worsening the situation.
2. If uncommanded trim motion occurs with no trim switch operation, refer immediately to Chapter 3, EMERGENCY PROCEDURES, FLIGHT CONTROLS, Pitch Axis Uncommanded Motion.

1. Retrim airplane ..... Monitor closely the direction of trim movement

If movement is not in the desired direction:

Problem identified when using pilot trim switch

Yes

2. Pilot's master disconnect switch ..... Depress
3. Master disconnect switch and Pilot's trim switch ..... Release
4. **Do not** use pilot trim switch in either pitch or roll.

FLIGHT CONTROLS

Stabilizer Trim Malfunction (Cont)

5. Avoid changing aircraft flap configuration or significantly changing speed.
6. Wait 3 minutes without trimming.

NOTE: 1. Waiting 3 minutes with no trim inputs by either pilot may allow the system to identify a faulty trim switch and disregard inputs from that switch, allowing control to be regained through the operative side.

2. If the failure is intermittent, the malfunction may reoccur.

7. Use copilot trim switch to trim the aircraft.

NOTE: Once aircraft is in–trim, engaging the autopilot will relieve the need for further trim switch operations and reduce the likelihood of unexpected trim responses.

8. If manual trim operation is or becomes unsatisfactory, discontinue trimming, set STAB TRIM switch to OFF, hold out of trim forces and land as soon as practical.

– END –

No

(Copilot's trim switch malfunction)

2. Copilot's master disconnect switch ..... Depress
3. Master disconnect switch and Copilot's trim switch ..... Release
4. **Do not** use copilot trim switch in either pitch or roll.
5. Use pilot's trim switch to trim the aircraft.
6. If trim operation is or becomes unsatisfactory, discontinue trimming, set STAB TRIM switch to OFF, hold out of trim forces and land as soon as practical.

END

FUEL

L (R) FUEL COLLECTOR LOW (C)

1. Affected FUEL PUMP switch ..... ON
2. Sideslip ..... Minimize
3. Land as soon as possible.

END

L (R) FUEL EJECTOR FAIL (C)

Is fuel leak evident? (fuel imbalance developing, or abnormally fast fuel depletion from one side):

Yes

1. Affected engine ..... Shutdown,

   refer to Engine Shutdown In Flight procedure in the NON–NORMAL PROCEDURES chapter.

– END –

No

END

FUEL IMBALANCE (C)

1. Fuel quantities ..... Check

CAUTION:
- Do not taxi until imbalance is rectified.
- Do not land until imbalance is rectified, unless a greater emergency exists.

Correct fuel distribution, if required:

2. FUEL XFER switch ..... Open
3. L or R FUEL PUMP switch (heavy wing) ..... ON
4. Monitor wing fuel quantity.

When fuel balance is achieved:

5. L or R FUEL PUMP switch ..... AUTO
6. FUEL XFER switch ..... Close

END

FUEL

L (R) FUEL PRESSURE LOW (C)

1. Affected FUEL PUMP switch ..... ON

FUEL PRESS LOW CAS remains on:

2. Affected thrust lever ..... Reduce to minimum practical setting
3. Maintain 18,500 ft or below to enable suction feed.

END

L (R) FUEL PUMP FAIL (C)

To balance fuel (if required) :

1. GRAVITY XFLOW switch ..... Open

NOTE: It may be necessary to use a sideslip to transfer fuel.

END

FUEL QUANTITY FAIL (C)

1. Monitor fuel quantity on the FMS.

END

FUEL QUANTITY LOW (C)

1. Fuel quantities ..... Check
2. L and R FUEL PUMP switches ..... ON
3. Land as soon as possible. A go–around is not recommended.

END

WING FUEL TEMP LOW (C)

1. Descend to a warmer ambient temperature.

END

HYDRAULICS

AUX HYD TEMP HIGH (C)

1. AUX HYDRAULIC PUMP switch ..... OFF

If temperature continues to rise:

2. AUX DC PUMP circuit breaker (CB1 D10) ..... Pull
3. Land as soon as practical.

END

L (R) HYD PRESS LOW (C)

1. Autopilot ..... Disconnect
2. Affected hydraulic pump switch ..... OFF
3. Affected HYDRAULIC SOV switch ..... CLOSED
4. Altitude ..... 41,000 ft maximum
5. Land as soon as practical.

Descent checks:

1. Pressurization ..... LNDG ALT set
2. WING ANTI–ICE switch ..... As required
3. L and R ENG ANTI–ICE switches ..... As required

Transition level (or FL 180) checks:

4. Altimeters ..... Set
5. L and R LANDING light switches ..... On
6. Passenger brief/cabin check ..... Complete
7. SMKG/BELTS switch ..... SMKG/BELTS
8. Fuel quantities and balance ..... Check

Approach checks:

9. APU and bleeds ..... Set

L HYD PRESS LOW is displayed:

Yes

10. Final approach speed ..... V_{REF}
11. Normal actual landing distance ..... Multiply by:
    1.40 without thrust reversers
    1.35 with thrust reversers

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW and when landing at an airport pressure altitude of 4000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

CAUTION: Reducing weight below MLW or landing at an alternate airport shall only be attempted at pilot discretion and only if this can be achieved in a safe manner and within a reasonable time period.

HYDRAULICS

L (R) HYD PRESS LOW (C) (Cont)

12. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

13. Approach setup and crew briefing ..... Complete
14. RA MIN or BARO MIN ..... Set
15. MIN ALERT ..... Set
16. R HYDRAULIC PUMP switch ..... AUTO

Before landing checks:

17. LANDING GEAR switch ..... DN

CAUTION: Do not push PUSH TO STOW button while pulling handle.

18. LG PULL handle ..... PULL

NOTE: Performing a sideslip to each side may help achieve MLG downlock. Increased airspeed may be required to ensure downlock during sideslip.

19. GEAR Indication ..... Check for three green DN indications.

CAUTION: Do not stow the handle until the gear pins are installed.

20. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
21. FLAPS 30
22. NWS switch ..... OFF
    Maintain directional control using differential braking.

After touchdown:

23. Limit reverse thrust on the right side as required to maintain directional control.

NOTE: Do not deploy the left thrust reverser.

– END –

No

R HYD PRESS LOW is displayed:

10. Final approach speed ..... V_{REF}
11. Normal actual landing distance ..... Multiply by:
    1.40 without thrust reversers
    1.35 with thrust reversers

HYDRAULICS

L (R) HYD PRESS LOW (C) (Cont)

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW and when landing at an airport pressure altitude of 4000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

CAUTION: Reducing weight below MLW or landing at an alternate airport shall only be attempted at pilot discretion and only if this can be achieved in a safe manner and within a reasonable time period.

12. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

13. ALTN FLAPS ..... ON
14. Approach setup and crew briefing ..... Complete
15. RA MIN or BARO MIN ..... Set
16. MIN ALERT ..... Set
17. L HYDRAULIC PUMP switch ..... AUTO

Before landing checks:

18. LANDING GEAR switch ..... DN
19. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
20. FLAPS selector 30

After touchdown:

21. Limit reverse thrust on left side as required to maintain directional control.

NOTE: Do not deploy the right thrust reverser.

END

HYDRAULICS

HYD PTU FAIL (C)

1. HYDRAULIC quantity for both systems ..... Check

Quantities are normal:

Yes

2. PTU switch ..... ON

– END –

No

Either quantity goes low or the message persists:

2. PTU switch ..... OFF

END

L (R) HYD SOV FAIL (C)

1. Affected SOV switch ..... Check proper position

END

L (R) HYD TEMP HIGH (C)

1. Affected HYDRAULIC PUMP switch ..... OFF
2. Affected HYDRAULIC temperature ..... Monitor

Hydraulic temperature reaches 135 °C:

Yes

3. Autopilot ..... Disconnect
4. Affected HYDRAULIC L (R) SOV ..... CLOSED, the associated HYD PRESS LOW (C) is displayed.

NOTE: The hydraulic SOV should automatically close at approximately 135°C.

5. Altitude ..... 41,000 ft maximum
6. Land as soon as practical.

Hydraulic temperature reaches 155 °C:

Yes

7. Autothrottle (if installed) ..... Disengage
8. Affected thrust lever ..... Idle
9. Affected engine RUN switch ..... OFF
10. Rudder trim ..... As required
11. Applicable BLEED switch ..... OFF
12. XBLEED switch ..... OPEN
13. Applicable ENGINE ANTI–ICE switch ..... OFF

HYDRAULICS

L (R) HYD TEMP HIGH (C) (Cont)

No

14. Fuel balance ..... Monitor

Descent checks:

3. Pressurization ..... LNDG ALT set
4. WING ANTI–ICE switch ..... As required
5. L and R ENG ANTI–ICE switches ..... As required
6. Transponder ..... TA Only

Transition level (or FL 180) checks:

7. Altimeters ..... Set
8. L and R LANDING light switches ..... On
9. Passenger brief/cabin check ..... Complete
10. SMKG/BELTS switch ..... SMKG/BELTS
11. Fuel quantities and balance ..... Check

Approach checks:

12. APU and Bleeds ..... Set

L HYD PRESS LOW is displayed:

Yes

13. Final approach speed ..... V_{REF}
14. Normal actual landing distance ..... Multiply by:
    1.40 without thrust reversers
    1.35 with thrust reversers

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW and when landing at an airport pressure altitude of 4000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

CAUTION: Reducing weight below MLW or landing at an alternate airport shall only be attempted at pilot discretion and only if this can be achieved in a safe manner and within a reasonable time period.

15. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

16. Approach setup and crew briefing ..... Complete
17. RA MIN or BARO MIN ..... Set

HYDRAULICS

L (R) HYD TEMP HIGH (C) (Cont)

18. MIN ALERT ..... Set
19. R HYDRAULIC PUMP switch ..... AUTO

Before landing checks:

20. LANDING GEAR switch ..... DN

CAUTION: Do not push PUSH TO STOW button while pulling handle.

21. LG PULL handle ..... PULL

NOTE: Performing a sideslip to each side may help achieve MLG downlock. Increased airspeed may be required to ensure downlock during sideslip.

22. GEAR Indication ..... Check for three green DN indications.

CAUTION: Do not stow the handle until the gear pins are installed.

23. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
24. FLAPS 30
25. NWS switch ..... OFF

Maintain directional control using differential braking.

After touchdown:

26. Limit reverse thrust on the right side as required to maintain directional control.

NOTE: Do not deploy the left thrust reverser.

– END –

No

R HYD PRESS LOW is displayed:

Yes

13. Final approach speed ..... V_{REF}
14. Normal actual landing distance ..... Multiply by:
    1.40 without thrust reversers
    1.35 with thrust reversers

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW and when landing at an airport pressure altitude of 4000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

CAUTION: Reducing weight below MLW or landing at an alternate airport shall only be attempted at pilot discretion and only if this can be achieved in a safe manner and within a reasonable time period.

HYDRAULICS

L (R) HYD TEMP HIGH (C) (Cont)

15. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

16. ALTN FLAPS ..... ON
17. Approach setup and crew briefing ..... Complete
18. RA MIN or BARO MIN ..... Set
19. MIN ALERT ..... Set
20. L HYDRAULIC PUMP switch ..... AUTO

Before landing checks:

21. LANDING GEAR switch ..... DN
22. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
23. FLAPS 30

After touchdown:

24. Limit reverse thrust on left side as required to maintain directional control.

NOTE: Do not deploy the right thrust reverser.

– END –

No

13. Approach set up and crew briefing ..... Complete
14. RA MIN or BARO MIN ..... Set
15. MIN ALERT ..... Set

Before landing checks:

16. LANDING GEAR ..... DN
17. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
18. L and R HYDRAULIC PUMP switches ..... Auto
19. FLAPS 30

END

ICE & RAIN PROTECTION

L (R) AOA VANE HEAT FAIL (C)

NOTE: – If L AOA VANE HEAT FAIL (C) posts simultaneously with L PITOT HEAT FAIL (C) and STBY PITOT HEAT FAIL (C) refer to LEFT AIR DATA HEAT FAIL procedure, this section. No further crew action is required for L AOA VANE HEAT FAIL (C).

– If R AOA VANE HEAT FAIL (C) posts simultaneously with R PITOT HEAT FAIL (C) and R STBY STAT HT FAIL (C) refer to RIGHT AIR DATA HEAT FAIL procedure, this section. No further crew action is required for R AOA VANE HEAT FAIL (C).

1. Affected PROBES switch ..... OFF, then On

AOA VANE HEAT FAIL remains displayed:

2. Leave icing conditions as soon as possible.

If icing is encountered:

3. STALL PUSHER switch ..... OFF
4. Final approach speed ..... V_{REF} +10
5. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.20 with thrust reversers
6. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

ICE DETECTED (C)

1. WING ANTI–ICE switch ..... ON
2. L and R ENG ANTI–ICE switches ..... ON

END

ICE & RAIN PROTECTION

ICE DETECTOR FAIL (C)

If in visible moisture or at night and TAT is 10 °C or below except when SAT is –40 °C or below:

1. WING ANTI–ICE switch ..... ON
2. L and R ENG ANTI–ICE switches ..... ON

END

L (R) ENG ANTI–ICE FAIL (C)

1. ANTI–ICE synoptic ..... Check

Affected engine anti–ice flow line is amber:

Yes

2. Autothrottle (if installed) ..... Disengage
3. IGNITION switch ..... ON
4. Engine N_1 ..... Increase to improve airflow

If ENG ANTI–ICE FAIL remains on:

5. Leave icing conditions as soon as possible.

– END –

No

An amber T_2 is displayed next to the engine graphic:

2. Leave icing conditions as soon as possible.

END

L (R) PITOT HEAT FAIL (C)

NOTE:
- If L PITOT HEAT FAIL (C) posts simultaneously with L AOA VANE HEAT FAIL (C) and STBY PITOT HEAT FAIL (C) refer to LEFT AIR DATA HEAT FAIL procedure, this section. No further crew action is required for L PITOT HEAT FAIL (C).
- If R PITOT HEAT FAIL (C) posts simultaneously with R AOA VANE HEAT FAIL (C) and R STBY STAT HT FAIL (C) refer to RIGHT AIR DATA HEAT FAIL procedure, this section. No further crew action is required for R PITOT HEAT FAIL (C).

1. Affected PROBES switch ..... OFF, then On

ICE & RAIN PROTECTION

L (R) PITOT HEAT FAIL (C) (Cont)

PITOT HEAT FAIL remains displayed:

Yes

2. Cross–check the three pitot–static systems.

PITOT HEAT FAIL is accompanied by erroneous pitot–static indications:

Yes

If L PITOT HEAT FAIL:

3. AIR DATA reversion switch ..... Select 2

If R PITOT HEAT FAIL:

3. AIR DATA reversion switch ..... Select 1

– END –

No

END

L (R) PROBE HEAT OFF (C)

In flight:

1. Affected PROBES switch ..... On

END

ICE & RAIN PROTECTION

STBY PITOT HEAT FAIL (C)

NOTE: If STBY PITOT HEAT FAIL (C) posts simultaneously with L AOA VANE HEAT FAIL (C) and L PITOT HEAT FAIL (C) refer to LEFT AIR DATA HEAT FAIL procedure, this section. No further crew action is required for STBY PITOT HEAT FAIL (C).

1. L PROBES switch ..... OFF, then On

STBY PITOT HEAT FAIL remains on:

Yes

2. Use the pilot's and copilot's airspeed/Mach indicators.
   Do not use the standby instrument.

– END –

No

END

L (R) STBY STAT HT FAIL (C)

NOTE:
- If L STBY STAT HT FAIL (C) posts simultaneously with L AOA VANE HEAT FAIL (C), L PITOT HEAT FAIL (C) and STBY PITOT HEAT FAIL (C) refer to LEFT AIR DATA HEAT FAIL procedure, this section. No further crew action is required for L STBY STAT HT FAIL (C).
- If R STBY STAT HT FAIL (C) posts simultaneously with R AOA VANE HEAT FAIL (C) and R PITOT HEAT FAIL (C) refer to RIGHT AIR DATA HEAT FAIL procedure, this section. No further crew action is required for R STBY STAT HT FAIL (C).

1. Affected PROBES switch ..... OFF, then On

If STBY STAT HT FAIL remains on:

Yes

2. Use the pilot's and copilot's airspeed/Mach indicators.
   Do not use the standby instrument.

– END –

No

END

ICE & RAIN PROTECTION

L (R) WINDOW HEAT FAIL (C)

1. Affected WSHLD/WINDOW switch ..... OFF, then On
2. Moving the COCKPIT and CABIN COLD–HOT knobs to HOT may help reduce fogging.

END

L (R) WING A/I PRESS HI (C)

1. WING SOURCE switch ..... Select FROM L or FROM R as required
2. AUTO SYNC switch ..... OFF

WING A/I PRESS HI remains displayed:

Yes

3. WING ANTI–ICE switch ..... Off
4. Leave icing conditions as soon as possible.

If approach and landing must be made with any ice or suspected ice:

5. Refer to Wing Anti–Ice Failure Landing procedure, this section.

– END –

No

END

L (R) WING ANTI–ICE FAIL (C)

NOTE: If a L (R) WING A/I LOW TEMP (C) and a L (R) WING ANTI–ICE FAIL (C) are displayed at the same time, perform the procedure for L (R) WING A/I LOW TEMP (C) in this chapter.

Both the L WING ANTI–ICE FAIL (C) and the R WING ANTI–ICE FAIL (C) are on:

Yes

1. WING ANTI–ICE switch ..... Off
2. Leave icing conditions as soon as possible.
3. Refer to Wing Anti–Ice Failure Landing procedure, this section.

No

1. WING SOURCE switch ..... Select FROM L or FROM R as required
2. AUTO SYNC switch ..... OFF
3. Autothrottle (if installed) ..... Disengage
4. Affected thrust lever ..... Increase to 74% N_2 minimum

ICE & RAIN PROTECTION

L (R) WING ANTI–ICE FAIL (C) (Cont)

WING ANTI–ICE FAIL (C) remains displayed:

Yes

5. WING ANTI–ICE switch ..... Off
6. Leave icing conditions as soon as possible.
7. Refer to Wing Anti–Ice Failure Landing procedure, this section.

CAUTION: If conditions persists, do not engage Autothrottle.

No

END

L (R) WING A/I LOW TEMP (C)

NOTE: If a L (R) WING A/I LOW TEMP (C) and a L (R) WING ANTI–ICE FAIL (C) are displayed at the same time, perform the procedure for L (R) WING A/I LOW TEMP (C).

1. Autothrottle (if installed) ..... Disengage
2. Affected thrust lever ..... Increase to 74% N_2 minimum

WING A/I LOW TEMP (C) extinguishes:

Yes

– END –

No

3. WING SOURCE switch ..... Select FROM L or FROM R as required
4. AUTO SYNC switch ..... OFF
5. Affected thrust lever ..... Increase to 74% N_2 minimum

CAUTION: If conditions persists, do not engage Autothrottle.

WING A/I LOW TEMP (C) remains displayed:

Yes

6. WING ANTI–ICE switch ..... Off
7. Leave icing conditions as soon as possible.
8. Refer to Wing Anti–Ice Failure Landing procedure, this section.

No

END

ICE & RAIN PROTECTION

WING ANTI–ICE FAULT (C)

1. Leave icing conditions as soon as possible.

When out of icing:

2. WING ANTI–ICE switch ..... Off

END

L (R) WSHLD HEAT FAIL (C)

1. Affected WSHLD/WINDOW switch ..... OFF, then On

If WSHLD HEAT FAIL (C) remains on:

2. Leave icing conditions as soon as possible.
3. Moving the COCKPIT and CABIN COLD–HOT knobs to HOT may help reduce fogging.

END

LEFT AIR DATA HEAT FAIL

Indication: Simultaneous posting of L PITOT HEAT FAIL (C), STBY PITOT HEAT FAIL (C) and L AOA VANE HEAT FAIL (C).

NOTE: No crew action is required for the following procedures:

- Caution messages: L PITOT HEAT FAIL (C), STBY PITOT HEAT FAIL (C), L AOA VANE HEAT FAIL (C).

If L STBY STAT HT FAIL (C) posts no crew action is required.

1. L Probes switch ..... OFF, then On.

L PITOT HEAT FAIL (C), STBY PITOT HEAT FAIL (C) and L AOA VANE HEAT FAIL (C) remain displayed:

Yes

2. Leave icing conditions as soon as possible.

NOTE: If the Pitch attitude, thrust setting or external noise are not consistent with copilot's indicated airspeed, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed.

3. AIR DATA reversion switch ..... Select 2
   Do not use the standby instruments.

If icing is encountered:

4. STALL pusher switch ..... OFF
5. Final approach speed ..... VREF +10
6. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.20 with thrust reversers
7. ROAAS (if installed) ..... As required

ICE & RAIN PROTECTION

LEFT AIR DATA HEAT FAIL (Cont)

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

– END –

No

END

RIGHT AIR DATA HEAT FAIL

Indication: Simultaneous posting of R PITOT HEAT FAIL (C), R STBY STAT HT FAIL (C) and R AOA VANE HEAT FAIL (C).

NOTE: No crew action is required for the following procedures:

– Caution messages: R PITOT HEAT FAIL (C), R STBY STAT HT FAIL (C), R AOA VANE HEAT FAIL (C).

1. R Probes switch ..... OFF, then On.

R PITOT HEAT FAIL (C), R STBY STAT HT FAIL (C) and R AOA VANE HEAT FAIL (C) remain displayed:

Yes

NOTE: TAT probe heater has also failed.

2. Leave icing conditions as soon as possible.

NOTE: If the Pitch attitude, thrust setting or external noise are not consistent with pilot's indicated airspeed, refer to Chapter 3, EMERGENCY PROCEDURES, AVIONICS, Unreliable Airspeed.

3. AIR DATA reversion switch ..... Select 1
   Note: Do not use the standby instruments.

If icing is encountered:

4. STALL pusher switch ..... OFF
5. Final approach speed ..... VREF +10
6. Normal actual landing distance ..... Multiply by:
   1.25 without thrust reversers
   1.20 with thrust reversers
7. ROAAS (if installed) ..... As required

ICE & RAIN PROTECTION

RIGHT AIR DATA HEAT FAIL (Cont)

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

– END –

No

END

Cracked, Shattered, Delaminated, or Arcing Windshield or Window

1. Affected WSHLD/WINDOW switch ..... OFF
2. Cabin differential pressure ..... Reduce to 5.8 maximum
3. Altitude ..... 15,000 ft maximum
4. Leave icing conditions as soon as possible.
5. Moving the COCKPIT and CABIN COLD–HOT knobs to HOT may help reduce fogging.

If core or inside plies are shattered:

6. Airspeed ..... 205 KIAS maximum below 8,000 ft

END

Wing Anti–Ice Failure Landing

WARNING:
- Approach low speed flight with care so that detection of abnormal flying qualities can be obtained. Increased buffet may indicate ice formation on the wing leading edge.
- Even **small** accumulations of ice on the wing leading edge can cause an increase in stall speed, and possibly a degradation in stall characteristics.
- Visually inspect wing for ice accumulation if possible. Use WING INSP light at night

NOTE: Select a suitable landing field with a glidepath angle of 3.5 degrees or less.

Descent Checks:

1. Pressurization ..... LNDG ALT set
2. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

3. Altimeters ..... Set

ICE & RAIN PROTECTION

Wing Anti–Ice Failure Landing (Cont)

4. L and R LANDING light switches ..... On
5. Passenger brief/cabin Check ..... Complete
6. SMKG/BELTS switch ..... SMKG/BELTS
7. Fuel quantities and balance ..... Check
8. Airspeed ..... Increase to V_{MO}/M_{MO} if possible to disperse ice

Approach Checks:

9. APU and Bleeds ..... Set
10. Final approach speed ..... V_{REF} + 25
11. Normal actual landing distance ..... Multiply by:
    1.55 without thrust reversers
    1.45 with thrust reversers

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL if FLAPS are not at 30 degrees, AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

12. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

13. FLAPS TAWS WARN ..... OFF
14. Approach setup and crew briefing ..... Complete
15. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks:

16. LANDING GEAR switch ..... DN
17. N LDG/TAXI light switch ..... On
18. FLAPS 20
19. Autothrottle (if installed) ..... Disengage prior to 200 feet AGL

END

LANDING GEAR, WHEEL & BRAKE SYSTEM

CPLT BRAKE FAULT (C)

1. Use the pilot's brakes.

END

GEAR DISAGREE (C)

1. Airspeed ..... 250 KIAS maximum
2. LANDING GEAR switch ..... DN

NOTE: Ensure landing gear switch is firmly in the ”DN” position.

If CAS remains with the landing gear selected down:

Yes

Three DN indications are present:

Yes

3. Land as soon as practical.

CAUTION: Do not stow the handle until the gear pins are installed.

– END –

No

CAUTION: Do not push PUSH TO STOW button while pulling handle.

3. LG PULL handle ..... PULL

NOTE: Performing a sideslip to each side may help achieve MLG downlock. Increased airspeed may be required to ensure downlock during sideslip.

4. GEAR Indication ..... Check for three DN indications

Three DN indications are present:

Yes

5. Land as soon as practical.

CAUTION: Do not stow the handle until the gear pins are installed.

– END –

No

5. Refer to Landing Gear Up/Unsafe Landing procedure in the EMERGENCY PROCEDURES chapter.

– END –

No

LANDING GEAR, WHEEL & BRAKE SYSTEM

GEAR DISAGREE (C) (Cont)

All landing gear are down (three DN indications) :

Yes

3. Land as soon as practical.

CAUTION: Do not stow the handle until the gear pins are installed.

– END –

No

Combined with WOW FAIL (C)

Yes

All landing gear are down as confirmed by control tower:

Yes

3. Land as soon as practical.

CAUTION: Do not stow the handle until the gear pins are installed.

– END –

No

3. Refer to Landing Gear Up/Unsafe Landing procedure in the EMERGENCY PROCEDURES chapter.

END

GEAR SYS FAIL (C)

1. Airspeed ..... 250 KIAS maximum
2. LANDING GEAR switch ..... DN
3. GEAR indication ..... Check for three DN indications

All landing gear are down (three DN indications):

Yes

4. Land as soon as practical.

– END –

No

LANDING GEAR, WHEEL & BRAKE SYSTEM

GEAR SYS FAIL (C) (Cont)

CAUTION: Do not push PUSH TO STOW button while pulling handle.

4. LG PULL handle ..... PULL

NOTE: Performing a sideslip to each side may help achieve MLG downlock. Increased airspeed may be required to ensure downlock during sideslip.

5. GEAR indication ..... Check for three DN indications

All landing gear are down (three DN indications):

Yes

6. Land as soon as practical.

CAUTION: Do not stow the handle until the gear pins are installed.

– END –

No

6. Refer to Landing Gear Up/Unsafe Landing procedure in the EMERGENCY PROCEDURES chapter.

END

L (R) INBD BRAKE FAIL (C)

1. Normal actual landing distance ..... Multiply by:
   1.35 without thrust reversers
   1.25 with thrust reversers

NOTE: If heavy braking is used, the affected brake may lock up below 30 knots.

2. ROAAS (if Installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

LANDING GEAR, WHEEL & BRAKE SYSTEM

INBD BRAKE PRESS LO (C)

1. If less than 60 minutes has elapsed from takeoff, operate with landing gear extended for 15 minutes prior to landing (to ensure cool brakes).
2. Normal actual landing distance ..... Multiply by:
   1.60 without thrust reversers
   1.45 with thrust reversers

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW or when landing at an airport pressure altitude of 6000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

3. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

INBD BRAKES FAIL (C)

1. If less than 60 minutes has elapsed from takeoff, operate with landing gear extended for 15 minutes prior to landing (to ensure cool brakes).
2. Normal actual landing distance ..... Multiply by:
   1.60 without thrust reversers
   1.45 with thrust reversers

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW or when landing at an airport pressure altitude of 6000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

3. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

NOSE GEAR DOOR (C)

1. Airspeed ..... 250 KIAS maximum
2. Land as soon as practical.

END

LANDING GEAR, WHEEL & BRAKE SYSTEM

NWS FAIL (C)

At Normal Taxi Speeds:

1. Maintain directional control using differential braking.
2. NWS switch ..... OFF
3. Thrust levers ..... IDLE
4. Brake to a stop.

In flight:

1. NWS switch ..... OFF

NOTE: Select the longest runway available with minimum turbulence and crosswind.

2. Maintain directional control using differential braking on landing.

END

NWS LIMIT EXCEEDED (C)

1. Do not take off.

END

L (R) OUTBD BRAKE FAIL (C)

1. Normal actual landing distance ..... Multiply by:
   1.35 without thrust reversers
   1.25 with thrust reversers

NOTE: If heavy braking is used, the affected brake may lock up below 30 knots.

2. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

LANDING GEAR, WHEEL & BRAKE SYSTEM

OUTBD BRAKE PRESS LO (C)

1. If less than 60 minutes has elapsed from takeoff, operate with landing gear extended for 15 minutes prior to landing (to ensure cool brakes).
2. Normal actual landing distance ..... Multiply by:
   1.60 without thrust reversers
   1.45 with thrust reversers

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW or when landing at an airport pressure altitude of 6000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

3. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

OUTBD BRAKES FAIL (C)

1. If less than 60 minutes has elapsed from takeoff, operate with landing gear extended for 15 minutes prior to landing (to ensure cool brakes).
2. Normal actual landing distance ..... Multiply by:
   1.60 without thrust reversers
   1.45 with thrust reversers

WARNING: Maximum brake energy may be exceeded for a landing weight above MLW or when landing at an airport pressure altitude of 6000 ft and above. In this situation, consider reducing weight or land at an alternate airport.

3. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

END

LANDING GEAR, WHEEL & BRAKE SYSTEM

PARK/EMER BRAKE ON (C)

1. PARK/EMER BRAKE handle ..... Stow

If message remains:

2. Normal actual landing distance ..... Multiply by:
   2.40 without thrust reversers
   1.90 with thrust reversers
3. ROAAS (if installed) ..... As required

NOTE: ROAAS should be selected OFF when landing on a runway with RCC less than 6.

4. Use normal brakes.

CAUTION: All four brakes may be locked and landing control will be affected.

END

PK/EMER BRK PRESS LO (C)

1. Normal brakes ..... Apply until chocks are in

END

PLT BRAKE FAULT (C)

1. Use the copilot's brakes.

END

WOW FAIL (C)

1. ROAAS (if installed) ..... OFF
2. Normal actual landing distance ..... Multiply by 1.30

NOTE: Select the longest runway available with minimum turbulence and crosswind.

3. Autothrottle (if installed) ..... Disengage

After touchdown:

4. FLIGHT SPOILERS ..... EMER
5. Directional control ..... Maintain with differential braking

CAUTION: Normal brakes may be inoperative below 10 knots.

6. PARK/EMER BRAKE handle ..... Apply below 10 knots

END

LANDING PROCEDURES

Single Engine Landing

Descent Checks:

1. Pressurization ..... LNDG ALT set
2. WING ANTI–ICE switch ..... As required
3. L or R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

4. Altimeters ..... Set
5. L and R LANDING light switches ..... On
6. Passenger Brief/Cabin Check ..... Complete
7. SMKG/BELTS switch ..... SMKG/BELTS
8. Fuel quantities and balance ..... Check

Approach Checks:

9. APU and Bleeds ..... Set
10. Final approach speed ..... V_{REF}
11. Normal actual landing distance ..... Multiply by:
    1.15 without thrust reversers
    1.10 with thrust reversers
12. ROAAS (if installed) ..... As required

NOTE:
- For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).
- ROAAS should be selected OFF when landing on a runway with RCC less than 6.

13. Approach setup and crew briefing ..... Complete
14. RA MIN or BARO MIN ..... Set
15. MIN ALERT ..... Set
16. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks:

17. LANDING GEAR switch ..... DN
18. FLAPS 30
19. GEAR indication ..... Check
20. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On

LANDING PROCEDURES

Single Engine Landing (Cont)

After landing:

21. Applicable thrust reverser ..... As required, limit to maintain directional control

NOTE: Do not deploy the thrust reverser on the inoperative engine.

END

Wing Anti–Ice Failure Landing

WARNING:
- Approach low speed flight with care so that detection of abnormal flying qualities can be obtained. Increased buffet may indicate ice formation on the wing leading edge.
- Even **small** accumulations of ice on the wing leading edge can cause an increase in stall speed, and possibly a degradation in stall characteristics.
- Visually inspect wing for ice accumulation if possible. Use WING INSP light at night

NOTE: Select a suitable landing field with a glidepath angle of 3.5 degrees or less.

Descent Checks:

1. Pressurization ..... LNDG ALT set
2. L and R ENG ANTI–ICE switches ..... As required

Transition Level (or FL 180) Checks:

3. Altimeters ..... Set
4. L and R LANDING light switches ..... On
5. Passenger brief/cabin Check ..... Complete
6. SMKG/BELTS switch ..... SMKG/BELTS
7. Fuel quantities and balance ..... Check
8. Airspeed ..... Increase to V_{MO}/M_{MO} if possible to disperse ice

Approach Checks:

9. APU and Bleeds ..... Set
10. Final approach speed ..... V_{REF} + 25
11. Normal actual landing distance ..... Multiply by:
    1.55 without thrust reversers
    1.45 with thrust reversers

LANDING PROCEDURES

Wing Anti–Ice Failure Landing (Cont)

12. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

13. FLAPS TAWS WARN ..... OFF
14. Approach setup and crew briefing ..... Complete
15. RA MIN or BARO MIN ..... Set
16. MIN ALERT ..... Set
17. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks:

18. LANDING GEAR switch ..... DN
19. L LANDING, N LDG/TAXI, and R LANDING light switches ..... On
20. FLAPS 20

END

MISCELLANEOUS SYSTEMS

EMER LIGHTS OFF (C)

1. EMER LTS switch ..... ARM

END

EMER LIGHTS ON (C)

The cabin emergency lights are on.

END

POWERPLANT

L (R) ENG DSPL MISCOMP (C)

1. L DISPLAYS switch ..... PFD REV

L (R) ENG DSPL MISCOMP (C) extinguishes:

Yes

2. L DISPLAYS switch ..... Leave in PFD REV

– END –

No

2. L DISPLAYS switch ..... NORM

The left MFD is not corrupting the engine data. One of the other displays is.

END

L (R) ENGINE FLAMEOUT (C)

1. Autothrottle (if installed) ..... Disengage
2. Affected engine thrust lever ..... IDLE

If engine does not auto restart:

3. Refer to Engine Shutdown In Flight procedure, this section.

END

ENGINES FUEL BYPASS (C)

1. L and R FUEL PUMP switches ..... ON
2. Land as soon as possible.

END

L (R) ENGINE VIBRATION (C)
VIB (EI icon)

During icing conditions:

1. Autothrottle (if installed) ..... Disengage
2. Affected thrust lever ..... Increase above 70% N_1, then as desired

CAUTION: If condition persists, do not engage Autothrottle.

3. If ENGINE VIBRATION (C) persists, go to During Non–Icing Conditions procedure below.

– END –

POWERPLANT

L (R) ENGINE VIBRATION (C)
VIB (EI icon) (Cont)

During non–icing conditions:

1. Engine instruments ..... Monitor for abnormal indications (oil temperature/pressure, N_1, ITT and N_2) or unusual sounds or vibrations.

If ENGINE VIBRATION CAS remains on for more than 30 seconds and if conditions permit:

2. Autothrottle (if installed) ..... Disengage
3. Respective Thrust lever ..... Adjust

CAUTION: If condition persists, do not engage Autothrottle.

NOTE: Engine shutdown is not recommended unless there are other indications of severe engine abnormalities.

END

L (R) ENG FUEL SOV FAIL (C)

If affected engine fuel SOV has failed to close when commanded closed:

1. Affected ENGINE RUN switch ..... OFF
2. Refer to Engine Shutdown In Flight procedure, this section.

END

L (R) ENG OIL PRESS HIGH (C)

1. Autothrottle (if installed) ..... Disengage
2. Affected thrust lever ..... Reduce

CAUTION: If condition persists, do not engage Autothrottle.

END

L (R) ENG OIL TEMP HIGH (C)

1. Autothrottle (if installed) ..... Disengage
2. Affected thrust lever ..... Reduce

CAUTION: If condition persists, do not engage Autothrottle.

NOTE: Upon reduction of engine power, the oil temperature may rise initially due to a reduction in fuel flow through the Fuel Heater Oil Cooler.

3. OIL TEMP ..... Monitor

POWERPLANT

L (R) ENG OIL TEMP HIGH (C) (Cont)

OIL TEMP remains high:

Yes

4. Affected engine thrust lever ..... IDLE
5. Land as soon as practical.

– END –

No

4. Continue flight.

END

L (R) FADEC FAIL (C)

If engine shutdown:

1. Refer to Engine Shutdown In Flight procedure, this section.

If engine decelerates to idle:

1. Autothrottle (if installed) ..... Disengage
2. Affected engine thrust lever ..... IDLE

CAUTION: If condition persists, do not engage Autothrottle.

3. Land as soon as practical. Refer to Single–Engine Landing procedure, this section.

If engine continues to operate:

1. Avoid rapid thrust lever movements. Expect deteriorated engine response.
2. Engine instruments ..... Monitor

CAUTION: If condition persists, do not engage Autothrottle.

END

IGN (EI icon) (C)

One or both ignitor channels have failed.

1. Engine starts will not be possible if both channels have failed.

END

POWERPLANT

Effectivity:

If Autothrottle installed:

AT RETARD INHIBIT (C)

NOTE: Below 200 feet AGL, AT RETARD INHIBIT (C) may post if autothrottle engaged and aircraft not in landing configuration. Disengaging the autothrottle will clear the message. The autothrottle can be re−engaged once the aircraft is above 200 feet AGL.

CAUTION: Autothrottle will not arm RETARD and will not reduce the thrust levers to idle at 50 feet AGL.

1. Autothrottle ..... Disengage
2. Thrust levers ..... Position manually

END

L (R) REVERSER FAIL (C)

1. Affected thrust reverser ..... Do not use

END

L (R) START ABORTED (C)

1. Affected engine RUN switch ..... OFF
2. Affected STARTER switch ..... CRANK, hold for 30 seconds

If conditions warrant, another start may be initiated:

3. Affected engine RUN switch ..... RUN
4. Affected STARTER switch ..... START and release

END

L (R) STARTER FAIL (C)

GROUND:

If the message comes on during start:

1. Affected engine RUN switch ..... OFF

If the message comes on any other time:

1. Continue.

IN FLIGHT:

If attempting an airstart:

1. Refer to Engine Airstart – Windmill Airstart, this section.

If the message comes on any other time:

1. Continue.

END

POWERPLANT

L (R) STARTER FAIL ON (C)

GROUND:

1. Affected engine RUN switch ..... OFF
2. L, R, and APU BLEED switches ..... OFF

IN FLIGHT:

L STARTER FAIL ON (C) is displayed.

Yes

1. XBLEED switch ..... Close
2. L BLEED switch ..... OFF

– END –

No

R STARTER FAIL ON (C) is displayed.

1. XBLEED switch ..... Close
2. APU BLEED switch ..... OFF
3. R BLEED switch ..... OFF

END

Effectivity:

If Autothrottle installed:

AT (Amber FMA annunciation flashing on PFD)  **"AUTOTHROTTLE"**

1. Autothrottle ..... Disengage
2. Thrust levers ..... Position Manually

END

Effectivity:

If Autothrottle installed:

OSPD (Amber FMA annunciation flashing on PFD)

1. Airspeed ..... Monitor

END

Effectivity:

If Autothrottle installed:

LIM (Amber FMA annunciation flashing on PFD)

1. Reference speed/Vertical speed ..... Adjust

END

POWERPLANT

Engine Shutdown In Flight

1. Autothrottle (if installed) ..... Disengage

Affected engine:

2. Thrust lever ..... IDLE
3. Engine RUN switch ..... OFF

NOTE: 1. The ENG FIRE switch should not be pushed unless a fuel or hydraulic leak is suspected.

2. Autothrottle (if installed) may be re−engaged for the operative engine once the engine run switch for the affected engine is selected OFF.

4. Rudder trim ..... As required
5. Electrical load ..... Reduce, within generator limits
6. Applicable BLEED switch ..... OFF
7. XBLEED switch ..... Open
8. Applicable ENG ANTI−ICE switch ..... Off
9. Monitor fuel balance. Transfer as required.
10. Transponder ..... TA Only
11. Land as soon as practical.
12. Refer to Engine Airstart, this section, if applicable. Refer to Single−Engine Landing procedure, this section or Thrust Reverser Deployed Landing procedure, EMERGENCY PROCEDURES chapter, as appropriate.

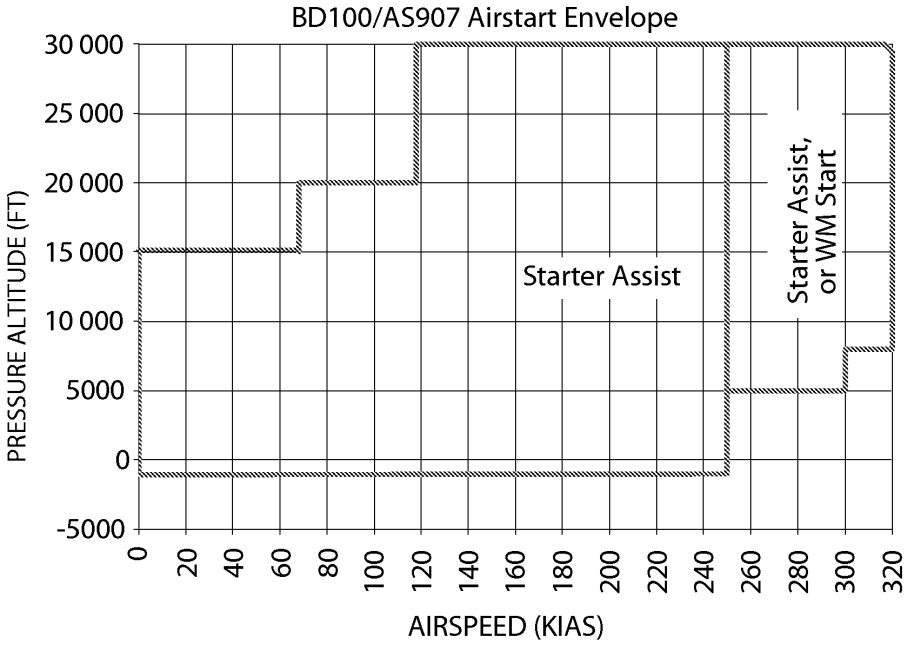
END

POWERPLANT

Engine Airstart

WARNING: **Do not** attempt an airstart following an engine failure which was accompanied by indications of internal engine damage or fire.

CAUTION: **Do not** attempt an airstart without an indication of N_1 rotation.



BEFORE START

Affected engine:

1. Make sure that the aircraft is within the appropriate Airstart Envelope as shown in figure above.
2. Fuel panel XFER switch ..... Closed
3. Fuel panel PUMP switch ..... Auto
4. ENG ANTI–ICE switch ..... Off
5. BLEED switch ..... OFF
6. Autothrottle (if installed) ..... Disengage
7. Thrust lever ..... IDLE
8. Conduct the following crossbleed, APU, or windmill assisted airstart.
9. If IGNITION switch is ON:

   Affected RUN switch ..... OFF for 3 seconds minimum.

POWERPLANT

Engine Airstart (Cont)

CROSSBLEED STARTER ASSISTED AIRSTART

1. BLEED pressure ..... 32 minimum
2. Autothrottle (if installed) ..... Disengage

Affected engine:

3. ENGINE RUN switch ..... RUN
4. STARTER switch ..... START and release
5. IGN and FUEL FLOW ..... Check
6. ITT ..... Check rise

If no indication of light–off is obtained within:

20 seconds (if engine has been windmilling for 2 minutes or less) after STARTER switch–START, or

45 seconds (if engine has been windmilling for more than 2 minutes) after STARTER switch–START:

7. Affected ENGINE RUN switch ..... OFF
8. Repeat a starter assisted airstart or refer to Engine Shutdown In Flight procedure, this chapter.

If engine started:

9. Go to AFTER START. →

APU BLEED STARTER ASSISTED AIRSTART (BELOW 20,000 FT)

1. L and R BLEED switches ..... OFF
2. APU BLEED switch ..... On
3. Autothrottle (if installed) ..... Disengage

Affected engine:

4. ENGINE RUN switch ..... RUN
5. STARTER switch ..... START
6. IGN and FUEL FLOW ..... Check
7. ITT ..... Check rise

If no indication of light–off is obtained within:

20 seconds (if engine has been windmilling for 2 minutes or less) after STARTER switch–START, or

45 seconds (if engine has been windmilling for more than 2 minutes) after STARTER switch–START:

8. Affected ENGINE RUN switch ..... OFF
9. Repeat a starter assisted airstart or refer to Engine Shutdown In Flight procedure, this chapter.

POWERPLANT

Engine Airstart (Cont)

If engine started:

10. Go to AFTER START.

WINDMILL AIRSTART

ALTITUDE	MINIMUM N_2
≤ 10,000 ft	6.0%
20,000 ft	7.1%
30,000 ft	8.2%

Affected engine:

1. ENGINE RUN switch ..... RUN
2. IGN and FUEL FLOW ..... Check
3. ITT ..... Check rise

NOTE: Start may be as long as 3 minutes to idle.

If no indication of light–off is obtained within:

20 seconds (if engine has been windmilling for 2 minutes or less) after ENGINE RUN switch–RUN, or

45 seconds (if engine has been windmilling for more than 2 minutes) after ENGINE RUN switch–RUN:

4. Affected ENGINE RUN switch ..... OFF
5. Repeat an airstart or refer to Engine Shutdown In Flight procedure, this chapter.

AFTER START

Affected Engine:

1. Engine instruments ..... Check
2. GEN switch ..... Check on
3. ENG ANTI–ICE switch ..... As required
4. L and R, and APU BLEED switch(es) ..... As required
5. Transponder ..... TA/ RA

END

POWERPLANT

Single Engine Landing

Descent Checks:

1. Pressurization ..... LNDG ALT set
2. WING ANTI–ICE switch ..... As required
3. L or R ENG ANTI–ICE switches ..... As required
4. Transponder ..... TA Only

Transition Level (or FL 180) Checks:

5. Altimeters ..... Set
6. L and R LANDING light switches ..... On
7. Passenger Brief/Cabin Check ..... Complete
8. SMKG/BELTS switch ..... SMKG/BELTS
9. Fuel quantities and balance ..... Check

Approach Checks:

10. APU and Bleeds ..... Set
11. Final approach speed ..... V_{REF}
12. Normal actual landing distance ..... Multiply by:
    1.15 without thrust reversers
    1.0 with thrust reversers
13. ROAAS (if installed) ..... As required

NOTE: – For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased actual landing distance plus 2,000 ft (600 m).

– ROAAS should be selected OFF when landing on a runway with RCC less than 6.

14. Approach setup and crew briefing ..... Complete
15. L and R HYDRAULIC PUMP switches ..... AUTO

Before Landing Checks:

16. LANDING GEAR switch ..... DN
17. FLAPS 30
18. GEAR indication ..... Check
19. N LDG/TAXI light switch ..... On

After landing:

20. Applicable thrust reverser ..... As required, limit to maintain directional control

NOTE: Do not deploy the thrust reverser on the inoperative engine.

END

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POWERPLANT

Single Engine Go–Around

1. Autopilot ..... Disconnect with TO/GA button
2. Autothrottle (if installed) ..... Disengage
3. Thrust lever ..... TO
4. FLIGHT SPOILERS ..... RETRACT
5. Pitch attitude ..... Adjust as required to achieve V_{GA}

NOTE: Initially rotate toward flight director pitch guidance command, adjust pitch as required to maintain V_{GA}.

6. FLAPS selector 10
7. LANDING GEAR switch ..... UP, after positive rate of climb is established
8. Climb at V_{GA}.

WARNING: It is prohibited to have the Autothrottle engaged during a single engine go–around until flaps are retracted and the aircraft has accelerated to en route climb speed.

9. When clear of obstacles, accelerate to V_{GA} + 15 and retract flaps.
10. Climb ..... At en route climb speed
11. N LDG/TAXI light switch ..... OFF
12. Applicable ENG ANTI–ICE ..... OFF

END

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CL-350



CL-350 SUPPLEMENTAL MANUAL

PERFORMANCE 10

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Challenger 350

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.

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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

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Figure 06–01–2

Challenger 350

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

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Figure 06–01–3

Challenger 350

INTRODUCTION

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			

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Figure 06–01–4

Challenger 350

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			

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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

CONVERSION CHART FOR PRESSURE (inHG/ mbar-hPa)

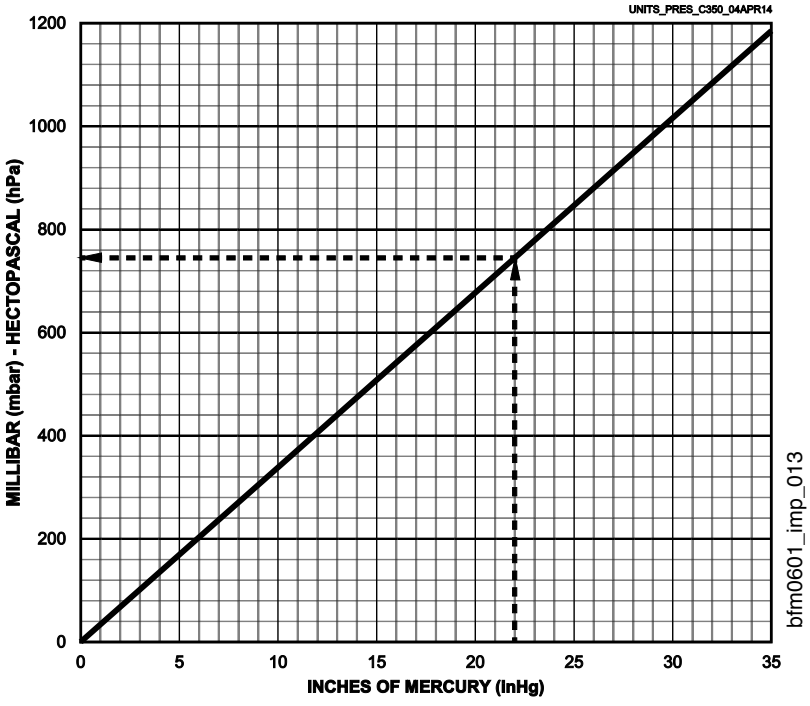


Figure 06–01–7

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

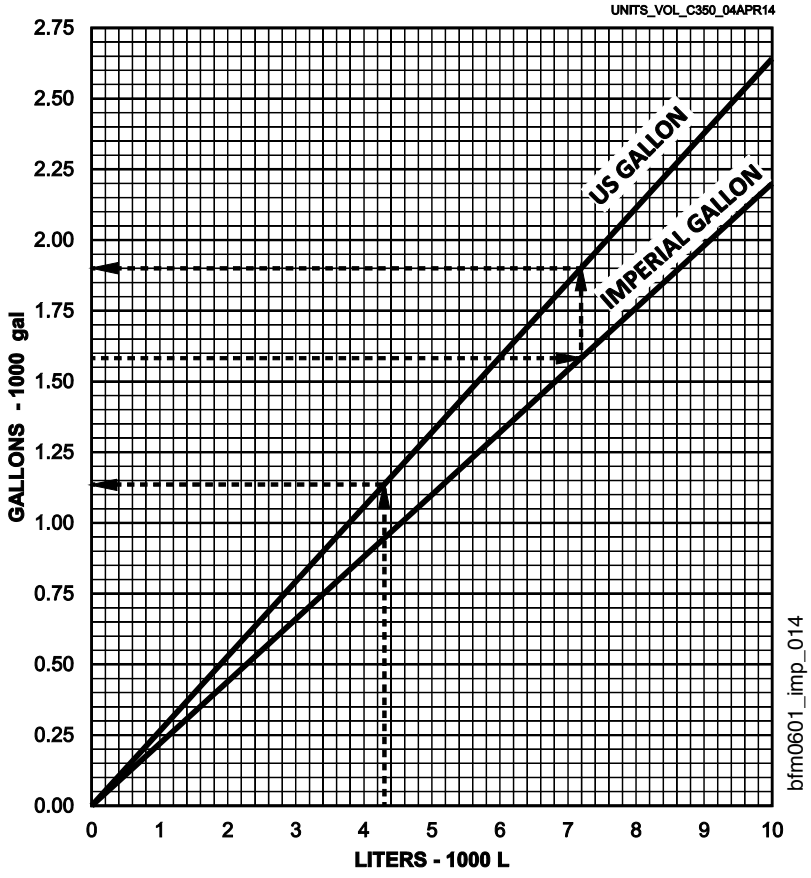


Figure 06–01–8

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

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

bfm0601_imp_007

Figure 06–01–9

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

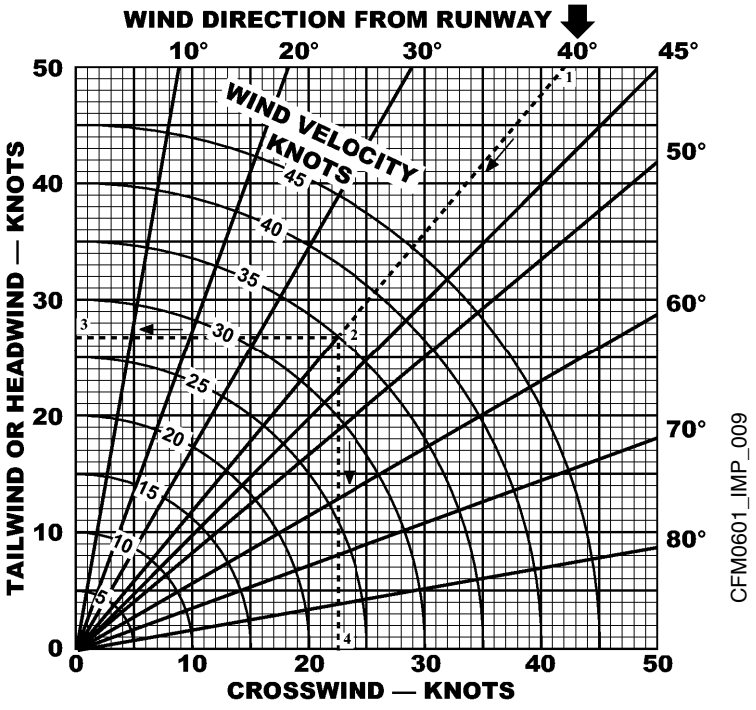


Figure 06–01–11

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

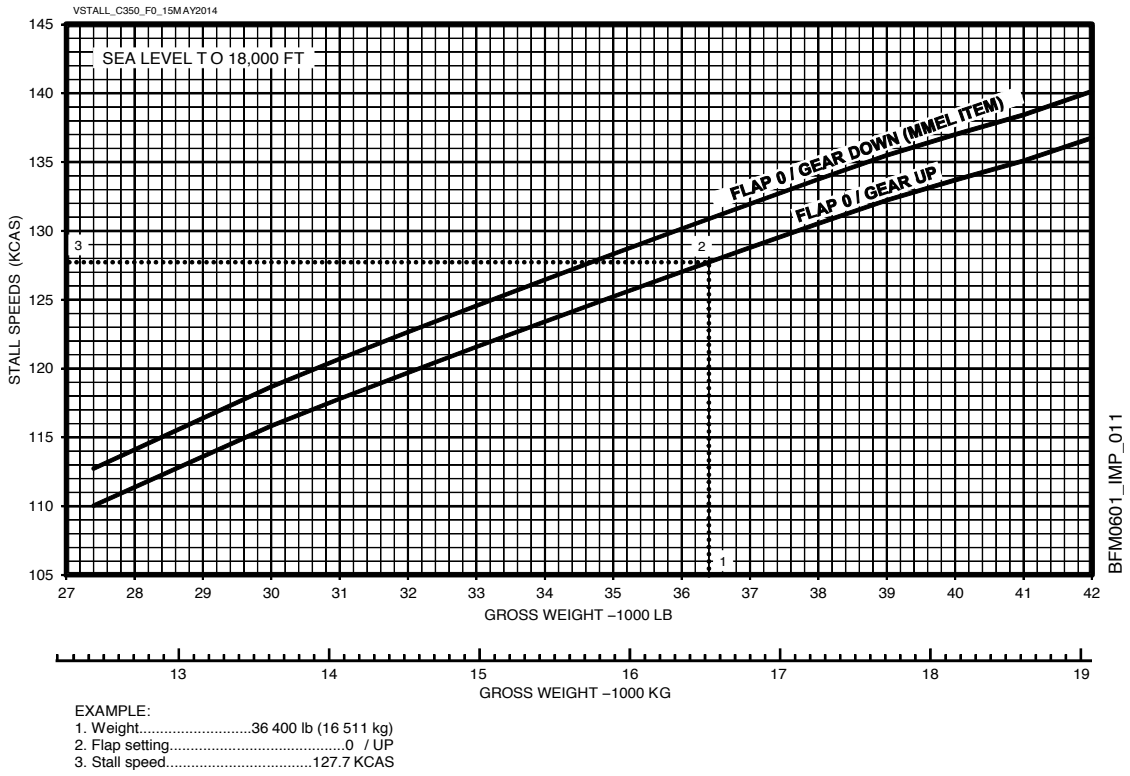
Maneuvering Capability calculations are presented within the General Module of the CAFM. These calculations establish the maneuvering margin for a given load factor, bank angle, weight, CG position, altitude and speed combination and is calculated relative to buffet onset or stick shaker activation,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

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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

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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

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

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

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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 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.

- 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)

TAKEOFF

- 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.

Challenger 350

PERFORMANCE

TAKEOFF

STABILIZER TRIM FOR TAKEOFF
FLAPS = 10°

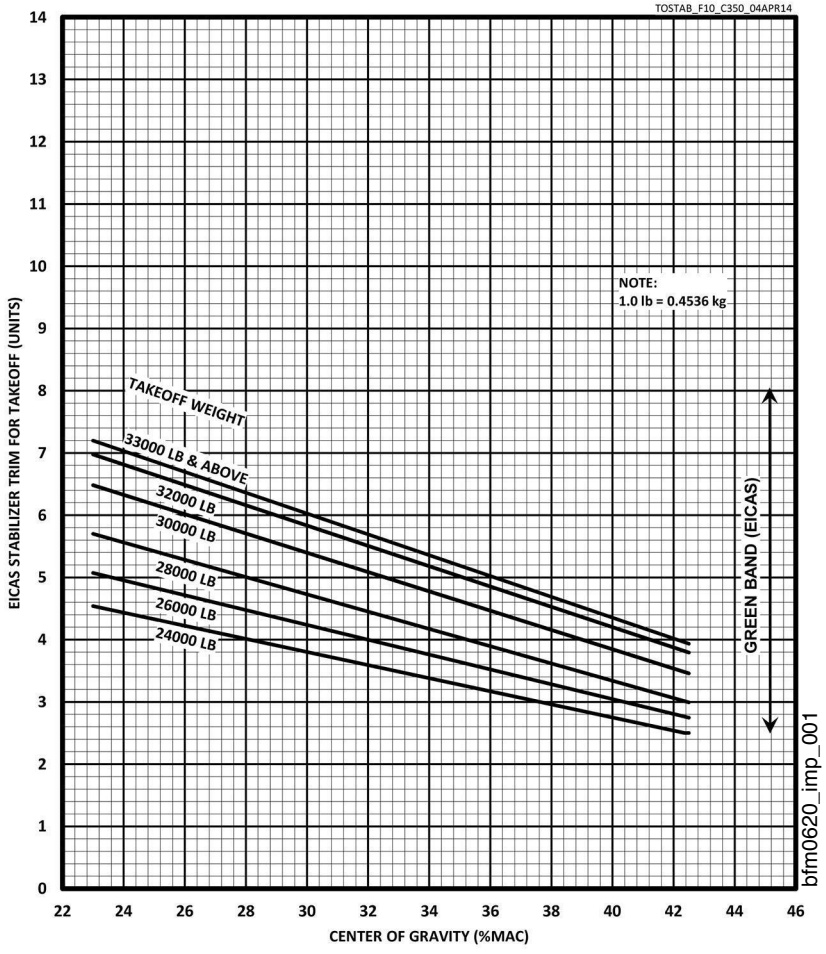


Figure 06–20–1

TAKEOFF

STABILIZER TRIM FOR TAKEOFF
FLAPS = 20°

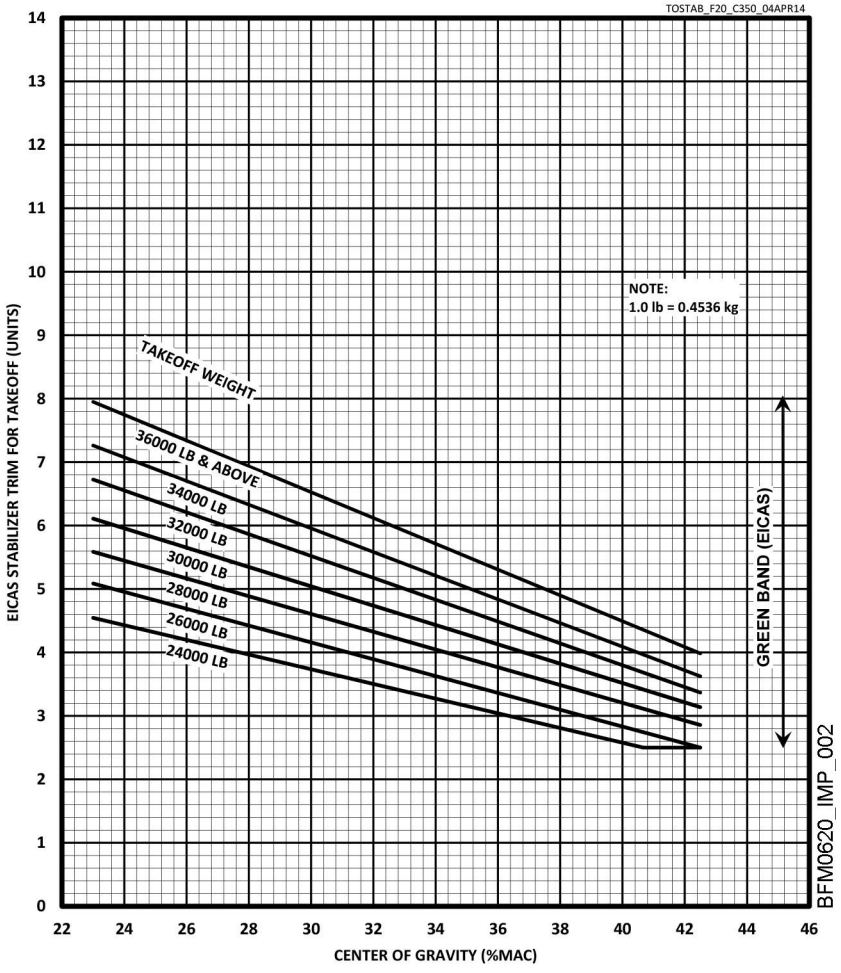


Figure 06–20–2

TAKEOFF

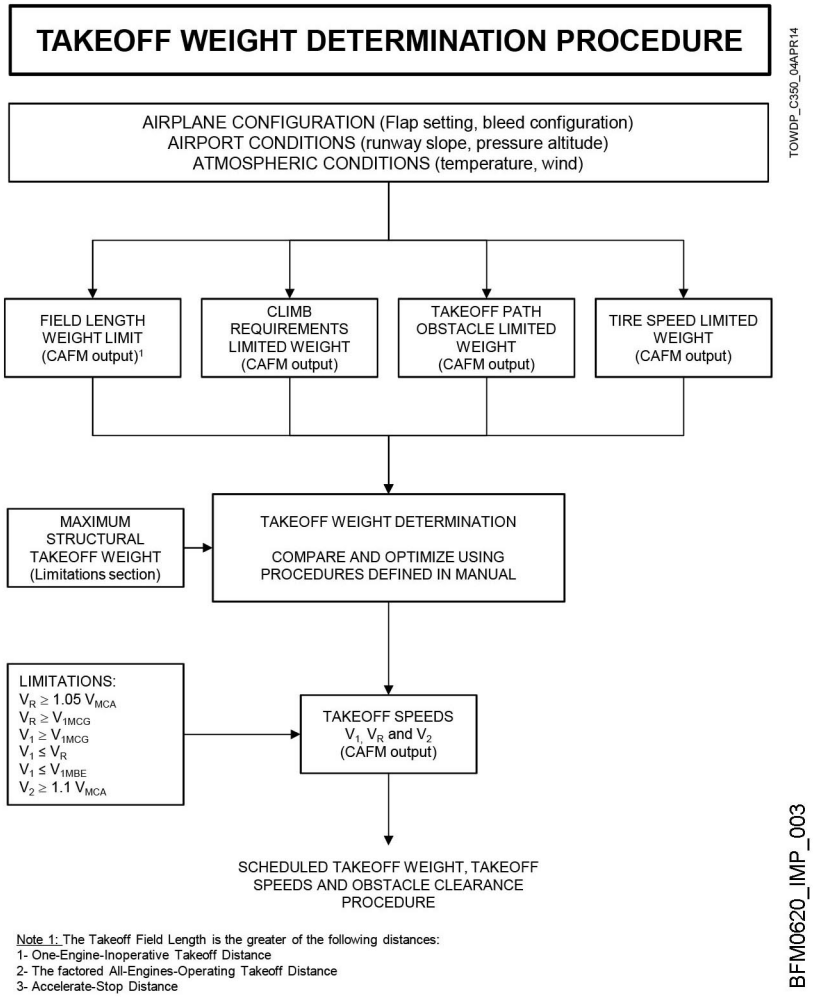


Figure 06–20–3

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TAKEOFF

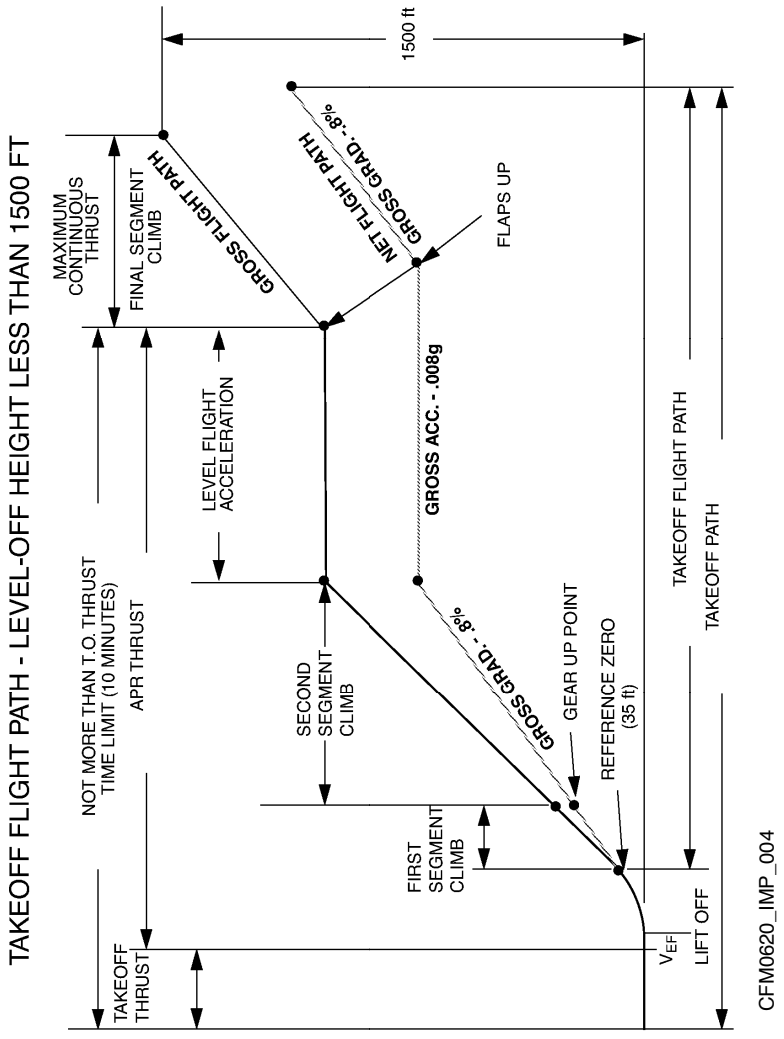


Figure 06–20–4 (Sheet 1 of 2)

TAKEOFF

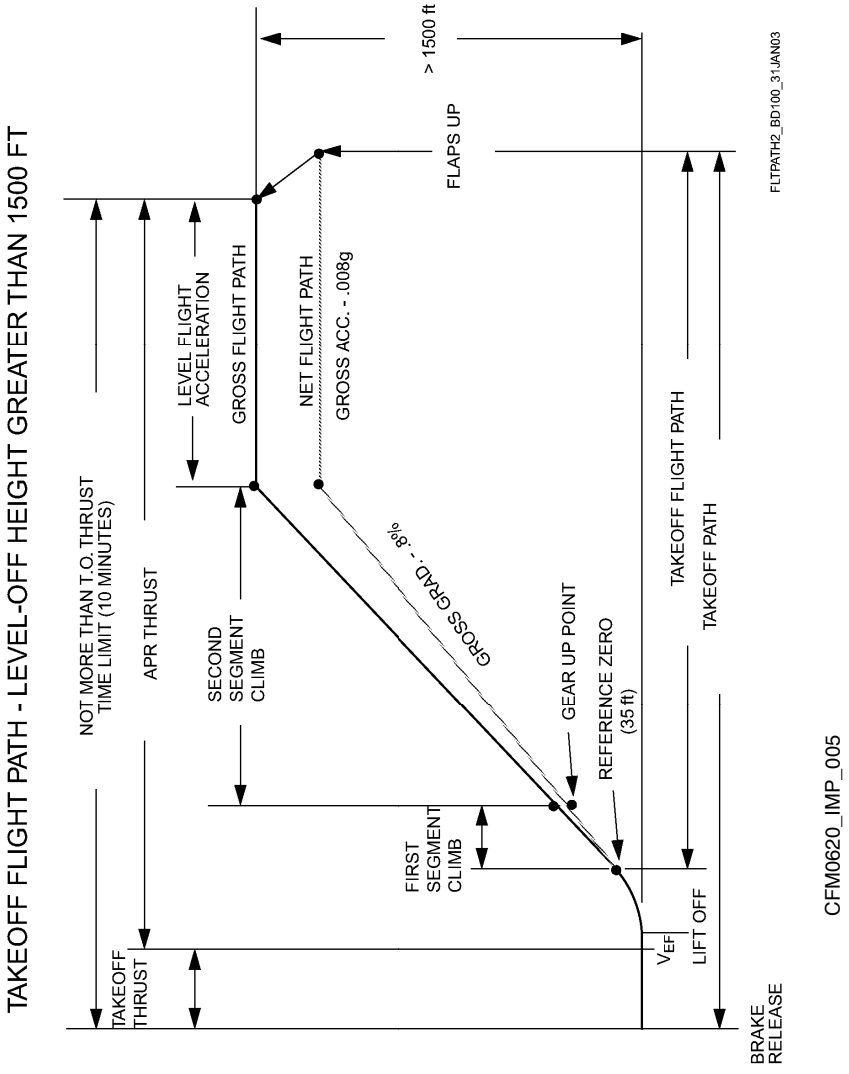


Figure 06–20–4 (Sheet 2 of 2)

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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).

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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.

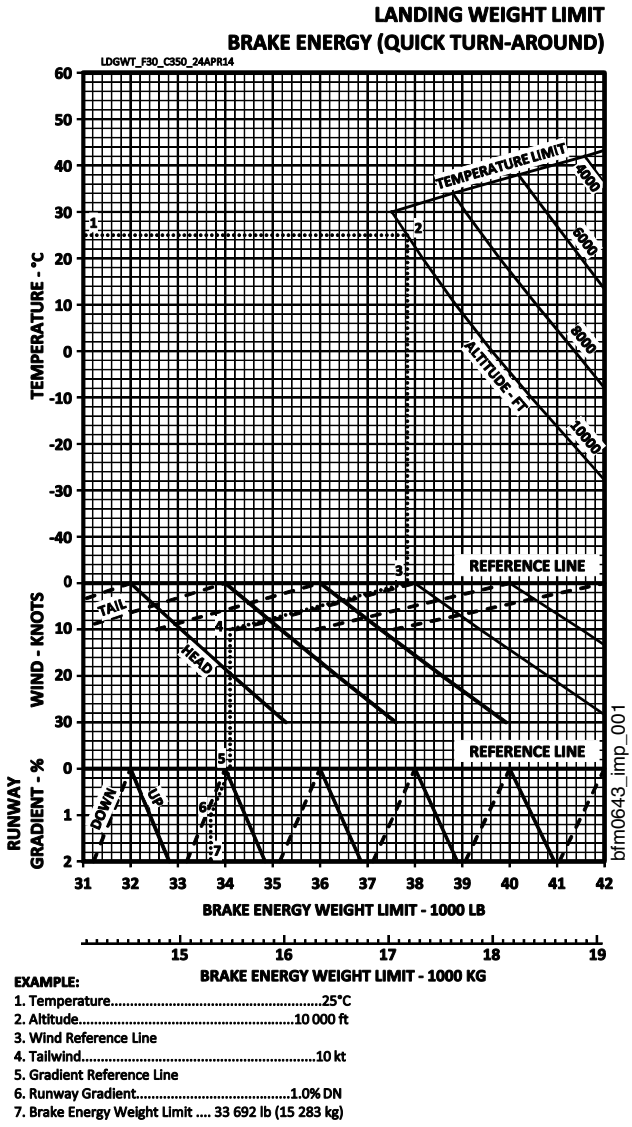
Landing Weight: 34150 lb (MLW)

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

Challenger 350

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

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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.

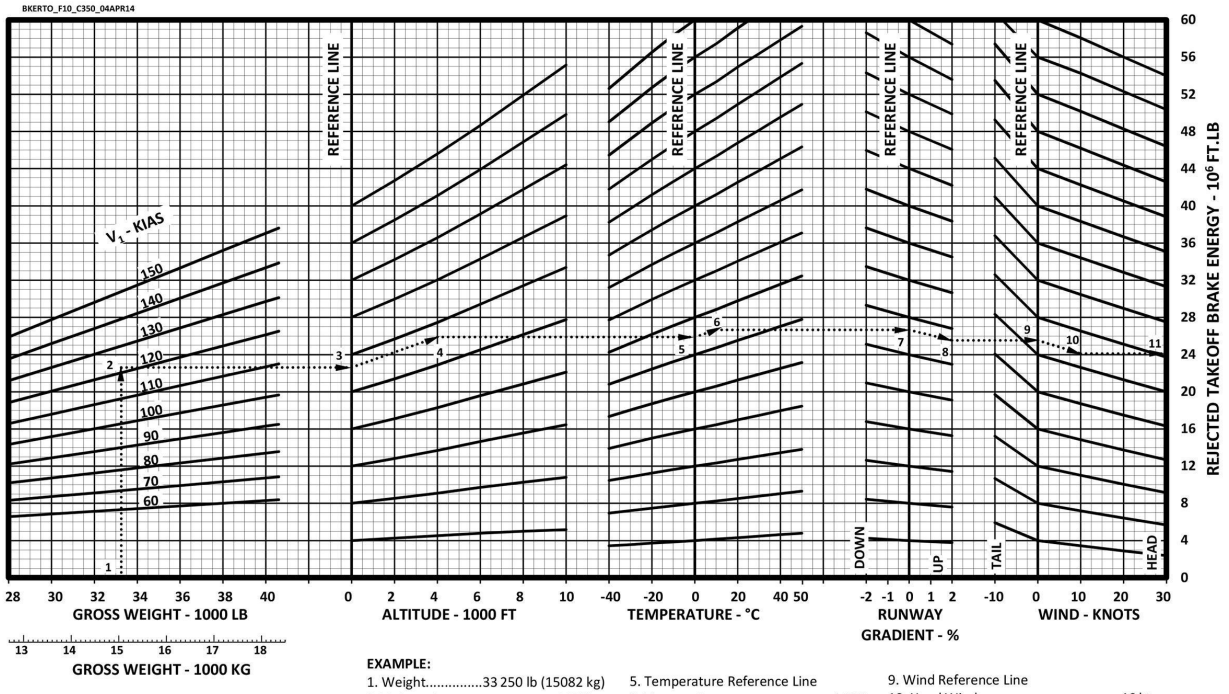
Associated Conditions:

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.

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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

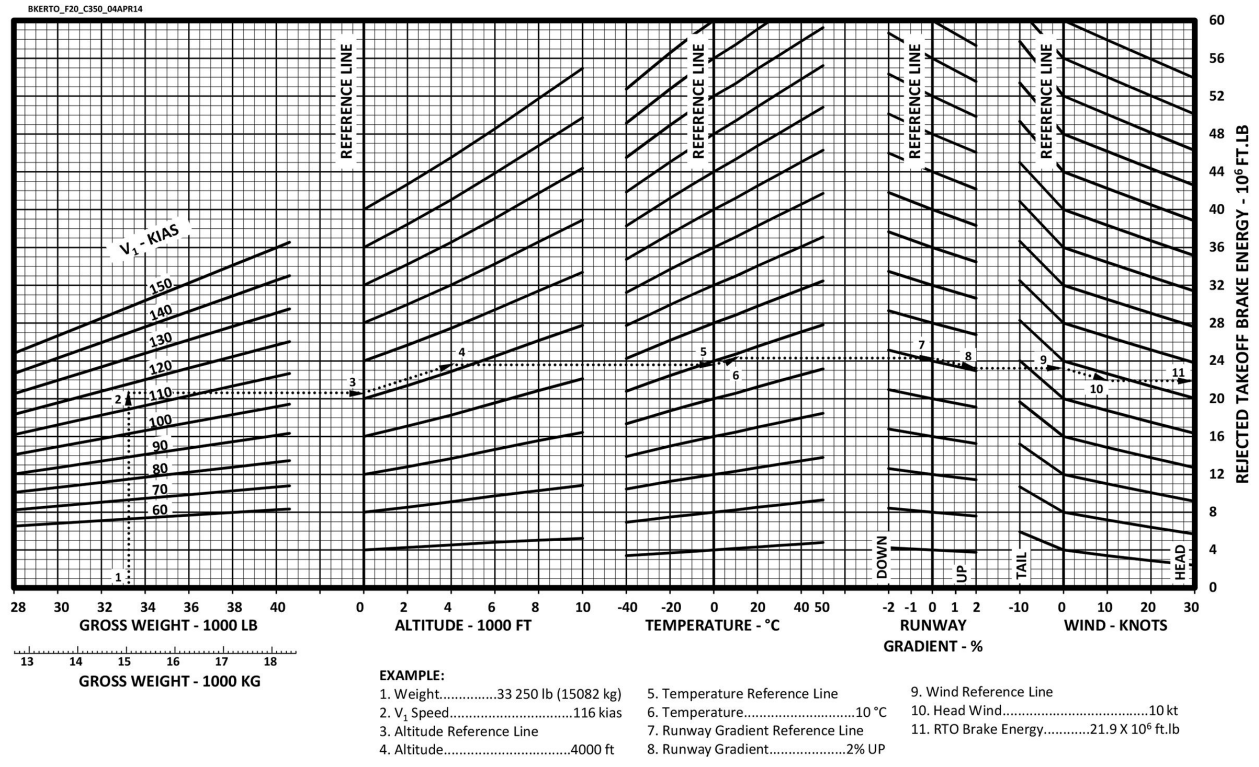
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Figure 06–50–1

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TURN–AROUND TIME

REJECTED TAKEOFF BRAKE ENERGY
FLAPS 20°



EXAMPLE:

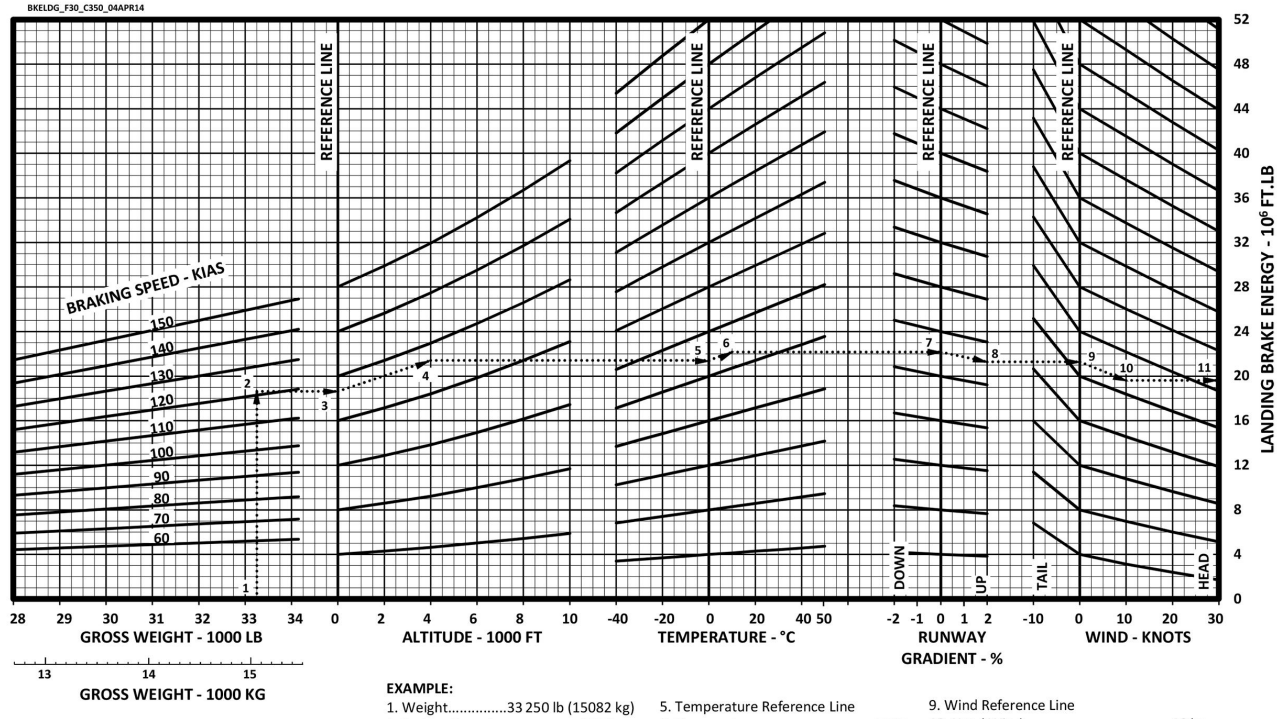
1. Weight.....33 250 lb (15082 kg)
2. V_1 Speed.....116 kias
3. Altitude Reference Line
4. Altitude.....4000 ft
5. Temperature Reference Line
6. Temperature.....10 °C
7. Runway Gradient Reference Line
8. Runway Gradient.....2% UP
9. Wind Reference Line
10. Head Wind.....10 kt
11. RTO Brake Energy.....21.9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

BFM0650_IMP_002

Figure 06–50–2

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LANDING BRAKE ENERGY
FLAPS 30°



EXAMPLE:

1. Weight.....33 250 lb (15082 kg)
2. Braking Speed.....121 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. Landing Brake Energy.....19.6 X 10^6 ft.lb

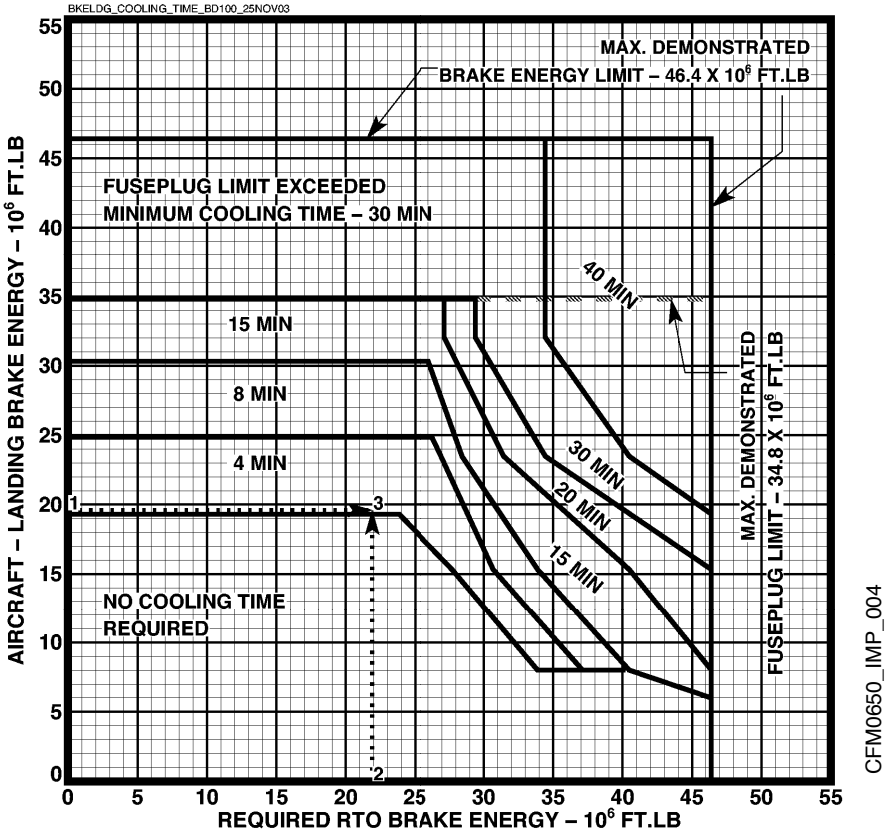
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Figure 06–50–3

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TURN–AROUND TIME

MAIN WHEEL BRAKE COOLING TIME FOLLOWING A LANDING



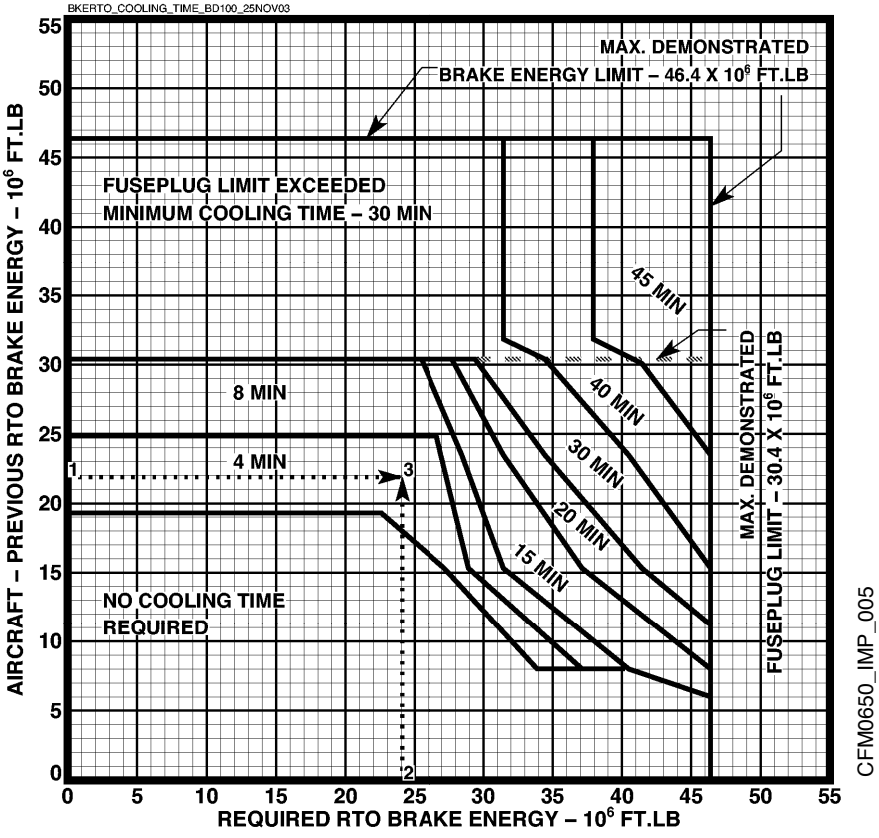
EXAMPLE:

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

Figure 06–50–5

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CL-350



CL-350 SUPPLEMENTAL MANUAL

PERFORMANCE PROBLEM 11

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CHALLENGER 350

BD-100-1A10

PERFORMANCE EXERCISE

Flight Planning & Performance

San Diego (KSAN) → Chicago / Rockford (KRFD)



LOFT · CL-350 Ground School · Part 142 · Revision: Original · 17 March 2026

Before You Begin — Exercise Notes

- Performance values (takeoff/landing field length, V-speeds, N1, max weight for a required climb gradient) come from the CL-350 CAFM (Computerized AFM) — questions needing them are marked "CAFM." Limitation speeds (e.g. VFE) are from the AFM.
- Airport data (KSAN / KRFD) is from AirNav; confirm against current charts.

Flight Planning and Performance Exercise

San Diego (KSAN) to Chicago / Rockford (KRFD)

Your Chief Pilot hands you the following for this afternoon's CL-350 charter to Rockford — 6 passengers and their bags. Plan the flight, complete the weight & balance, and answer the performance questions. Will it work?

I. Planning Data

WEIGHT AND BALANCE INFORMATION

- **True Empty Weight (TEW):** 23,981 lb @ 607.06 in (aircraft weighing report / WBM)
- **Operating items (crew, baggage, provisions):** default weights & arms shown in the Weight & Balance table
- **Passengers (arms from W&B slide 24):** Seat 1: 210 · Seat 2: 185 · Seat 3: 200 · Seat 4: 190 · Seat 5: 195 · Seat 6: 175 lb
- **Baggage (aft compartment, arm 650.00):** 320 lb
- **Fuel plan:** Ramp 11,000 lb · Taxi/APU 250 lb · Enroute (trip) burn 7,300 lb (fuel CG from OEM Table 3A)

WEATHER (KSAN)

- **METAR:** KSAN 091853Z 27010KT 10SM FEW015 SCT250 24/17 A2996

ROUTE

- **Departure:** PADRES FOUR Departure, then as filed Cruise: FL430 Alternate: Chicago O'Hare (KORD)

CLEARANCE

N350LT CLEARED TO THE ROCKFORD AIRPORT VIA THE PADRES FOUR DEPARTURE, THEN AS FILED. CLIMB VIA SID EXCEPT MAINTAIN FL230. EXPECT FL430 ONE-ZERO MINUTES AFTER DEPARTURE. SQUAWK 5150.

ARRIVAL WEATHER (KRFD)

- **ATIS "B":** KRFD 092253Z 07012KT 10SM BKN035 OVC060 21/14 A2989 — ILS RWY 7 IN USE

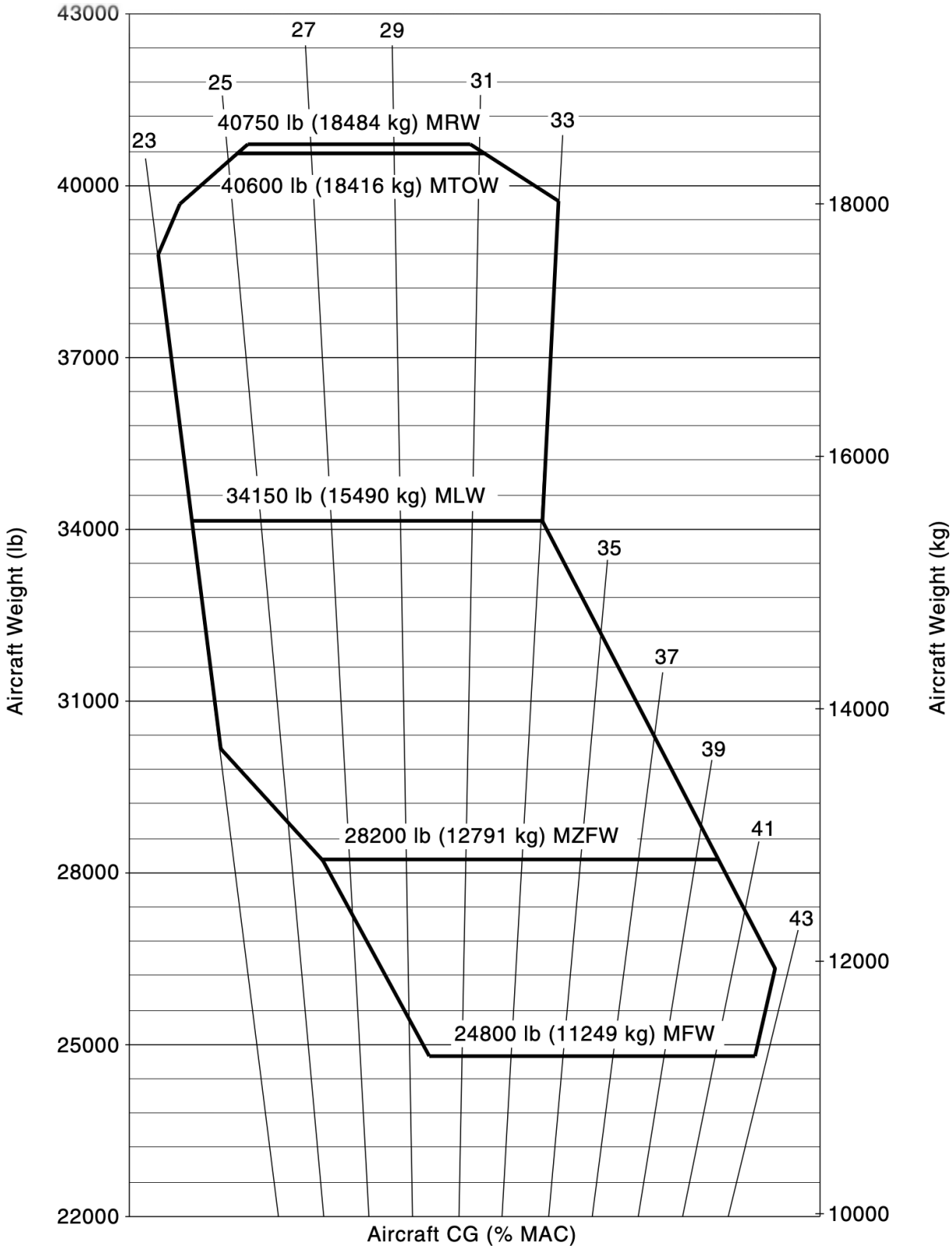
II. Performance Exercise

A. Weight & Balance

Item	Op	Weight (lb)	Arm (in)	Moment/1000	%MAC	Limit
True Empty Weight (TEW)	=	23,981	607.06	14,557.91	44.90	
Pilot	+	199	305.20			
Copilot	+	199	305.20			
Crew Carry-On Baggage	+	40	385.00			
Crew Baggage	+	60	650.00			
Flight Manuals	+	30	320.00			
Galley Supplies	+	109	366.30			
Aft Potable Water	+	20	636.00			
Lav Chemicals	+	20	610.00			
Lav Supplies	+	5	610.00			
Aft Equipment Bay Ladder	+	9	737.10			
OPERATING WEIGHT EMPTY (OWE)	=	_____	_____	_____	_____	
Passenger — Seat 1	+	210	422.70			
Passenger — Seat 2	+	185	422.70			
Passenger — Seat 3	+	200	469.30			
Passenger — Seat 4	+	190	471.30			
Passenger — Seat 5	+	195	518.70			
Passenger — Seat 6	+	175	520.70			
Baggage — aft compartment	+	320	650.00			
ZERO FUEL WEIGHT (gear down)	=	_____	_____	_____	_____	**MZFW 28,200**
Add gear-retraction moment (−4.60 / 1000)	+	—	—	−4.60		
ZERO FUEL WEIGHT (gear up)	=	_____	_____	_____	_____	
Ramp fuel (Table 3A)	+	11,000	565.0			
RAMP WEIGHT (= ZFW + ramp fuel)	=	_____	_____	_____	_____	**MRW 40,750**
Remaining fuel prior takeoff (Table 3A)	+	10,750	564.4			
TAKEOFF WEIGHT (= ZFW + fuel)	=	_____	_____	_____	_____	**MTOW 40,600**
Fuel for FCBP1 — 11,660 lb (Table 3A)	+	11,660	566.1			
FCBP1 (gear down) = ZFW + fuel	=	_____	_____	_____	_____	
Add gear-retraction moment (−4.60 / 1000)	+	—	—	−4.60		
FCBP1 (gear up)	=	_____	_____	_____	_____	**23.0–33.0%**
Fuel for FCBP2 — 9,310 lb (Table 3A)	+	9,310	562.0			
FCBP2 (gear down) = ZFW + fuel	=	_____	_____	_____	_____	
Add gear-retraction moment (−4.60 / 1000)	+	—	—	−4.60		
FCBP2 (gear up)	=	_____	_____	_____	_____	**23.0–33.0%**
Remaining fuel at landing (Table 3A)	+	3,450	550.3			
LANDING WEIGHT (= ZFW + fuel)	=	_____	_____	_____	_____	**MLW 34,150**

Is the aircraft within all weight limits? ☐ Yes ☐ No

Is the CG within the envelope at every point (plot the fuel curve)? ☐ Yes ☐ No


43000
40000
37000
34000
31000
28000
25000
22000
Aircraft Weight (lb)
18000
16000
14000
12000
10000
Aircraft Weight (kg)
Aircraft CG (% MAC)
23
25
27
29
31
33
35
37
39
41
43
40750 lb (18484 kg) MRW
40600 lb (18416 kg) MTOW
34150 lb (15490 kg) MLW
28200 lb (12791 kg) MZFW
24800 lb (11249 kg) MFW

B. Climb Gradient Conversion Chart

Gradient (%) = tan(angle) × 100 *Rate (ft/NM) = gradient(%) × 60.76*

Deg	%	Ft/NM	Deg	%	Ft/NM
1.0	1.7	106	5.0	8.7	532
1.2	2.1	127	5.2	9.1	553
1.4	2.4	148	5.4	9.5	574
1.6	2.8	170	5.6	9.8	596
1.8	3.1	191	5.8	10.2	617
2.0	3.5	212	6.0	10.5	639
2.2	3.8	233	6.2	10.9	660
2.4	4.2	255	6.4	11.2	682
2.6	4.5	276	6.6	11.6	703
2.8	4.9	297	6.8	11.9	725
3.0	5.2	318	7.0	12.3	746
3.2	5.6	340	7.2	12.6	768
3.4	5.9	361	7.4	13.0	789
3.6	6.3	382	7.6	13.3	811
3.8	6.6	404	7.8	13.7	832
4.0	7.0	425	8.0	14.1	854
4.2	7.3	446	8.2	14.4	876
4.4	7.7	468	8.4	14.8	897
4.6	8.0	489	8.6	15.1	919
4.8	8.4	510	8.8	15.5	941

C. Performance Exercise Questions

NOTE: Assume Flaps 10 for all takeoffs unless otherwise specified.

1. At KSAN, RWY 27 lists declared distances TORA 9,401 / TODA 9,401 / ASDA 9,401 / LDA 7,591 ft. Which value is the runway length available for LANDING? **CHART SUPP**

- **A.** TORA 9,401
- **B.** TODA 9,401
- **C.** ASDA 9,401
- **D.** LDA 7,591

2. How many flap positions does the Challenger 350 have? **FCOM/ASTM 05**

- **A.** Three (0, 20, 30)
- **B.** Four (0, 10, 20, 30)
- **C.** Five
- **D.** Two (UP, DN)

3. Which flap settings are approved for takeoff? **FCOM NORMAL**

- **A.** 10 only
- **B.** 20 only
- **C.** 10 or 20
- **D.** Flaps 0

4. Maximum flap-extended speed (V_{FE}) for Flaps 30 is: **AFM LIM**

- **A.** 175 KIAS
- **B.** 200 KIAS
- **C.** 210 KIAS
- **D.** 250 KIAS

5. V_1 is best defined as: **AFM**

- **A.** The speed at which the aircraft lifts off
- **B.** The maximum speed at which the crew must take the first action to reject the takeoff (takeoff decision speed)
- **C.** The target speed to fly after liftoff with an engine failure
- **D.** 1.3 × stall speed

6. V_2 (takeoff safety speed) is: **AFM**

- **A.** The minimum speed to maintain after an engine failure to at least 35 ft, meeting the required 2nd-segment climb gradient
- **B.** The rotation speed
- **C.** A never-exceed speed
- **D.** The flap-retraction speed

7. A departure requires a climb of 404 ft/NM. Using the Climb Gradient Conversion Chart, this is about: **CLIMB CHART**

- **A.** 3.8%
- **B.** 5.2%
- **C.** 6.6%
- **D.** 8.0%

8. Departing KSAN RWY 27 (275° M) with wind 250° at 20 kt, the approximate components are: AFM WIND

- **A.** 20 kt HW / 0 kt XW
- **B.** 18 kt HW / 8 kt left XW
- **C.** 10 kt HW / 17 kt right XW
- **D.** 8 kt HW / 18 kt left XW

9. Takeoff Field Length (TOFL) for the transport-category CL-350 is: CAFM

- **A.** The all-engine takeoff distance
- **B.** The accelerate-stop distance only
- **C.** The greatest of accelerate-go, accelerate-stop, or 1.15 × all-engine takeoff distance
- **D.** The ground roll only

10. A "balanced field" exists when: CAFM

- **A.** Runway slope is zero
- **B.** The accelerate-go distance equals the accelerate-stop distance
- **C.** Headwind equals crosswind
- **D.** TOW equals LDW

11. From the Planning Data, compute the ZERO FUEL WEIGHT. Within MZFW (28,200 lb)? ZFW = _____ lb

☐ Within ☐ Over W&B

12. Compute the TAKEOFF WEIGHT (ZFW + remaining fuel prior takeoff). Within MTOW (40,600 lb)?

TOW = _____ lb ☐ Within ☐ Over W&B

13. Compute the LANDING WEIGHT (ZFW + remaining fuel at landing). Within MLW (34,150 lb)?

LW = _____ lb ☐ Within ☐ Over W&B

14. Using %MAC = [(Xarm − 556.675)/112.22]×100, the takeoff CG ≈ _____ %MAC.

Within the envelope (TOW band ≈ 23.5–33%)? ☐ Yes ☐ No W&B ENVELOPE

15. Selecting engine (cowl) anti-ice ON for the departure will: CAFM

- **A.** Have no effect on takeoff performance
- **B.** Reduce available thrust, increasing required field length and reducing the maximum permissible takeoff weight
- **C.** Increase available thrust
- **D.** Only affect the landing

16. Using the CAFM (KSAN elev 17 ft, RWY 27, the day's OAT/QNH, Flaps 10) and your TOW, find the takeoff field length required and confirm it fits the 9,401 ft available. TOFL required = _____ ft CAFM

17. Record your takeoff V-speeds for the computed TOW and conditions: V_1 _____ V_R _____ V_2 _____ V_{FTO} _____ CAFM

18. V_{REF} for a normal Flaps 30 landing is based on: AFM

- **A.** 1.3 × V_{S0}
- **B.** Approximately 1.23 × the reference stall speed (V_{SR}) in the landing configuration
- **C.** V_2 + 10
- **D.** The single-engine climb speed

19. After a Flaps 10 takeoff, the flaps are retracted to 0 at: FCOM NORMAL

- **A.** V_2
- **B.** V_2 + 15
- **C.** V_{REF}
- **D.** 250 KIAS

20. If a required SID climb gradient exceeds the CL-350's single-engine climb capability at your takeoff weight, you should:

- **A.** Depart anyway — the SID is only for all-engines
- **B.** Plan and brief an engine-out obstacle departure (EOSID) and/or reduce takeoff weight to meet the requirement
- **C.** Ask for radar vectors after liftoff
- **D.** Use Flaps 30 for takeoff

Performance Exercise — TOLD Cards

Fill in the takeoff and landing data cards for this flight.

// TAKEOFF DATA CL-350

ATIS:

Airport	
Elevation	
Runway Required	
Runway Length	
Actual Weight	
Flap Setting	

V_1	
V_R	
V_2	
V_{FTO}	
$N_{1\%}$	

CLEARANCE:

// LANDING DATA CL-350

ATIS:

Airport	
Elevation	
Runway Length	
Runway Required	
Actual Weight	

V_{REF}	
V_{GA}	
V_{FTO}	



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INSTRUCTOR ANSWER KEY — remove before issuing to students

Weight & Balance (worked — real arms; fuel CG from OEM Table 3A)

Stage	Weight (lb)	CG Arm (in)	%MAC	Check
TRUE EMPTY WEIGHT (TEW) — given	23,981	607.06	44.9	
OPERATING WEIGHT EMPTY (OWE)	24,672	600.59	39.1	
ZERO FUEL WEIGHT (ZFW)	26,147	595.42	34.5	≤ MZFW 28,200 ✓
RAMP WEIGHT (RW)	37,147	586.40	26.5	≤ MRW 40,750 ✓
TAKEOFF WEIGHT (TOW)	36,897	586.39	26.5	≤ MTOW 40,600 ✓
ZERO FUEL WEIGHT (gear up)	26,147	595.24	34.4	in-flight CG
FCBP1 (gear down)	37,807	586.38	26.5	
FCBP1 (gear up)	37,807	586.26	26.4	23.0–33.0% ✓
FCBP2 (gear down)	35,457	586.64	26.7	
FCBP2 (gear up)	35,457	586.51	26.6	23.0–33.0% ✓
LANDING WEIGHT (LW)	29,597	590.16	29.8	≤ MLW 34,150 ✓

Fuel CG used (Table 3A): ramp 11000 lb @ 565.0 in · T/O 10750 lb @ 564.4 in · landing 3450 lb @ 550.3 in. Also verify the fuel-curve boundary points (RW → FCBP → ZFW) all plot inside the envelope, per the W&B presentation. All weights and CG are within limits.

Questions

1. D — LDA 7,591 ft (RWY 27 has a 1,810 ft displaced threshold).
2. B — Four: 0, 10, 20, 30.
3. C — 10 or 20.
4. A — 175 KIAS (Flaps 10/20 = 210).
5. B — takeoff decision speed; the reject decision must be made by V_1.
6. A.
7. C — ≈ 6.6% (404 / 60.76).
8. B — 25° off: HW = 20·cos25 ≈ 18 kt; XW = 20·sin25 ≈ 8 kt from the left.
9. C.
10. B.
11. ZFW = 26,147 lb @ 34.5%MAC — within.
12. TOW = 36,897 lb @ 26.5%MAC — within.
13. LW = 29,597 lb @ 29.8%MAC — within.
14. ≈ 26.5 %MAC — within the ≈23.5–33%MAC takeoff band.
15. B.
16. From the CAFM — takeoff (value depends on conditions; confirm ≤ TODA 9,401 ft).
17. From the CAFM / FMS TOLD for the actual weight & conditions.
18. B.
19. B — V_2 + 15 (Flaps 10); V_2 + 25 (Flaps 20).
20. B.

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CL-350



CL-350 SUPPLEMENTAL MANUAL

SUPPLEMENTS 12

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CONTAMINATED – GENERAL

CONTAMINATED RUNWAY PERFORMANCE DATA

GENERAL

This supplement contains information and procedures for operation of the Challenger 350 BD−100−1A10 airplane, fitted with two AS907−2−1A engines, on contaminated runways. The following information and procedures have been prepared by the manufacturer for use when operating on runway surfaces contaminated by standing water, slush, dry snow, wet snow, compacted snow or ice.

- This information has been prepared by the manufacturer and approved as guidance material to assist operators in developing suitable guidance, recommendations or instructions for use by their flight crews when operating on contaminated runway surface conditions.
- The data have been prepared using industry accepted calculations to determine the effects of contaminated runway surfaces on the accelerating ground roll and braking ground roll. **The effects of actual conditions may differ from those used to establish this data.**
- The level of safety is decreased when operating on contaminated runways, therefore, every effort should be made to ensure that the runway surface is cleared adequately of any significant precipitation.
- Contaminated runway performance data were calculated assuming that the runway is completely contaminated, with the contaminant (standing water, slush, or snow) to be of uniform depth and density.
- When operating on contaminated runways, ground handling characteristics will not be as good as can be achieved on dry runways. In particular, this is applicable in crosswind conditions and when using thrust reversers.

Performance calculations in the Computerized Airplane Flight Manual (CAFM) automatically take into account the runway surface condition as required, based upon the selection made in the drop−down list of the Runway Surface Condition section under the Runway Data pane of the CAFM calculator.

The performance data in Chapter 6 – PERFORMANCE (CAFM) are applicable.

DEFINITION OF RUNWAY CONDITIONS

SPECIFIC GRAVITY

Specific gravity is defined as the density of the runway contaminant divided by the density of water.

STANDING WATER OR SLUSH

A runway is considered to be contaminated when more than 25% of the runway surface area (whether in isolated areas or not), within the required length and width being used, is covered by more than 1/8 inch (3 mm) of standing water or its equivalent in slush (see table below).

CONTAMINATED – GENERAL

DEPTH OF STANDING WATER	EQUIVALENT DEPTH
	SLUSH
0.125 in (3.2 mm)	0.125 in (3.2 mm)
0.250 in (6.4 mm)	0.250 in (6.4 mm)

Standing water is accumulated water on the runway surface caused by heavy rainfall or by poor drainage.

Slush is partly melted snow or ice with high water content, from which water can readily flow, with an assumed specific gravity of 0.85. Slush is normally a transient condition found only at temperatures close to 0 °C (32 °F).

WET SNOW

A runway is considered to be contaminated when more than 25% of the runway surface area (whether in isolated areas or not), within the required length and width being used, is covered by wet snow.

Wet snow is snow that will stick together when compressed, but will not readily allow water to flow from it when squeezed, with an assumed specific gravity of 0.5.

COMPACTED SNOW

A runway is considered to be contaminated by compacted snow when covered by snow which has been compacted into a solid mass such that the airplane wheels, at representative operating pressures and loading, will run on the surface without causing significant rutting (i.e. resists further compression).

Compacted snow will hold together or break into lumps if picked up by hand.

DRY SNOW

A runway is considered to be contaminated by dry snow when more than 25% of the runway surface area (whether in isolated areas or not), within the required length and width being used, is covered by dry snow.

Dry snow is fresh snow that can be blown, or, if compacted by hand, will fall apart upon release (also commonly referred to as loose snow), with an assumed specific gravity of 0.2.

ICE

A runway surface condition where braking action is expected to be very low, due to the presence of ice.

Ice is water which has frozen on the runway surface, including the condition where compacted snow transitions to a polished ice surface.

CONTAMINATED – GENERAL

MAXIMUM CONTAMINANT DEPTHS

The maximum depths of runway contaminants covering an appreciable part of the runway are:

MAXIMUM CONTAMINANT DEPTHS		
CONTAMINANT	**TAKEOFF**	**LANDING**
STANDING WATER	0.25 in (6.4 mm)	0.50 in (12.7 mm)
SLUSH	0.25 in (6.4 mm)	0.50 in (12.7 mm)
WET SNOW	0.50 in (12.7 mm)	1.00 in (25.4 mm)
DRY SNOW	2.00 in (50.8 mm)	3.00 in (76.2 mm)

TAKEOFF FROM CONTAMINATED RUNWAYS

The use of takeoff distance on a contaminated runway that is shorter than the takeoff distance on a dry runway is prohibited.

Distances for runways contaminated with standing water, slush, wet snow, dry snow, compacted snow or ice are calculated by the CAFM assuming that the runway is completely contaminated. However, selection of the type and amount of contaminant should be based on the runway conditions where the high speed portion of the takeoff will occur and, in the case of an ice covered runway, where braking would be used during a rejected takeoff.

STANDARD PERFORMANCE CONDITIONS

All contaminated runway takeoff performance is based on the following performance conditions:

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

CONTAMINATED RUNWAY TAKEOFF DATA

NOTE: Dispatch with only one thrust reverser available is not recommended on a ice covered runway.

CAFM calculators provide the following runway contaminants for takeoff:

- Ice
- Compacted Snow
- 2 in (50.8 mm) Dry Snow
- 0.125 in (3.2 mm) Standing Water or equivalent
- 0.250 in (6.4 mm) Standing Water or equivalent

CONTAMINATED – GENERAL

- 0.250 in (6.4 mm) Wet Snow
- 0.500 in (12.7 mm) Wet Snow.

If the runway is covered by less than 2 in (50.8 mm) of Dry Snow, the performance data for 2 in (50.8 mm) of Dry Snow shall be used. If the runway is covered by less than 0.25 in (6.4 mm) of Wet Snow, the performance data for 0.25 in (6.4 mm) of Wet Snow shall be used.

When a contaminated 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)

The CAFM calculators input checking ensures that the proper anti–ice system is selected for the specified runway contaminant and ambient temperature. It is verified that the anti–ice requirements on contaminated runways are applied (see the Basic Limitations 'Operation in Icing Conditions' Section, Limitations Chapter 2).

The takeoff performance on a contaminated runway is determined using the same methodology as described for the dry and wet runway conditions in Chapter 6 of the AFM.

ACTUAL LANDING DISTANCE ON CONTAMINATED RUNWAYS

The use of actual landing distance on contaminated runways that is shorter than the dry runway factored landing distance is prohibited.

The Landing Performance Module of the CAFM calculates the actual landing distance on a contaminated runway. The data are provided for the following runway contaminants:

- Ice
- Compacted Snow
- Dry Snow
- Slush or Standing Water
- Wet Snow.

The actual landing distances presented are based on:

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

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

CONTAMINATED – GENERAL

The actual landing distance calculations on contaminated runways with both engines operating, are predicated upon speeds at the runway threshold from V_{REF} to V_{REF}+ 10 KIAS, corrected for the effects of wind and usage of thrust reversers.

The operator can also specify a Landing Distance Factor to be applied on the Actual Landing Distance determined by the CAFM.

Effectivity:

For EASA registered aircraft

NOTE: The landing distance on contaminated runways must be factored by 1.15 and this is accomplished in the CAFM by entering the factor in the Ldg Dist Factor field within the Landing Distance and Speed Calculator. This factored landing distance output must then be compared with the corresponding factored landing distance output for wet runways and the longer of the two utilized.

NOTE: ROAAS (if installed) may not provide timely alerts to reduce the risk of overrun on contaminated runways with braking reports less than RCC 5.

NORMAL PROCEDURES

The normal procedures in Chapter 4 are applicable, except as modified by the following:

If landing on a contaminated runway:

1. ROAAS RCC 5 switch (if installed) ..... ON

NOTE: ROAAS may not provide timely alerts to reduce the risk of overrun on contaminated runways with braking reports less than RCC 5.

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INTRODUCTION

This supplement is only applicable when used in conjunction with a Minimum Equipment List (MEL) approved by the appropriate authority.

The performance corrections to be applied when dispatching with airplane systems inoperative as allowed by the MEL, are calculated automatically in the CAFM when specified in the MMEL/CDL section of the CAFM calculator. In order for the effect of these inoperative equipment to be taken into account in the calculation, the MMEL/CDL extension of the CAFM calculator dialog must be open or activated **and the check box appropriate for the MEL item selected**.

The following data must be used in conjunction with the basic Airplane Flight Manual (AFM), its supplements and the CAFM.

LIMITATIONS

The limitations established in Chapter 2 are applicable, except as modified by the following:

FLIGHT WITH LANDING GEAR DOWN

Category II Operations are prohibited.

NOSEWHEEL STEERING INOPERATIVE

The maximum crosswind is 15 knots.

EMERGENCY PROCEDURES

The emergency procedures in Chapter 3 are applicable.

NORMAL PROCEDURES

The normal procedures in Chapter 4 are applicable.

NON–NORMAL PROCEDURES

The non–normal procedures in Chapter 5 are applicable.

PERFORMANCE

The performance data in Chapter 6 PERFORMANCE, the CAFM **and Chapter 7 – SUPPLEMENTS** are applicable, with the addition of the following:

- Activate the MMEL/CDL extension of the CAFM calculator and toggle the check box for the appropriate item(s) in the MMEL listing of inoperative systems.

NOTE: The provision of performance information for inoperative equipment in the CAFM does not imply approval for dispatch in the MMEL/MEL. The MMEL/MEL must be consulted to ensure that dispatch with inoperative equipment is permitted

FLIGHT DIRECTOR GUIDANCE OR TOGA SWITCHES INOPERATIVE

Dispatch with one or both flight directors inoperative and/or with TOGA switches inoperative is conducted following the normal takeoff procedure using the target pitch attitude for takeoff specified in the following tables. The ΔV between V_2 and V_R for the specified conditions is used to find the target pitch attitude. Different pitch attitudes are provided depending on takeoff flap setting, V_R value and the number of engines operating. Go–around procedure with one or both flight directors inoperative is conducted using a fixed target pitch attitude of 8 degrees.

Target Pitch Attitude for Takeoff Flaps 10

$\Delta V = (V_2 - V_R)$ (KIAS)	$V_R \leq$ 121 KIAS		$V_R >$ 121 KIAS	
	Single Engine Pitch Guidance (Degrees)	All Engine Pitch Guidance (Degrees)	Single Engine Pitch Guidance (Degrees)	All Engine Pitch Guidance (Degrees)
0	8.5	13.4	7.5	9.8
1	8.8	14.0	8.0	11.1
2	9.2	14.7	8.6	12.4
3	9.5	15.3	9.2	13.7
4	9.9	16.0	9.8	15.0
5	10.3	16.6	10.4	16.3
6	10.6	17.2	11.0	17.6
7	11.0	17.9	11.6	18.9
8	11.3	18.5	12.2	20.2
9	11.7	19.2	12.8	21.5
10	12.0	19.8	13.4	22.8
11	12.4	20.5	14.0	22.8
12	12.7	21.1	14.0	22.8
13	13.1	21.7	14.0	22.8
14	13.4	22.4	14.0	22.8
15 or more	13.8	23.0	14.0	22.8

Target Pitch Attitude for Takeoff Flaps 20

$\Delta V = (V_2 - V_R)$ (KIAS)	$V_R \leq$ 120 KIAS		$V_R >$ 120 KIAS	
	Single Engine Pitch Guidance (Degrees)	All Engine Pitch Guidance (Degrees)	Single Engine Pitch Guidance (Degrees)	All Engine Pitch Guidance (Degrees)
0	5.9	11.3	6.9	10.8
1	6.3	11.9	7.5	11.9
2	6.7	12.5	8.2	13.0
3	7.0	13.1	8.9	14.1
4	7.4	13.7	9.6	15.2
5	7.8	14.3	10.3	16.3
6	8.2	14.9	10.9	17.4
7	8.5	15.5	11.6	18.5
8	8.9	16.1	12.3	19.6
9	9.3	16.7	12.3	19.6
10	9.6	17.3	12.3	19.6
11	10.0	17.9	12.3	19.6
12	10.4	18.5	12.3	19.6
13	10.8	19.1	12.3	19.6
14	11.1	19.7	12.3	19.6
15 or more	11.5	19.7	12.3	19.6

PITCH_C350_04APR14

Figure 07–02–01–1

FLIGHT WITH LANDING GEAR DOWN

The performance data in Chapter 6 are applicable, with the addition of the following:

– Activate the MMEL/CDL extension of the CAFM calculator and toggle the check box for Flight with Landing Gear Down in the MMEL listing of inoperative systems.

Alternatively, apply the following performance corrections to the data determined using the CAFM without activation of any MMEL item.

TAKEOFF FIELD PERFORMANCE

Table 1 presents the takeoff performance corrections to be applied to the basic CAFM Takeoff data.

TABLE 1: TAKEOFF PERFORMANCE CORRECTIONS – LANDING GEAR DOWN

AFFECTED CAFM DATA	EFFECT OF FLIGHT WITH LANDING GEAR DOWN
Dry (or Wet or Contaminated) Runway Takeoff Data – Flaps 10 or 20 – All Bleeds – All Altitudes	Increase the V_1, V_R and V_2 from basic CAFM data by 3 KIAS. Increase the Takeoff Field Length obtained from the basic CAFM data by 6.0%. Reduce the takeoff weight limited by tire speed from basic CAFM data by 1600 lb.

NOTE: V_1 limited by maximum brake energy (V_{1MBE}) is unaffected by this MMEL item. Hence, when the correction from Table 1 is applied to V_1, the operator must make sure the corrected value still respects the V_{1MBE} limit.

TAKEOFF AND LANDING WEIGHT LIMITED BY CLIMB REQUIREMENTS

The alternative performance penalty for dispatch with landing gear down is calculated as a weight decrement to be applied to the basic CAFM data and is presented in Table 2.

TABLE 2: TAKEOFF AND LANDING WEIGHT LIMITED BY CLIMB REQUIREMENTS CORRECTIONS – LANDING GEAR DOWN

AFFECTED CAFM DATA	EFFECT OF FLIGHT WITH LANDING GEAR DOWN
Takeoff Weight Limit – Flap 10	Reduce the takeoff weight limited by climb requirements from basic CAFM data by 9000 lb.
Takeoff Weight Limit – Flap 20	Reduce the takeoff weight limited by climb requirements from basic CAFM data by 6500 lb.
Landing Weight Limit	Reduce the landing weight limited by climb requirements from basic CAFM data by 7500 lb.

TAKEOFF FLIGHT PATH

The following takeoff flight path related items are affected by the landing gear being down:

- Second segment gradient
- Maximum level–off height
- Net acceleration distance from V_2 to V_{FTO}
- Final segment gradient.

The following paragraphs provide a simplified alternative to consider the above flight path effects for flight with landing gear down. There are two possible cases depending on the location of the obstacles:

Case 1:

Obstacles are present in the takeoff flight path and they are all cleared by the required margin when the aircraft reaches the level–off height (i.e. the acceleration distance and the final segment climb are not limiting):

- Flap 10 and Flap 20: Reduce the normal performance limited takeoff weight by 7000 lb.

Case 2:

For far away obstacles which are cleared in the level acceleration segment or in the final segment, use the CAFM to calculate performance with landing gear down.

ENROUTE

Table 3 presents the corrections to be applied to the basic CAFM enroute data. The corrections are valid for all engine bleed configurations.

TABLE 3: ENROUTE GRADIENT CORRECTION – LANDING GEAR DOWN	
AFFECTED CAFM DATA	**EFFECT OF FLIGHT WITH LANDING GEAR DOWN**
Net Enroute Climb Gradient – All Bleeds	Reduce the Net Enroute Climb Gradient from basic CAFM data by 5.0%.

LANDING

Table 4 presents the corrections to be applied to the basic CAFM landing data. The corrections are valid for all engine bleed configurations.

TABLE 4: GRADIENT CORRECTION AND APPROACH CLIMB SPEED – LANDING GEAR DOWN	
AFFECTED CAFM DATA	**EFFECT OF FLIGHT WITH LANDING GEAR DOWN**
Approach Climb Gradient – All Bleeds	Reduce the Approach Climb Gradient from basic CAFM data by 2.7%.
Approach Climb Speed	Increase the Approach Climb Speed, V_{2GA}, from basic CAFM data by 3 KIAS.

FLAP 0 STALL SPEEDS WITH LANDING GEAR DOWN

The Flap 0 Stall Speeds presented on Figure 06–01–12 (Chapter 6 Performance) supersede the corresponding speeds determined with the General Module, Stall Speeds calculator of the CAFM.

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

NOSEWHEEL STEERING INOPERATIVE

The performance data in Chapter 6 are applicable, with the addition of the following:

– Activate the MMEL/CDL extension of the CAFM calculator and toggle the check box for Nosewheel Steering Inoperative in the MMEL listing of inoperative systems.

Alternatively calculations can be performed using the distance penalty for Nosewheel Steering Inoperative as presented in Table 5 and can be applied to previously calculated CAFM performance data (with the Nosewheel Steering Inoperative MMEL item not selected).

TAKEOFF

The performance corrections are summarized in Table 5.

TABLE 5: TAKEOFF WEIGHT CORRECTION – NOSEWHEEL STEERING INOPERATIVE

AFFECTED CAFM DATA	EFFECT OF NOSEWHEEL STEERING INOPERATIVE
Dry (or Wet) Takeoff Data – Flaps 10 or 20 – All Bleeds – All Altitudes	Increase the Takeoff Field Length obtained from the basic CAFM data by 1.0%.

RADIO ALTIMETER INOPERATIVE

LANDING DATA

Performance corrections must be applied to the corrected Landing Distance for dry, wet, or contaminated runway operations as follows:

AFFECTED CAFM OUTPUT	EFFECT OF RADIO ALTIMETER INOPERATIVE
Dry and Wet Runway Landing Data, Contaminated Runway Actual Landing Distance	Increase the Actual (ALD), Factored (FLD) and Wet Factored (FLD WET) Landing Distances, when using the applicable CAFM data, by 10.0%.

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INTRODUCTION

NOTE: This Airplane Flight Manual supplement does not constitute approval to conduct Category II operations.

The Bombardier Challenger 350 has been shown to meet the airworthiness requirements for Category II Operations contained in Appendix 1 of AC 120–29 and Subpart 2 of CS–AWO. The data in this supplement must be used when conducting Category II operations.

These data complement or supersede data contained in the basic Airplane Flight Manual. This supplement must therefore be read in conjunction with the basic Airplane Flight Manual.

The effect of this supplement on the basic Airplane Flight Manual is given below.

LIMITATIONS

The limitations in the Aircraft Flight Manual are applicable with the addition of the following:

1. Flaps must be at 30°.
2. The minimum decision height is 100 ft AGL.
3. Single engine Cat II AP coupled approaches are prohibited.
4. FD only Cat II operations are prohibited.
5. Cat II approaches with autothrottle engaged are prohibited.
6. Cat II approaches must be flown with the Autopilot coupled.
7. YD must be selected on.
8. Use of FMS computed approach speeds is prohibited.
9. Cat II approaches are prohibited if one or more of the following messages are displayed:
   - AFCS MESSAGES FAIL Caution
   - EFIS COMPARATOR INOP Caution
   - EFIS MISCOMPARE Caution.
10. The maximum ILS glidepath angle for Category II approaches is 3.5 degrees.

An ILS approach to Category II minima must not be commenced or continued unless all required airborne equipment (specified in the Category II Required Equipment List below), and their ground installations are operating satisfactorily.

CATEGORY II REQUIRED EQUIPMENT LIST

EQUIPMENT	REQUIREMENT
YD	Must be operational
Autopilot	Must be operational
VHF NAV 1 & 2	Both must be operational and displayed onside
L/R PFD	One PFD available and operational for each side
PRI STAB Trim	Must be operational
Radio Altimeter*	Must be operational, with display on both sides
IRS 1 & 2	Both must be operational
ADC 1 & 2	Both must be operational
FD 1 & 2	Both must be operational
Hydraulics	L, R, & Aux systems must be operational
Electrical	Two generators on and sharing load, (Two engine generators, or one engine generator and the APU generator)

EMERGENCY PROCEDURES

The emergency procedures in chapter 3 are applicable, except as modified by the following:

If RA is displayed on the PFD:

1. Do not conduct Cat II approaches.
2. Normal actual landing distance ..... Multiply by:
   1.20 without thrust reversers
   1.15 with thrust reversers

NORMAL PROCEDURES

APPROACH

A category II monitor is enabled when specific conditions have been met. When the category II monitor is enabled, deviations beyond 1/3 dot localizer or 1 dot glideslope will result in the respective pointer flashing amber.

The category II monitor is enabled when:

- The glideslope is captured
- The radio altitude is less than 600 ft (Lateral deviation indicator expands at 600 feet AGL)
- The radio altitude is greater than RA MIN or 100 ft (whichever is greater)
- RA MIN is less than 200 ft and selected for display
- MIN ALERT is set to RA.

NON–NORMAL PROCEDURES

Engine Failure During Approach:

1. Autopilot ..... Disconnect
2. Operating Engine Thrust Lever ..... Increase as required
3. Rudder Trim ..... As required
4. Conduct approach to Category I minima or go–around.
5. Refer to the following procedures as applicable:
   a. Engine Shutdown in Flight, NON–NORMAL Chapter
   b. Single Engine Landing, NON–NORMAL Chapter
   c. Single Engine Go–Around, NON–NORMAL Chapter.

PERFORMANCE

The performance data in the PERFORMANCE Chapter of the AFM are applicable, except as modified by the following:

MAXIMUM DEMONSTRATED WIND COMPONENTS

The maximum demonstrated wind components, measured at 10 meters (33 ft) tower height, for Category II operations are as follows:

Headwind ..... 19 kts
Crosswind ..... 20 kts
Tailwind ..... 10 kts

MAXIMUM ALLOWABLE LANDING WEIGHT

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

- Maximum certified landing weight of 34,150 lb (15,490 kg)
- Runway length available
- Climb requirements or brake energy limits.

MAXIMUM LANDING WEIGHT LIMITED BY CLIMB REQUIREMENTS OR BRAKE ENERGY

The maximum allowable landing weight limited by climb requirements for Category II operations is determined from the Approach and Landing Performance Module, using the calculation scenario Landing Weight Limited by Climb Requirements. In order for the CAFM calculator to take into account the Category II climb requirements, the CAT II field in the Aircraft Data pane must be selected to Yes.

The Maximum permissible quick turn–around landing weight limited by brake energy must be based on the data presented in the PERFORMANCE Chapter of the AFM.

SUPPLEMENTS

The supplementary data in Chapter 7 are applicable.

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GENERAL

This Supplement provides data for the operational capabilities and the applicable standards of certain airplane systems.

NOTE: Compliance with the standards noted below does not constitute an operational approval.

The effect of this Supplement on the basic Airplane Flight Manual is given below:

INTRODUCTION

The general information in Chapter 1 is applicable.

LIMITATIONS

The limitations in Chapter 2 are applicable.

EMERGENCY PROCEDURES

The emergency procedures in Chapter 3 are applicable.

NORMAL PROCEDURES

The normal procedures in Chapter 4 are applicable.

ABNORMAL PROCEDURES

The abnormal procedures in Chapter 5 are applicable.

PERFORMANCE

The performance data in Chapter 6 is applicable.

SUPPLEMENTS

The supplements in Chapter 7 are applicable.

NAVIGATION

RVSM

This airplane complies with the Airworthiness Requirements specified in “Interim Guidance Material on the Approval of Operators / Aircraft for RVSM Operations”, 91–RVSM dated June 30, 1999, or with AC 91–85 dated August 21/2009 , and with JAA Temporary Guidance Leaflet, TGL No. 6, revision 1, RVSM. Airworthiness approval does not constitute operational approval for flight in RVSM airspace. Operational approval for flight in RVSM airspace must be obtained from the appropriate regulatory authority.

RVSM operations must not be commenced or continued unless all of the required equipment specified below is operational:

RVSM REQUIRED EQUIPMENT LIST	
EQUIPMENT	**REQUIREMENTS FOR RVSM**
Autopilot (FGC, FGP, Elevator servo)	Must be operational
Altitude Alerting System	Two AFDs must be operational displaying 2 primary altimeters
Altitude Reporting Transponder / Traffic Surveillance System	One must be operational
Air Data Computers	Two must be operational

FLIGHT MANAGEMENT SYSTEM (FMS)

Approval Status

Provided the FMS is receiving adequate usable signals, the FMS has been demonstrated capable of and has been shown to meet the performance requirements for the following operations:

Lateral Navigation

1) VFR/IFR en route oceanic and remote, en route domestic, terminal operation, and instrument approach using WGS84 (or NAD83) coordinate reference datum in accordance with the performance/accuracy requirements of AC 20−138D.
2) Global Navigation Satellite System (GNSS) TSO C145a B3/AC 20−138D and Flight Management System (FMS) TSO−C115b and TSO−C146c D4/AC 20−138D: The installed equipment complies with AC 20−138D, AMC 20−27A and AMC 20−28; for navigation using GNSS and GNSS/SBAS (within the coverage of a satellite−based augmentation system complying with ICAO Annex 10) for enroute, terminal area, non−precision approach, and approach procedures with vertical guidance operations. Non−precision approach operations include those based on conventional navigation aids with or without GNSS in the title and those with GNSS and RNAV (GNSS) in the title to LNAV minimums. Approach procedures with vertical guidance include RNAV (GNSS) and LNAV/VNAV minimums as well as LPV approaches.

The installed system is compatible with the WAAS (North America), EGNOS (Europe), GAGAN (India) and MSAS (Japan) SBAS Service Providers, complying with ICAO Annex 10 and developed per RTCA DO−229().

RNP Operations

RNP 10 (RNAV 10) – In accordance with AC 90–105A Appendix G, ICAO Doc 9613 PBN Volume II, Part B, Chapter 1, and AMC 20–12 the FMS installation with the IRS has been demonstrated to meet the criteria as a primary means of navigation for flight up to 6.2 hours in duration without updating. The determination of flight duration starts when the airplane first begins to move after the system is placed in navigation mode.

– In accordance with AC 90–105A Appendix G, ICAO Doc 9613 PBN Volume II, Part B, Chapter 1, and AMC 20–12 the FMS installation with the GNSS with RAIM has been demonstrated to meet the criteria as a means of navigation for flights without time limitations.

RNP AR – Refer to Supplement 7 – RNP Authorization Required Approach Operations.

RNP–2 – In accordance with ICAO Doc 9613 PBN Volume II, Part C, Chapter 2, the FMS has been demonstrated capable of primary navigation for RNP–2 Enroute area operations provided that the FMS is receiving information from a GNSS sensor and operating in GNSS navigation mode.

RNP–4 – In accordance with ICAO Doc 9613 PBN Volume II, Part C, Chapter 1 and AC 90–105A Appendix F, the FMS has been demonstrated capable of primary navigation for RNP–4 Oceanic and remote area operations provided that two FMS systems are available and receiving information from two independent GNSS sensors and operating in GNSS navigation mode.

Basic RNP–1 – In accordance with ICAO Doc 9613 PBN Volume II, Part C, Chapter 3 and AC 20–138D Chap 9 for FAA RNP 1 (Terminal) operations, the FMS has been demonstrated capable of primary navigation for RNP–1 operations provided that the FMS is receiving information from a GNSS sensor and operating in GNSS navigation mode.

Effectivity:

On airplanes 20664 and subsequent and airplanes 20501–20663 incorporating SB 350–34–012.

RF Legs – In accordance with AC20–138D Appendix 3, the FMS has been demonstrated capable of performing RF Legs in the initial, intermediate, and missed approach segments of instrument approaches, RNP departure procedures (dP) and RNP STARS provided that:

- Autopilot is engaged or Flight Director is selected; and
- The FMS is receiving information from a GNSS sensor and operating in GNSS navigation mode.

RNP APCH – The FMS has been demonstrated capable of primary navigation for RNP APCH operations in accordance with ICAO Doc 9613 PBN Volume II, Part C, Chapter 5, AC 20–138D for FAA RNP instrument approach with Baro–VNAV and AMC 20–27A for RNP APCH with Baro–VNAV Provided FMS is receiving information from a GNSS sensor and operating in:

- GNSS navigation mode; and
- RNP APPR annunciation is displayed at the Final Approach Fix.

LPV Approaches The FMS and GNSS have been demonstrated capable of primary navigation for LPV operations in accordance with ICAO Doc 9613 PBN Volume II, Part B, Chapter 5, AC 20–138D for FAA LPV and AMC 20–28 for EASA LPV.

NOTE: LP approaches cannot be performed.

Baro–VNAV – Provided at least a single FMS, a single GNSS and dual ADC are installed and operational and the NO APPR (on PFD) messages are NOT posted, this FMS installation has been demonstrated to meet the requirements of AC 20–138D for performing Baro–VNAV.

Vertical Navigation (VNAV) – The FMS has been demonstrated capable of and has been shown to meet the accuracy requirements of: VFR/IFR en route, terminal and approach VNAV operation within the contiguous United States and Alaska in accordance with the criteria of AC 20–138D. VNAV Temperature Compensation meets the requirements of TCCA AC 500.020 FMS Barometric VNAV Temperature Compensation and RTCA DO–236B MASPS RNP for Area Navigation, Appendix H.

Primary Means Oceanic and Remote – Use of the FMS with GNSS has been found to comply with the requirements of AC 20–138D, Appendix 1 for GNSS primary means of navigation in oceanic and remote airspace, with two operational GNSS receivers and with two operational FMS systems.

NAT MNPS – Provided dual FMS and any two independent long range navigation systems, consisting of any combination of GNSS or IRS are installed and operating, the FMS with GNSS inputs has been demonstrated capable of flight into North Atlantic (NAT) minimum navigation performance specification (MNPS) and has been shown to meet the accuracy specification in accordance with AC 120–33.

RNAV–2 – In accordance with AC90–100A, the FMS has been demonstrated capable of primary navigation in RNAV–2 airspace provided that the FMS is operating in GNSS or DME/DME navigation mode.

RNAV–5 / BRNAV – This FMS installation has been demonstrated to meet the BRNAV requirements of AC 90–96A and JAA AMJ 20X2 Leaflet 2, Revision 1.

RNAV–1 / PRNAV – The FMS installation has been demonstrated to meet the PRNAV requirements of JAA TGL 10.

Compliance With AC 90−100A – When equipped with an operating FMS and GNSS, the airplane meets the functional and the +/−1 nm accuracy requirements of AC 90−100A, U.S. Terminal and En Route Area Navigation (RNAV) Operations.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

Pilots are authorized to deviate from their Air Traffic Control (ATC) clearance in order to comply with a resolution advisory (RA) command.

SURVEILLANCE

MODE S – ENHANCED SURVEILLANCE

The Mode–S Transponder satisfies the data requirements of ICAO Doc 7030/4, Regional Supplementary Procedures for SSR Mode S Enhanced Surveillance in designated European airspace. The capability to transmit parameters is shown in the following table:

PARAMETER	AVAILABLE
Magnetic Heading	Yes
Indicated Airspeed	Yes
Mach Number	Yes
Vertical Rate	Yes (see note 1)
Roll Angle	Yes
Track Angle Rate	No (see note 2)
True Track Angle	Yes (see note 3)
Groundspeed	Yes (see note 3)
Selected Altitude	Yes
Barometric Pressure Setting	Yes

NOTE: 1. The rate of climb/descent is generated from a barometric source (not inertial).

2. True Airspeed is transmitted in lieu of Track Angle Rate.

3. Airplane must be equipped with at least one functioning Flight Management Computer and FMS Control Display Unit.

Effectivity:

For airplanes 20501–20594 not incorporating SB 350–34–011.

ADS–B OUT

The installed ADS–B Out system meets Section 8 of EASA AMC 20–24, dated 2 May 2008.

ADS–B operations in Non–Radar Areas (ADS–B NRA) cannot be commenced or continued unless the required equipment specified below is operational:

ADS–B OUT EQUIPMENT LIST	
EQUIPMENT	**REQUIREMENT**
Transponder / Traffic Surveillance System	One must be operational.
Air Data Computers (2)	One must be operational.
Global Positioning System receivers (2)	One must be operational.

Effectivity:

For airplanes 20595–22999 and airplanes incorporating SB 350–34–011.

ADS–B OUT

The installed ADS–B Out system has been certified in accordance with the guidance provided in the FAA AC 20–165A, the EASA CS.ACNS.D.ADS and the Australian AC 21–45 and meets the equipment requirements of FAA 14 CFR 91.227 and those of CASA CAO 20.18.

ADS–B operations cannot be commenced or continued unless the required equipment specified below is operational:

ADS–B OUT EQUIPMENT LIST	
EQUIPMENT	**REQUIREMENT**
Transponder / Traffic Surveillance System	One must be operational.
Air Data Computers (2)	One must be operational.
Global Positioning System receivers (2)	One must be operational.

NOTE: This Supplement does not constitute an operational approval for the ADS–B Out capability.

COMMUNICATIONS

DATALINK

Effectivity:

Applicable to airplanes incorporating SB 350–23–010.

ATN B1 CPDLC (LINK 2000+)

The system has been demonstrated to comply with the applicable safety, performance and interoperability requirements for continental ATN B1 Data Link using VDL Mode–2.

The airplane ATC Data Link system does support multi–frequency operation as defined in ARINC Spec. 631–5.

Effectivity:

Applicable to airplanes incorporating SB 350–23–011.

FANS 1/A+

The system enables CPDLC and ADS–C capabilities in support of reduced airplane separations in remote and oceanic areas, by using Satellite Communications and ACARS ground networks. The system complies with the interoperability requirements of RTCA DO–258A and the guidelines of ICAO GOLD.

The system adopts FAA AC 20–140A as an acceptable means of compliance for the following datalink capabilities:

Interoperability Designators:

- FANS 1/A+ with automation (including "push to load")
- ATN B1
- ACARS ATS

ATS Subnetworks:

- VDL Mode A
- VDL Mode 2
- SATCOM Inmarsat Classic Aero
- SATCOM Iridium Short Burst Data (SBD)

Aircraft–Allocated performance:

- CPDLC: RCP 240
- ADS–C: RSP 180

VHF

VHF COM and VHF NAV radios installed comply with FM immunity requirements per ICAO Annex 10, and:

- ED–22B / DO–196 for VOR receivers
- ED–46B / DO–195 for LOC receivers
- ED–23B / DO–186 for VHF communication receivers.

Effectivity:

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

NOTE: Referenced North American or European regulatory material is in compliance with its RF and CIS countries' equivalent.

Flight in polar regions outside VHF coverage shall be allowed provided forecast is favorable for HF radio waves propagation.

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INTRODUCTION

NOTE:
- This Airplane Flight Manual Supplement is only applicable to airplanes incorporating Service Bulletin 350−34−008: Installation and Activation of TAWS Smart Runway and Smart Landing (C34−500).
- These data complement or supersede data contained in the basic Airplane Flight Manual. This supplement therefore must be read in conjunction with the basic Airplane Flight Manual.
- The effect on the basic Airplane Flight Manual is given below.

FUNCTIONAL OVERVIEW

The Runway Awareness Advisory System (RAAS) is a software enhancement hosted in the Enhanced Ground Proximity Warning System (EGPWS) unit, which provides aural and visual advisories to supplement flight crew awareness of position during ground and flight operations. RAAS uses existing EGPWS inputs to generate aural advisories in the flight deck. RAAS advisories are annunciated over the same audio system as the EGPWS. Unique voices are used for RAAS advisories to allow adequate differentiation from the current EGPWS Mode 1 – 7 and Terrain / Obstacle Awareness voice call outs. RAAS advisories are succinct by design. RAAS is designed to be fully compatible with normal aircraft operations. There is no requirement for pilot input to the system.

RAAS is configurable (during installation / activation) for voice gender, units (feet or meters) and most advisories may be configured ON or OFF. This generic flight manual supplement is arranged so that each configurable advisory is maintained in its own sub−section. This allows an operator to utilize this supplement by choosing each section that applies to them.

RAAS IMPLEMENTATION AND CONFIGURATION

RAAS may be configured for a variety of advisory callout options via the RAAS Configuration Database (RCD).

The Table below provides the settings of alert options certified on the aircraft. These options and configurations are set during installation and activation of RAAS on the aircraft, and are NOT pilot selectable.

The only customer selectable options are:

- Voice gender: Female/Male
- Units of measurement: Feet/Meter
- Altimeter Setting callout: ON/OFF.

A RAAS inhibit switch is installed on the TAWS WARN panel. It allows the crew to inhibit all Runway Awareness and Advisory System Visual Indications and Aural Alerts. The white OFF illuminates when switch is selected.

ADVISORY GROUP	ADVISORY/ ALERT	ENABLED YES/NO	SETTINGS	AUDIO	VISUAL
	GPS Antenna Location		15 feet	–	–
	Advisory Suppress Window	YES	450– 550 ft	–	–
RAAS	Approaching Runway – In Air/On Ground	YES		"Approaching XX" "Approaching Runways" (if more than one runway meets the qualifying condition)	APP XX (in green) APP RWYS (in green) (if more than one runway meets the qualifying condition)
RAAS	On Runway	YES		"On Runway XX" "On Runways" (if more than one runway meets the qualifying condition)	ON XX (in green) ON RWYS (in green) (if more than one runway meets the qualifying condition)
RAAS	Distance Remaining (Landing & Rollout)	YES	2000 feet max	"ZZ Remaining"	NONE
RAAS	Runway End (< 100 feet)	YES		"One Hundred Remaining" (in feet) "Thirty Remaining" (in meters)	NONE
RAAS	Insufficient Runway Length (In Air)	YES	5000 feet	"Approaching Runway XX, ZZ available"	APP XX ZZ (in amber)
RAAS	Short Runway Landing	NO			

ADVISORY GROUP	ADVISORY/ ALERT	ENABLED YES/NO	SETTINGS	AUDIO	VISUAL
RAAS	Insufficient Runway Length (On Ground)	YES	6000 feet	“On Runway XX, ZZ remaining”	ON XX ZZ (in amber)
RAAS	Short Runway Takeoff	NO			
RAAS	Extended Hold On Runway Initial/ Repeats	YES	180 sec/ 180 sec	“On Runway XX – On Runway XX”	ON XX (in amber)
RAAS	Taxiway Takeoff	YES		“Caution, On Taxiway! On Taxiway”	ON TAXIWAY (in amber) GND PROX alert on PFD also illuminated
RAAS	Distance Remaining (Rejected Takeoff)	YES	50% of Runway	“ZZ Remaining”	NONE
RAAS	Taxiway Landing	YES		“Caution, Taxiway! Caution, Taxiway!”	TAXIWAY (in amber) GND PROX alert on PFD also illuminated
RAAS	Takeoff Flaps	YES	Min: 6°; Max: 24°	“On Runway XX, Flaps– Flaps”	FLAPS (in amber) GND PROX alert on PFD also illuminated

ADVISORY GROUP	ADVISORY/ ALERT	ENABLED YES/NO	SETTINGS	AUDIO	VISUAL
Stability Approach Monitor	Landing Flaps (Not Aligned With Runway)	NO			
	Landing Flaps (Aligned With Runway)	YES	700 feet	“Flaps– Flaps”	FLAPS (in amber)
	Too High (During Approach)	YES		“Too High– Too High”	TOO HIGH (in amber)
	Too Fast (During Approach)	YES		“Too Fast– Too Fast”	TOO FAST (in amber)
	Unstable (During Approach)	YES		“Unstable– Unstable”	UNSTABLE (in amber) GND PROX alert on PFD also illuminated
Long Landing	Long Landing Distance	YES	2000 ft past approach end	“Long Landing – Long Landing”	LONG LANDING (in amber) GND PROX alert on PFD also illuminated
	Long Landing Percentage	YES	67% remaining	“Long Landing – Long Landing”	LONG LANDING (in amber) GND PROX alert on PFD also illuminated
	Long Landing Distance Remaining	YES	3000 ft past approach end	“ZZ Remaining”	
	Long Landing Distance Remaining Percentage	YES	60% remaining	“ZZ Remaining”	

ADVISORY GROUP	ADVISORY/ ALERT	ENABLED YES/NO	SETTINGS	AUDIO	VISUAL
Corrected Altitude Monitor	Altimeter Setting (Below Transition Altitude)	YES		“Altimeter Setting”	ALTM SETTING (in amber)
	Altimeter Setting (Above Transition Altitude)	YES		“Altimeter Setting”	ALTM SETTING (in amber)

XX = Runway Identifier

ZZ = Available runway distance in feet or meters

LIMITATIONS

The limitations in the Airplane Flight Manual are applicable with the addition of the following:

- RAAS advisories are not intended for navigation purposes.
- Pilots should not deviate from ATC clearances or otherwise correct aircraft position based solely on RAAS advisories.
- Pilots may not use Runway Awareness and Advisory System advisories as a replacement for NOTAM or Automatic Terminal Information Service (ATIS) information.
- RAAS Short and Insufficient Runway functions do not take into account aircraft performance factors such as aircraft weight, wind, runway conditions, slope, air temperature and altitude of airport. The runway length settings for these functions were determined from a review of takeoff and landing performance and are considered to be acceptable guidelines for RAAS purposes. This information is intended to enhance the flight crew awareness by identifying that the runway length available may be marginal for the current conditions.
- Data on newly constructed runways, changes to length of existing runways, or the rare change of runway identifier may not necessarily be included in the RAAS runway database.
- RAAS does not have knowledge of where painted hold lines are located at airports. In some cases, the RAAS Approaching Runway Advisory may be issued after an aircraft has crossed a hold line.
- The RAAS system is a situational awareness tool to the flight crew and should not be used as the primary source of determining field position, runway length, field performance, etc. The absence of RAAS aural and/or visual messages such as "short runway" or "long landing" does not guarantee that the aircraft can be safely operated from or onto the runway.
- Altimeter Monitor–Below Transition Altitude function, is not available at airports defined as QFE in the EGPWS database.

EMERGENCY PROCEDURES

The emergency procedures in chapter 3 are applicable with the addition of the following:

All Procedures Requiring TAWS Flaps Aural Warning to be Muted

1. TAWS WARN, RAAS Inhibit switch ..... OFF

NORMAL PROCEDURES

The normal procedures in chapter 4 are applicable with the addition of the following:

Effectivity:

For aircraft 20501 to 20598.

Refer to the Honeywell MK V Enhanced Ground Proximity Warning System (EGPWS) and Runway Awareness Advisory System (RAAS) Pilot Guide, document 060–4241–000 revision G or later appropriate revision for descriptive information.

Refer to Honeywell Pilot's guide for the MKV–A EGPWS, document PDS69000940–801, Rev A or later.

NON–NORMAL PROCEDURES

The non–normal procedures in chapter 5 are applicable with the addition of the following:

All Procedures Requiring TAWS Flaps Aural Warning to be Muted

1. TAWS WARN, RAAS Inhibit switch ..... OFF

RESPONSE TO RAAS ADVISORIES WHILE IN–AIR OR DURING HIGH SPEED OPERATIONS

If the advisory is in conflict with expectations, respond as follows:

1. Verify position and/or distance remaining/distance available.
2. Contact ATC for assistance if necessary.

NOTE: RAAS nuisance aurals can be selected off using RAAS Inhibit switch on the TAWS panel.

RESPONSE TO RAAS ADVISORIES WHILE ON THE GROUND DURING LOW SPEED OPERATIONS

If the advisory is in conflict with expectations, respond as follows:

1. Stop.
2. Verify position.
3. Contact ATC for assistance if necessary.

NOTE: RAAS nuisance aurals can be selected off using RAAS Inhibit switch on the TAWS panel.

RAAS ADVISORIES OPERATION STATUS

Effectivity:

For aircraft 20501–21047.

The following Runway Awareness and Advisory System messages can be verified on the ground only, by selecting Terrain for display and changing the display range:

1. **RAAS–OK–XX** (green): Runway Awareness and Advisory System is enabled, functioning, has good position information, and is at a validated airport. Distances enunciated in Feet or Meters. (XX=FT or M).
2. **RAAS–N/AVBL** (amber): Runway Awareness and Advisory System is enabled, but the system either has no position information, the accuracy of the position information is insufficient to allow Runway Awareness and Advisory System to function, or the aircraft is at an airport that has not been validated for Runway Awareness and Advisory System in the EGPWS Terrain Database.
3. **RAAS–INOP** (amber): Runway Awareness and Advisory System is enabled but function is inoperative.
4. **RAAS–RTO** (green): Runway Awareness and Advisory System is enabled and functioning, but Runway Awareness and Advisory System advisories are temporarily inhibited because Runway Awareness and Advisory System has detected a rejected take–off condition. To clear this message and enable Runway Awareness and Advisory System advisories, the aircraft must be taxied off the runway area.
5. **RAAS–INH** (amber): Runway Awareness and Advisory System is enabled but the advisories have been inhibited with the activation of an external discrete.

PERFORMANCE

The performance data in chapter 6 are applicable.

SUPPLEMENTS

The supplements in chapter 7 are applicable.

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INTRODUCTION

NOTE: This Airplane Flight Manual Supplement is only applicable to airplanes incorporating Service Bulletin 350−34−009: Modification – Flight Management System – Activation of the Required Navigation Performance with Authorization Required (RNP AR) Option (C34−501) .

This Supplement contains information and procedures for operation of the BD−100−1A10, for Required Navigation Performance Authorization Required – Approach operations.

This supplement complements and/or supersedes direction contained in the basic Airplane Flight Manual and must be complied with in conjunction with the basic Airplane Flight Manual.

Compliance with these performance standards does not constitute approval to conduct RNP AR Approach operations.

APPROVAL STATUS

The following approvals do not constitute operational approval. Some operations require additional crew qualification, communication and surveillance equipage in order to obtain operational approval from regulatory authorities.

- **Required Navigation Performance – Authorization Required**

– RNP AR Approach with RF Legs for RNP ≥ 0.3 Approach and RNP 1.0 Missed Approach:

The FMS has been demonstrated capable of primary navigation for RNP AR Approach operations in accordance with ICAO Doc 9613 PBN Volume II, Part C, Chapter 6; AC 90−101A, Appendix 2; AMC 20−26; and AC 20−138D, Appendix 2.

LIMITATIONS

The limitations in Chapter 2 and the Supplement Operational Capabilities (Page 07–05–01–1) are applicable, except as modified by the following:

An RNP AR approach must not be commenced or continued unless the required equipment, as specified in the RNP AR APPROACH Required Equipment List below, are operating satisfactorily.

RNP AR APPROACH REQUIRED EQUIPMENT LIST	
EQUIPMENT	**REQUIREMENT**
Yaw Damper and Autopilot	Both must be operational
PFD 1 and 2	One (1) PFD operational for each side
ADC 1, 2	Two (2) ADCs must be operational
GNSS 1 and 2	Two (2) GNSS sensors must be available to commence the approach, one (1) GNSS sensor is required to continue the approach
FMS 1, 2	Two (2) FMSs must be operational
IRS 1, 2 (ATT and HDG)	Two (2) IRSs must be operational
TAWS	TAWS must be operational and displayed
FD 1 and 2	Two (2) Flight Directors must be operational

RNP AR Approach operations beyond the IAF are prohibited unless RNP AR APPR is annunciated on the PFD.

RNP AR Approach operations are approved for RNP AR Approaches greater than or equal to RNP 0.3 in the approach segment and RNP 1.0 in the missed approach segment.

The autopilot must be engaged between the final approach point and the missed approach point on RNP AR approaches.

RNP AR Approach operations are approved with autothrottle engaged or disengaged.

RNP AR Approach operations are approved for any FLAP configuration up to the FAF and FLAP 30 from FAF to MAP.

RNP AR Approach operations must be accomplished in accordance with instrument approach procedures that are retrieved from the FMS navigation database.

RNP AR Approach operations are approved following failure of one engine.

RNP AR approach operations are prohibited in the area defined by A, B, C and D in Fig. 07–07–01–1.

Effectivity:

For airplanes NOT incorporating Service Bulletin SB350–34–025:

POINT	LAT	LONG
A	N75	W175
B	N75	W130
C	N50	W175
D	N50	W155

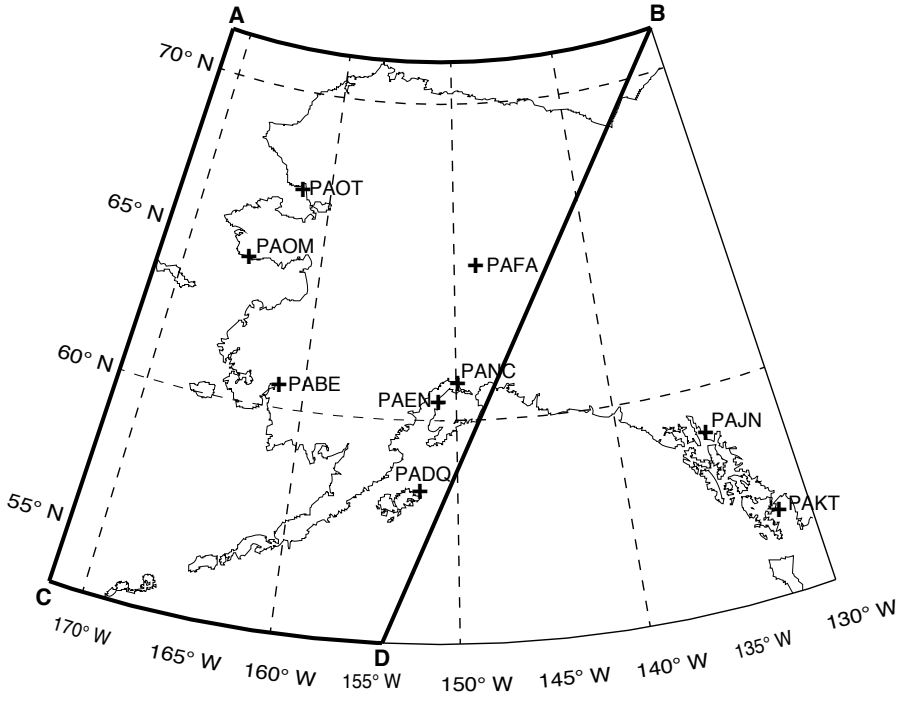


Figure 07–07–01–1

EMERGENCY PROCEDURES

The emergency procedures in Chapter 3 are applicable.

NORMAL PROCEDURES

The normal procedures in Chapter 4 are applicable, except as modified by the following:

Approach

1. FMS Navigation Source ..... Set independent source on each PFD
2. IRS and ADC ..... Set independent source on each PFD
3. Flight Director mode ..... APPR FMS
4. RNP AR APPR annunciations ..... Verify annunciated at IAF

NON–NORMAL PROCEDURES

The non–normal procedures in Chapter 5 are applicable, except as modified by the following:

NO APPR (Amber PFD annunciation)

Loss of GNSS Integrity or loss of GNSS Navigation.

1. RNP AR approach ..... Perform a Go–Around

– END –

Excess Lateral or Vertical Deviation annunciation (Amber flashing of lateral or vertical deviation indication)

Airplane lateral deviation is beyond 2 dots or vertical deviation is beyond 1 dot deviation.

1. RNP AR approach ..... Perform a Go–Around

– END –

EFIS MISCOMPARE (Caution)

Accompanied by amber ALT annunciation on PFD:

1. RNP AR approach ..... Perform a Go–Around

– END –

PERFORMANCE

The performance data in Chapter 6 and the compatible supplements are applicable.

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INTRODUCTION

GENERAL

This Supplement contains information and procedures for operation of the Challenger 350 Model BD−100−1A10 airplane, fitted with two AS907−2−1A engines, on a wet grooved runway surface.

The information has been prepared by the manufacturer and approved as guidance material, to assist operators in developing suitable guidance, recommendations or instructions for use by their flight crews when operating on wet grooved runways.

The take−off and landing procedures in Chapter 4 and FCOM Vol 1, Chapter 4 have been assumed. The data has been prepared using reasonable estimates of the effects of wet grooved runway surface conditions on the braking ground roll. The effects of actual conditions may differ from those used to establish the data.

When operating on wet grooved 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.

The use of this AFM Supplement requires that there are no areas of significant rubber deposit in the section where high−speed portion of braking is expected.

RUNWAY CONDITION

- The data is applicable to concrete runway surfaces with transverse grooves constructed and maintained to FAA standard AC 150/5320−12C, or equivalent.
- A grooved runway is considered wet when there is sufficient moisture on the runway surface to cause it to appear partially reflective, but without significant areas of standing water (runway grooves not overflowing).

LIMITATIONS

The limitations in Chapter 2 are applicable, except as modified by the following:

- The data may be used only for wet grooved runway, not contaminated.
- Use of this supplement for landing performance is prohibited if any of the following CAS messages are displayed:
  - SPOILERS FAIL (caution)
  - SPOILERS FAULT (caution)
  - FLT SPOILERS FAIL (caution)
  - FLT SPOILERS FAULT (caution)

  - ROLL SPOILERS FAIL (caution)
  - ROLL SPOILERS FAULT (caution)
  - GND SPOILERS FAIL (caution)
  - GND SPLRS NOT ARMED (caution).
- The use of this AFM Supplement for landing distance data requires both thrust reversers to be operational.
- ROAAS (if installed) must be selected OFF when using landing distance data from this supplement.
- This AFM Supplement is applicable only to grooved concrete surfaces.
- The wet grooved landing distance provided in this Supplement may not be shorter than the dry runway factored landing distance (Chapter 6) for the applicable conditions. The dry runway factored landing distance includes a factor for operational rules which require use of 60% of the available runway length. In this situation, the dry runway factored landing distance shall be used for operation on a wet grooved runway.
- If the takeoff weight obtained for a wet grooved 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 grooved runway condition at the limiting weight.
- Use of this supplement for calculation of corrected wet runway landing distance during emergency or non–normal procedures is prohibited. For these cases, Chapter 6 defined landing distances must be used.

Effectivity:

For EASA registered aircraft:

- This Supplement is approved for use on concrete runways having a grooved surface that has been constructed and maintained to the FAA standard of AC 150/5320–12C or equivalent. Operational approval must be obtained in order to use the performance data presented in this Supplement.

EMERGENCY PROCEDURES

The emergency procedures in Chapter 3 are applicable.

NORMAL PROCEDURES

The normal procedures in Chapter 4 are applicable.

NON–NORMAL PROCEDURES

The non–normal procedures in Chapter 5 are applicable.

PERFORMANCE

The performance data in Chapter 6 are applicable.

TAKEOFF ON WET GROOVED RUNWAYS

Wet grooved runway takeoff performance is estimated assuming that the runway is completely wet but without significant areas of standing water.

Wet grooved runway takeoff performance is available in the Takeoff Performance and Takeoff Path CAFM calculators, when appropriate. Select the Wet Grooved Runway option in the Runway Surface Condition drop–down menu of the Runway Data window. The CAFM calculator also 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 grooved 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 grooved runway condition at the limiting weight.

Refer to Chapter 6, Takeoff Performance Section for more information on the CAFM and on the determination of the takeoff weight limits.

LANDING ON A WET GROOVED RUNWAY

The following charts are used to obtain the landing distance required on wet grooved runways, for a flap 30º landing, for a given value of airplane weight, ambient temperature, airport pressure altitude, reported wind, runway slope and V_{REF} speed increment.

The landing distance required on a wet grooved runway for a flap 30º landing is given by the following:

- Fig. 07–09–01–1 provides the uncorrected landing distance for a wet grooved runway.
- Fig. 07–09–01–2 provides the landing distance for a wet grooved runway, corrected for reported wind, runway gradient and V_{REF} speed increment.

NOTE: 1. The wet grooved landing distance from Fig. 07–09–01–2 includes an operational distance factor of 1.15.

2. The wet grooved landing distance may not be less than the corresponding dry runway Factored Landing Distance (FLD). For the applicable conditions, refer to Chapter 6 Landing Performance Section to determine the dry runway FLD. If the wet grooved landing distance is shorter than the dry runway FLD, then the dry runway FLD shall be used for the wet grooved runway condition.

Effectivity:

For EASA registered aircraft:

3. The wet grooved landing distance determined at dispatch must account for the conditions expected at the time of arrival, including reported wind, runway slope and V_{REF} speed increment. For dispatch purposes, a V_{REF} speed increment of 10 Knots shall be assumed to determine the wet grooved landing distance required. The wet grooved landing distance must be re–assessed during flight for the actual conditions at the time of arrival.

Example:

Associated Conditions:

Runway condition	=	wet grooved
Aircraft weight	=	14,000 kg (30,865 lb)
Airport pressure altitude	=	2,000 ft
Ambient temperature	=	11 °C
Reported wind	=	–10 knots (tailwind)
Runway gradient	=	+1% (up slope)
V_{REF} speed increment	=	+5 KIAS

Effectivity:

For EASA registered aircraft:

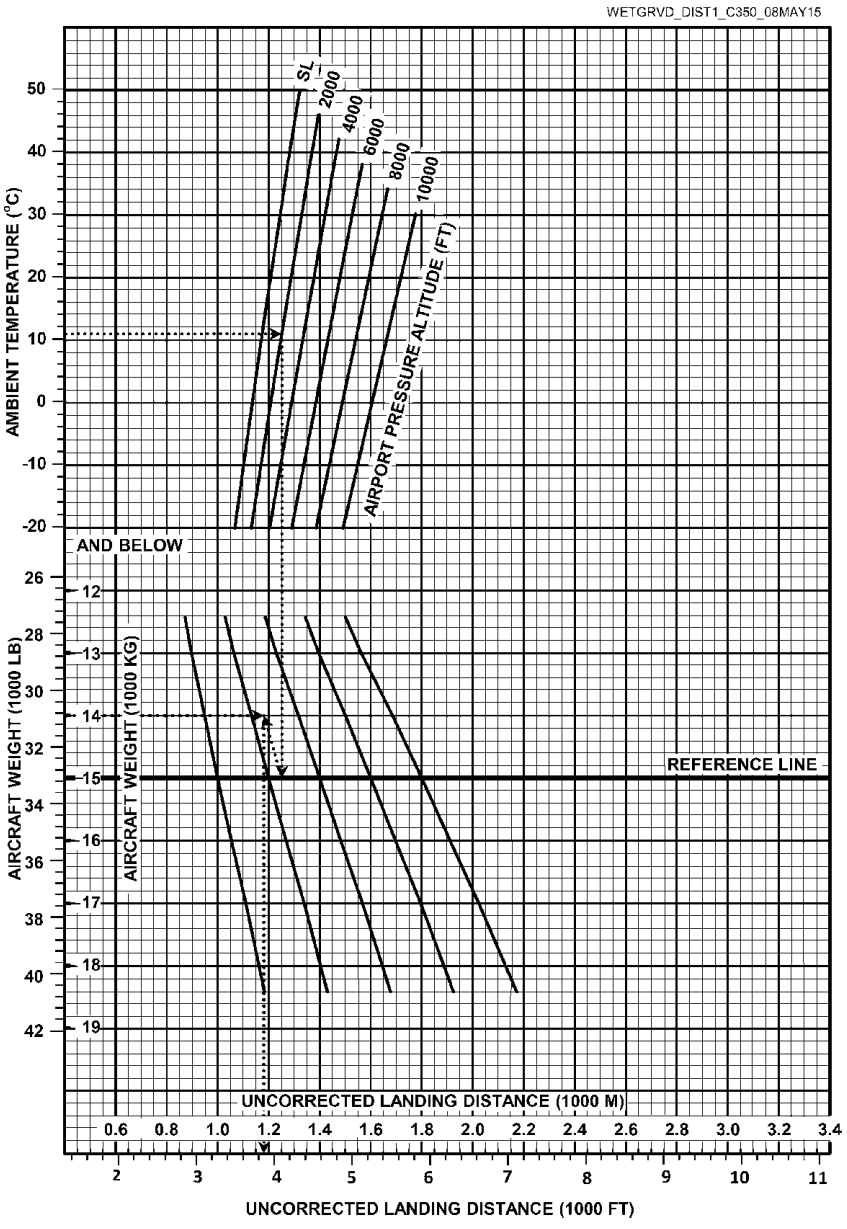
For dispatch, a 10 KIAS V_{REF} speed increment must be used on Fig. 07–09–01–2 to determine the wet grooved corrected landing distance. The actual V_{REF} increment during landing may be less than 10 KIAS. The in–flight wet grooved landing distance assessment is based on the actual V_{REF} increment.

The example in Fig. 07–09–01–1 and shows that for the above associated conditions, the wet grooved corrected landing distance is equal to 1410 meters (4615 feet).

The dry runway FLD must then be verified for the associated conditions:

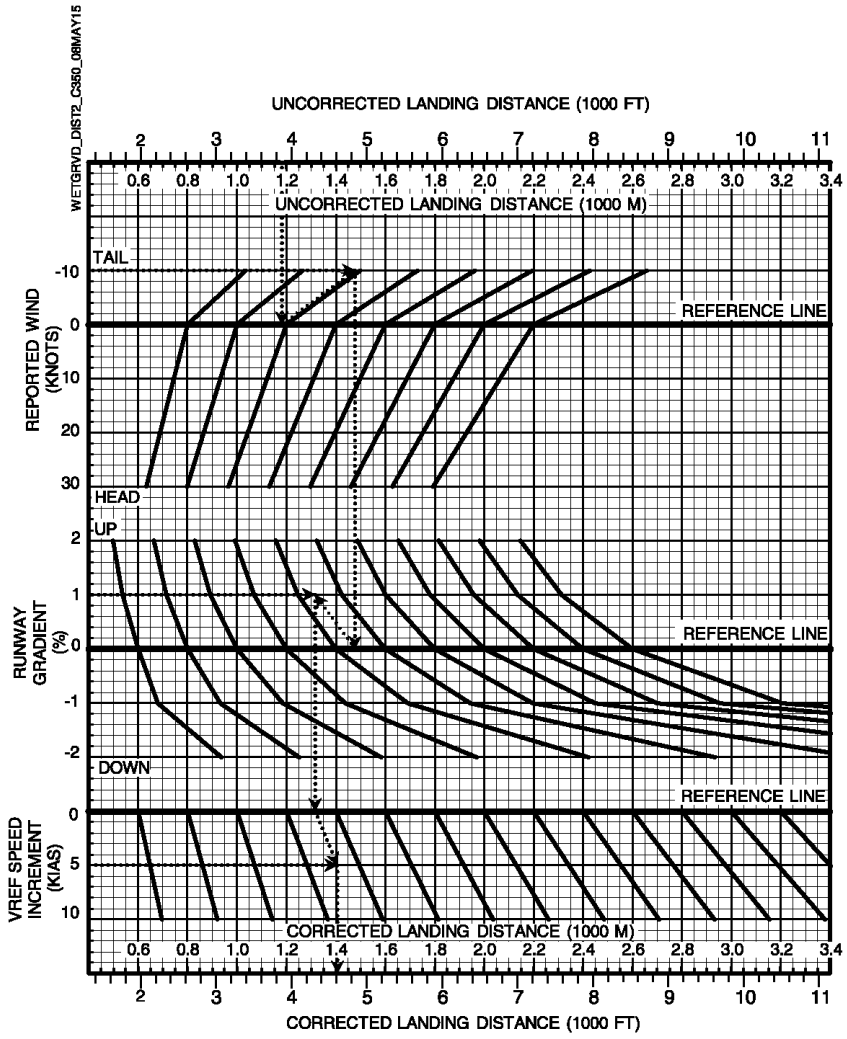
Runway condition	=	dry
Aircraft weight	=	14,000 kg (30,865 lb)
Airport pressure altitude	=	2,000 ft
Reported wind	=	–10 knots (tailwind)

Using the CAFM for the above conditions, the dry runway FLD is equal to 1598 meters (5243 feet). The dry FLD is longer than the wet grooved landing distance in this case. The wet grooved landing distance cannot be less than the dry FLD. Therefore, the landing distance to be used for wet grooved runway operations is equal to 1598 meters (5243 feet).



Uncorrected Landing Distance - Wet, Grooved Runway - Flaps 30 Degrees

Figure 07–09–01–1



Corrected Landing Distance - Wet, Grooved Runway - Flaps 30 Degrees

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INTRODUCTION

NOTE: 1. This supplement does not constitute operational approval to conduct steep approach operations.

2. This Airplane Flight Manual Supplement is only applicable to airplanes 20501 to 20758 incorporating Service Bulletin 350–34–018 and airplanes 20759 and subsequent incorporating SB 350–34–017.

This supplement must be used when flying steep approaches with published runway threshold glidepath angles from 4.5 to 5.5 degrees.

This supplement complements and/or supersedes data contained in the basic Airplane Flight Manual and must be complied with in conjunction with the basic Airplane Flight Manual. While on a steep glidepath, steep approaches are flown in the steep approach configuration at a landing reference speed of SV_{REF}.

Steep approach configuration is defined as:

- Flaps – 30 degrees
- Landing Gear – Down
- Spoilers – Max
- STEEP APPR PBA – ON

LIMITATIONS

The limitations in Chapter 2 are applicable, except as modified by the following:

WEIGHT AND C.G. LIMITATIONS

Maximum landing weight is 14,334 kg (31,600 lbs).

OPERATIONAL LIMITATIONS

LANDING AIRPORT LIMITS

Airport pressure altitude and outside air temperature limits are defined in Fig. 07–10–01–1.

ALTITUDE/TEMPERATURE LIMITATIONS

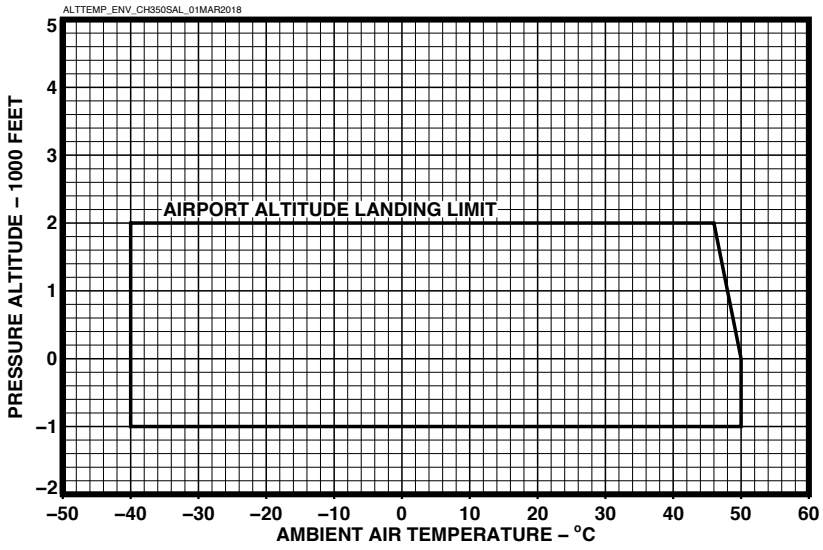


Figure 07–10–01–1

OPERATION IN ICING CONDITIONS

Steep approach in known icing conditions is prohibited.

WIND LIMITS

No tailwind component is permitted for steep approach landings.

Maximum crosswind component for steep approach landings is 20 kts.

Increasing approach landing reference speed for wind gusts is prohibited.

APPROACH

Operation with a glidepath angle that exceeds 5.5 degrees is prohibited.

Performing a steep approach in other than the steep approach configuration is prohibited.

Steep approach operations are approved with autothrottle engaged or disengaged.

Use of autothrottle (if installed) below 200 feet AGL on a steep approach is prohibited.

Steep approach landing on a contaminated runway is prohibited.

Deliberate one engine inoperative steep approach is prohibited.

It is prohibited to have the Autothrottle engaged during a single engine go–around until flaps are retracted and the aircraft has accelerated to en route climb speed.

Steep approach is prohibited unless using:

- ILS Guidance; or,
- Published Visual Approaches with vertical path guidance (e.g. PAPI).

Performing a non–steep approach in steep approach configuration is prohibited.

LANDING DECISION POINT

The minimum height for go–around following an engine failure (Landing Decision Point) is 200 feet AGL.

SYSTEMS LIMITATIONS

AIR CONDITIONING SYSTEM

Use of engine bleed during steep approach is prohibited.

ANTI–ICE SYSTEM

Steep Approach with WING and/or ENGINE ANTI–ICE systems ON is prohibited.

AUTOMATIC FLIGHT CONTROL SYSTEM

Use of autopilot for steep approach is prohibited.

FLIGHT CONTROLS

When conducting a steep approach, flight spoilers may remain extended to MAX below 500 ft AGL, for speeds down to SV_{REF}.

SYSTEMS INOPERATIVE

Steep approaches are prohibited if any of the following systems are not fully operative:

- Flaps,
- Ground Spoilers,
- Nose Wheel Steering,
- Thrust Reverser,
- Hydraulics,
- Flight Controls,
- Brakes,
- Radio altimeter,
- Auxiliary Power Unit.

NAVIGATION SYSTEM LIMITATIONS

FLIGHT MANAGEMENT SYSTEM

Use of the FMS approach performance function for steep approach is prohibited.

EMERGENCY PROCEDURES

The emergency procedures in Chapter 3 are applicable, except as modified by the following:

Discontinue steep approach and divert to the nearest suitable (non−steep approach) runway or airport if any emergency procedure necessitates:

- An approach speed greater than V_{REF},
- a landing with gear up or unsafe,
- landing in a configuration other than the defined steep approach configuration,
- an increase in actual landing distance by a factor greater than 1.50, and
- a landing with any of the systems inoperative as listed in the system limitations of this supplement.

Engine Failure (In Flight)

During Steep Approach Prior To Landing Decision Point

1. Perform Single Engine Go−around procedure. Refer to Single Engine Go−Around procedure in the NON−NORMAL PROCEDURES of this supplement.

NOTE: After an engine failure at or below Landing Decision Point, a one engine inoperative approach to landing may be continued.

NORMAL PROCEDURES

The normal procedures in Chapter 4 are applicable with the addition of the following:

NOTE:

1. Use of ILS with the flight director is approved.
2. Use of autothrottle (if installed) down to 200 feet AGL is approved.
3. For aircraft with ROAAS installed, ROAAS NOT AVAIL will post upon selection of STEEP APPR.

APPROACH

1. APU ..... Start and Release
2. R Bleed ..... OFF
3. APU BLEED ..... ON
4. L Bleed ..... OFF
5. XBLEED ..... OPEN
6. Landing Data (SV_{REF}, V_{GA}, distance) ..... Set
7. Approach setup and crew briefing ..... Complete
8. STEEP APPR ..... Select and verify ARM illuminated
9. BARO MIN ..... Set
10. MIN ALERT ..... Set
11. L and R HYDRAULIC PUMP ..... AUTO

BEFORE LANDING

1. LANDING GEAR switch ..... DN
2. L LANDING, N LDG/TAXI and R LANDING light switches ..... On
3. WING and ENGINE ANTI–ICE switches ..... Off
4. FLAPS 30
5. FLIGHT SPOILERS ..... MAX
6. STEEP APPR ..... Verify ON illuminated

NOTE: The airplane should be fully configured for landing and slowed to SV_{REF} prior to glideslope intercept.

Effectivity:

If Autothrottle installed:

CAUTION: Autothrottle will not arm RETARD mode at 200 feet AGL if it remains engaged on a steep approach. AT RETARD INHIBIT (C) will post, and Autothrottle will not retard thrust levers at 50 feet AGL.

7. Autothrottle (if installed) ..... Disengage prior to 200 feet AGL

GO–AROUND

CAUTION: If unreliable airspeed is suspected, disregard all reference to TO/GA. Do not use TO/GA button.

1. TO/GA button ..... Press
2. Thrust levers ..... TO
3. FLIGHT SPOILERS ..... RETRACT
4. Pitch attitude ..... Increase rapidly but smoothly to initial pitch attitude of 8 degrees at a speed of not less than SV_{REF}, then adjust pitch attitude to maintain V_{GA} speed.

NOTE: Go–around speed V_{GA} is the same as the SV_{REF} landing speed.

5. FLAPS 10
6. LANDING GEAR switch ..... UP after positive rate of climb is established.
7. Climb at V_{GA}, or above

NOTE: The flight director guidance only represents an initial target to rotate toward and does not guarantee that the climb speed will be achieved under all conditions.

When clear of obstacles:

8. Accelerate to V_{GA} +15 and retract flaps.
9. Pressurization ..... LNDG ALT set
10. STEEP APPR ..... Deselect

NOTE:
1. Due to the reduced engine idle in steep approach mode, engine acceleration time may be increased during go–around.
2. Contact with the ground may be unavoidable if go–around is initiated from a low altitude or high sink rate. If the airplane contacts the ground during the go–around, maintain the normal landing attitude or slightly higher. Airplane configuration (landing gear/flaps) should not be changed until the airplane is climbing if ground contact is made or not.

AFTER LANDING / CLEARING RUNWAY

1. L and R PROBES switches ..... OFF
2. WING ANTI–ICE switch ..... As required
3. L and R ENG ANTI–ICE switches ..... As required
4. Lighting ..... As desired
   a. STROBE switch ..... BCN
5. FLAPS ..... As desired
6. XPDR/TCAS ..... As required
7. FLIGHT SPOILERS ..... RETRACT
8. STEEP APPR ..... Deselect

NON–NORMAL PROCEDURES

The non–normal procedures in Chapter 5 are applicable except as modified by the following:

Discontinue steep approach and divert to the nearest suitable (non–steep approach) runway or airport if any non–normal procedure necessitates:

- An approach speed greater than V_{REF},
- landing with gear up or unsafe,
- landing in a configuration other than the defined steep approach configuration,
- an increase in actual landing distance by a factor greater than 1.50, and
- landing with any of the systems inoperative as listed in the system limitations of this supplement.

SINGLE ENGINE GO–AROUND

NOTE: 1. The demonstrated steep approach go–around minimum altitude loss is 150 feet.

2. Due to the reduced engine idle condition in steep approach mode, engine acceleration time may be increased during go–around.

1. TO/GA button ..... Press
2. Autothrottle (if installed) ..... Disengage
3. Thrust Levers ..... TO
4. FLIGHT SPOILERS ..... RETRACT
5. Pitch attitude ..... adjust as required to maintain V_{GA}.

NOTE: 1. Initially rotate towards flight director pitch guidance command (8 degrees), adjust pitch as required to maintain V_{GA}

2. Go–around speed V_{GA} is the same as the SV_{REF} landing speed.

3. Contact with the ground may be unavoidable if go–around is initiated from a low altitude or high sink rate. If the airplane contacts the ground during the go–around, maintain the normal landing attitude or slightly higher. Airplane configuration (landing gear/flaps) should not be changed until the airplane is climbing if ground contact is made or not.

6. FLAPS 10
7. LANDING GEAR switch ..... UP after positive rate of climb is established.
8. Climb at V_{GA}, or above.

WARNING: It is prohibited to have the Autothrottle engaged during a single engine go–around until flaps are retracted and the aircraft has accelerated to en route climb speed.

When clear of obstacles:

9. Accelerate to V_{GA} + 15 and retract flaps.
10. Climb ..... At en route climb speed
11. STEEP APPR ..... Deselect
12. N LDG / TAXI light switch ..... OFF

MISCELLANEOUS SYSTEMS

Steep Approach Mode

CONFIG STEEP (C)

Posted prior to decision height:

1. Go–around ..... Perform
2. Select another non–steep approach (less than 4.5 degrees) or divert to a suitable airfield.

NOTE: If CONFIG STEEP (C) was triggered due to passing 1500 ft AGL without being in steep approach configuration, then another steep approach can be attempted after properly configuring the aircraft.

Posted at or below Decision Height:

3. Approach ..... Continue to landing

PERFORMANCE

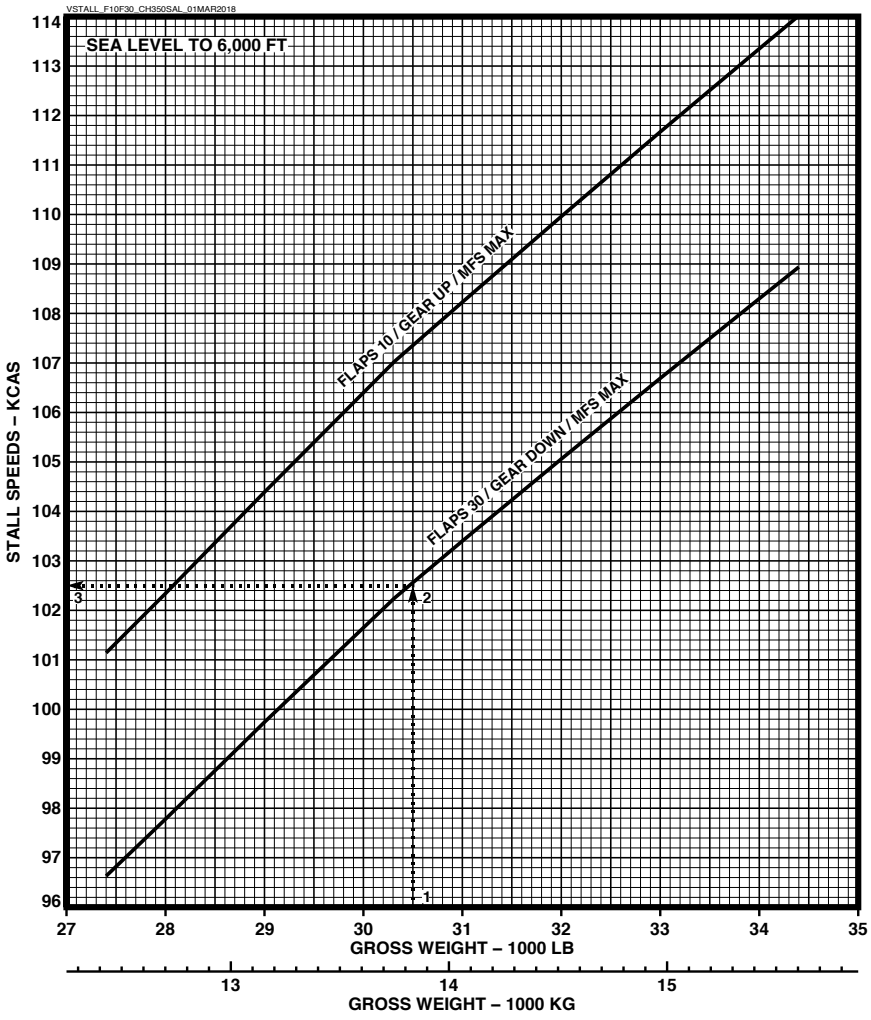
The performance data in Chapter 6 are applicable, except as modified by the following:

NOTE:
1. With the limited Steep Approach weight envelope (max 31,600 lbs or 14,334 kg), the maximum landing weight is not limited by minimum climb requirements (2.1% Approach Climb gradient and 3.2% Landing Climb gradient).
2. The CAFM must not be used for any steep approach performance calculation.

STALL SPEEDS

The stall speeds for the Flaps 10, Flight Spoilers MAX, gear up and for the Flaps 30, Flight Spoilers MAX, gear down configurations at various gross weights are provided in Fig. 07–10–01–2. The chart is based upon the forward center–of–gravity limit.

STALL SPEEDS



EXAMPLE:

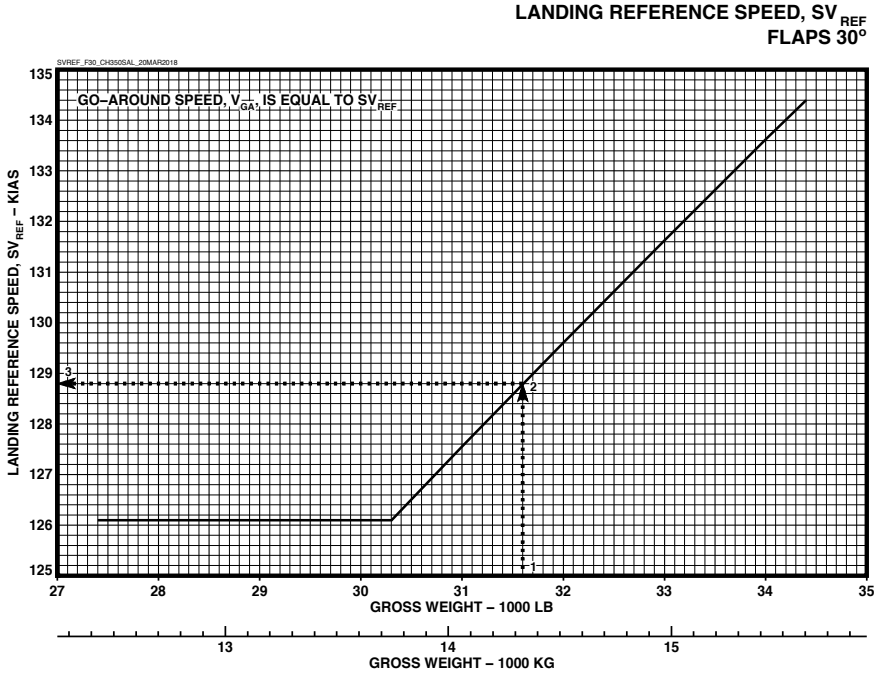
1. Weight..... 30 500 lb (13 835 kg)
2. Flaps Setting.....Flaps 30 / Gear Down / MFS MAX
3. Stall Speed..... 102.5 kcas

Figure 07–10–01–2

GO–AROUND SPEED (V_{GA}) AND LANDING REFERENCE SPEED (SV_{REF})

The Go–Around Speed (V_{GA}) and the Landing Reference Speed (SV_{REF}) are presented on Fig. 07–10–01–3 for varying conditions of airplane weight. On a Steep Approach, V_{GA} is equal to SV_{REF}.

NOTE:
1. Approach Climb gradient performance for Flaps 10, Gear up configuration is based on V_{GA};
2. Landing Climb gradient performance for Flaps 30, Gear Down configuration is based on SV_{REF};
3. Factored Landing Distance for Flaps 30, Gear Down configuration is based on SV_{REF}.



EXAMPLE:

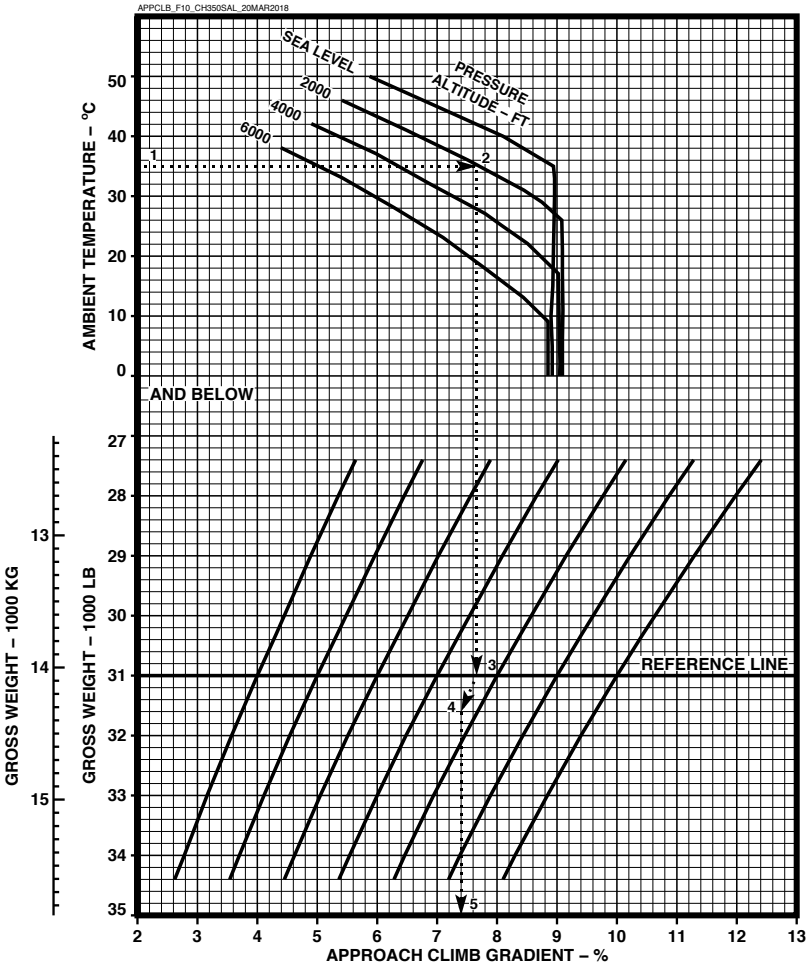
1. Weight..... 31 600 lb (14 334 kg)
2. Landing Reference Speed Curve
3. $SV_{REF} = V_{GA}$..... 128.8 kias

Figure 07–10–01–3

APPROACH CLIMB GRADIENT, FLAPS 10/GEAR UP

The Flaps 10, gear up, one–engine–inoperative configuration Approach Climb gradients for varying conditions of airport pressure altitude, ambient temperature and gross weight are provided in Fig. 07–10–01–4.

APPROACH CLIMB GRADIENT
FLAPS 10°



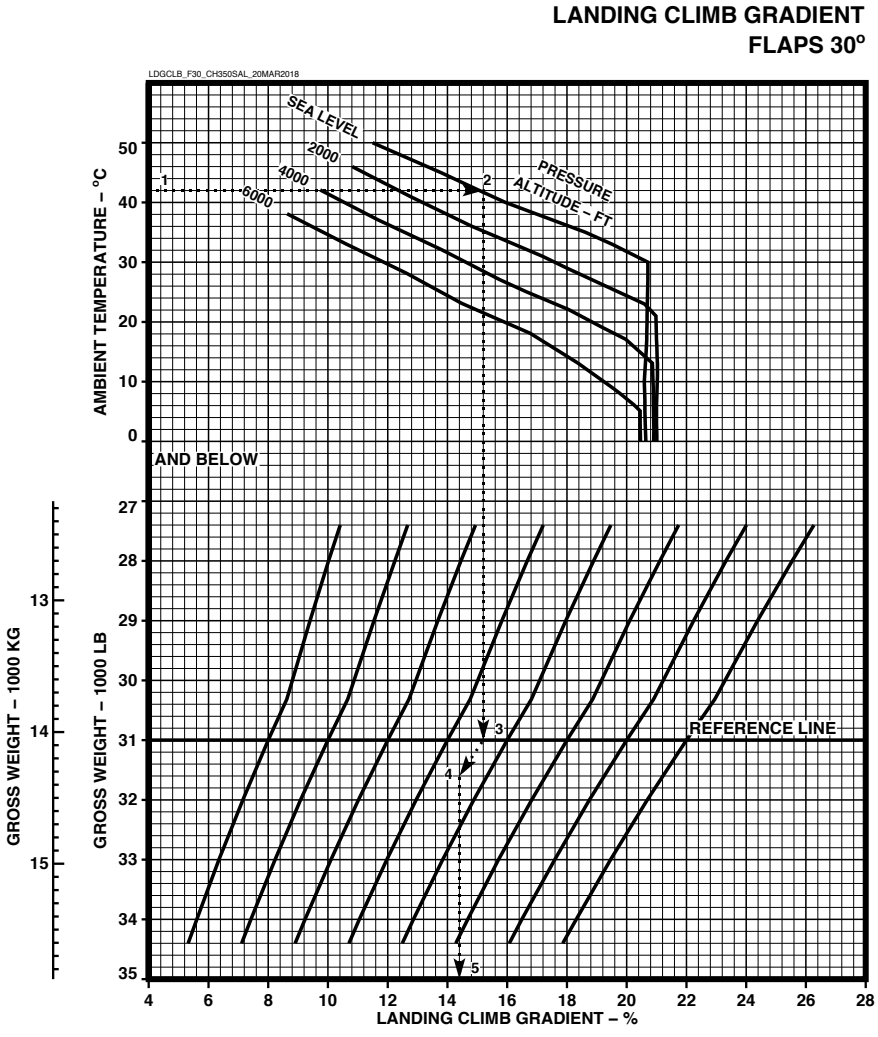
EXAMPLE:

1. Temperature..... 35 °C
2. Altitude..... 2 000 ft
3. Weight Reference Line
4. Weight..... 31 600 lb (14 334 kg)
5. Approach Climb Gradient.. 7.4 %

Figure 07–10–01–4

LANDING CLIMB GRADIENT, FLAPS 30/GEAR DOWN

The Flaps 30, gear down, all–engines–operative configuration Landing Climb gradients for varying conditions of airport pressure altitude, ambient temperature and gross weight are provided in Fig. 07–10–01–5.



EXAMPLE:

1. Temperature..... 42 °C
2. Altitude.....Sea Level
3. Weight Reference Line
4. Weight..... 31 600 lb (14 334 kg)
5. Landing Climb Gradient... 14.4 %

Figure 07–10–01–5

FACTORED LANDING DISTANCE, FLAPS 30/GEAR DOWN

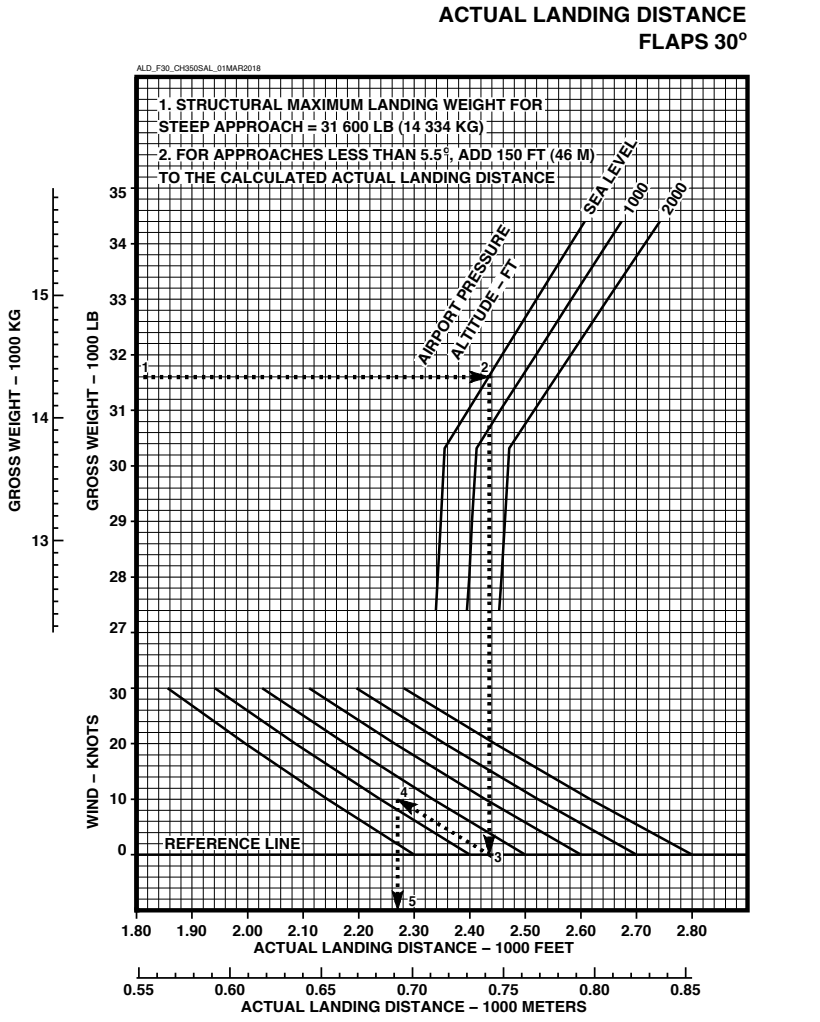
The Steep Approach Actual Landing Distance data (Fig. 07–10–01–6) can be achieved using the following procedure:

1. Approach at SV_{REF} in the steep approach configuration (Flaps 30, Gear down, MFS max) using thrust to maintain the 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 immediately 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.

The Steep Approach Actual Landing Distance performance data on Fig. 07–10–01–6 is based on flying the above procedure with Flaps 30 and spoilers MAX, to a full stop on a dry, level, hard–surfaced runway at ISA temperature. For approach path angles of 4.5° up to but not including 5.5°, add 150 ft (46 m) to the Actual Landing Distance derived from Fig. 07–10–01–6.

NOTE: 1. The Factored Landing Distance required data on Fig. 07–10–01–7 is the Actual Landing Distance (Fig. 07–10–01–6) multiplied by an operational factor of 1.67.

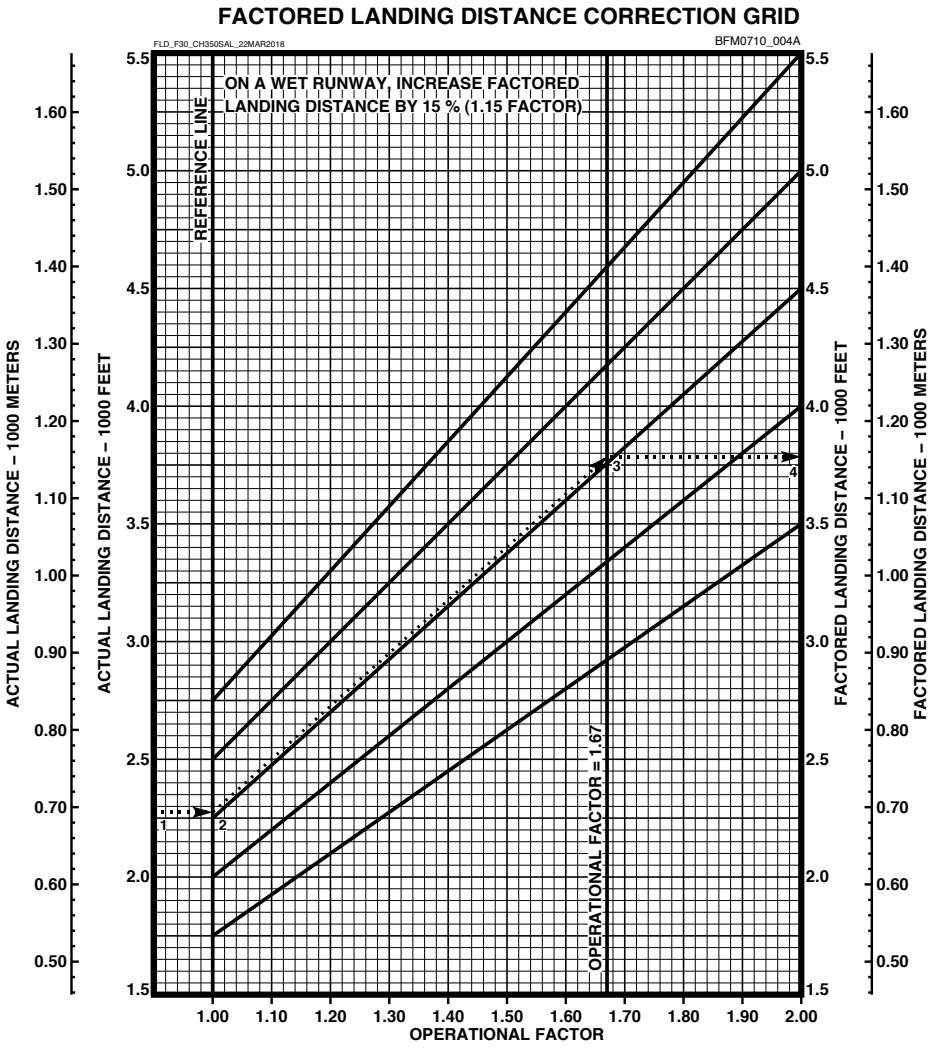
2. For wet runway surfaces, operational rules may require the runway length available to be at least 115% of the Factored Landing Distance derived from Fig. 07–10–01–7.



EXAMPLE:

1. Weight..... 31 600 lb (14 334 kg)
2. Altitude.....Sea Level
3. Wind Reference Line
4. Wind..... 10 kt
5. Actual Landing Distance... 2 270 ft (692 m)

Figure 07–10–01–6



EXAMPLE:

1. Actual Landing Distance..... 2 270 ft (692 m)
2. Operational Factor Reference Line
3. Operational Factor..... 1.67
4. Factored Landing Distance.. 3 783 ft (1 153 m)

Figure 07–10–01–7

SUPPLEMENTS

The supplementary data in chapter 7 are applicable except for the following:

- SUPPLEMENT 1 – Operation On Contaminated Runways
- SUPPLEMENT 2 – Supplemental Information for the MMEL
- SUPPLEMENT 3 – Category II Operations
- SUPPLEMENT 5 – Operational Capabilities: the listed operational capabilities in Supplement 5 are applicable except for RNP AR, RNP APCH, LPV Approaches, Baro–VNAV and Vertical Navigation (VNAV).
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INTRODUCTION

NOTE: This Airplane Flight Manual Supplement is only applicable to airplanes 20813 and subsequent including airplanes 20501 to 20812, incorporating SB 350–27–008, Rudder Travel Increase.

The data in this supplement can be used when conducting takeoffs from a short runway. It presents improved takeoff performance which allows heavier takeoff weights on short runways.

This supplement complements and/or supersedes data contained in the basic Airplane Flight Manual and must be complied with in conjunction with the basic Airplane Flight Manual.

The effect of this supplement on the basic Airplane Flight Manual is given below.

LIMITATIONS

The limitations in Chapter 2 are applicable, except as modified by the following:

WEIGHT AND C.G. LIMITATIONS

TAKEOFF WEIGHT

The maximum takeoff weight (MTOW) allowed for Short Field Operation (SFO) is 38,000 lb.

OPERATIONAL LIMITATIONS

TAKEOFF AIRPORT LIMITS

Airport pressure altitude and outside air temperature limits are defined in Fig. 07–11A–01–1.

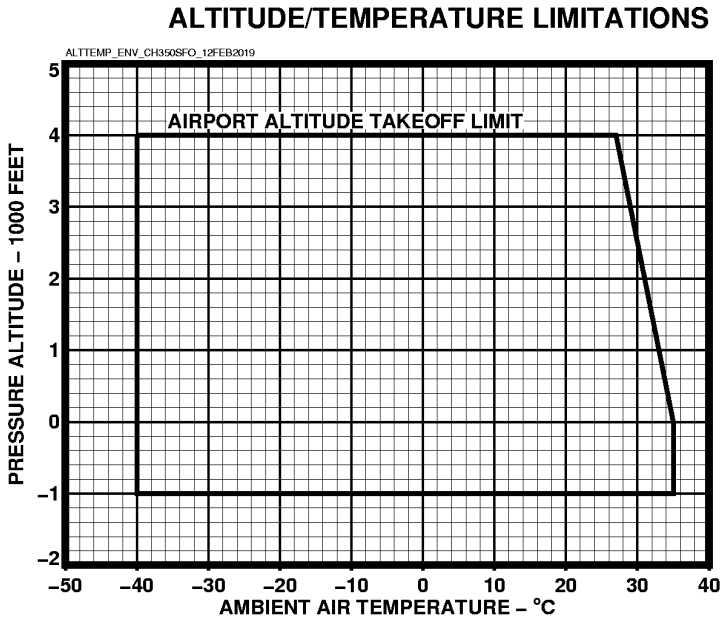


Figure 07–11A–01–1

TAKEOFF

Takeoff configuration for this Supplement is limited to Flaps 20°.

OPERATION ON CONTAMINATED RUNWAYS

This supplement does not provide performance information for operation on contaminated runways. Refer to Chapter 7, Supplement 1, for takeoff performance on a contaminated runway.

SYSTEMS LIMITATIONS

INOPERATIVE SYSTEMS

SFO takeoffs are prohibited if any of the following systems are not operative:

- Landing Gear Retraction System,
- Hydraulic Power Transfer Unit,
- Main Landing Gear Bay Overheat Detection Subsystem.

NAVIGATION SYSTEM LIMITATIONS

Use of the Flight Management System (FMS) takeoff performance function for SFO is prohibited.

EMERGENCY PROCEDURES

The emergency procedures in Chapter 3 are applicable.

NORMAL PROCEDURES

The normal procedures in Chapter 4 are applicable, except as modified by the following:

BEFORE TAXI

Replace step 2. with the following:

2. Flaps 20

NON–NORMAL PROCEDURES

The Non–Normal procedures in Chapter 5 are applicable.

PERFORMANCE

The standard takeoff procedures described in Chapter 6 for dry and wet runway operations remain applicable for the short runway performance data provided in this supplement.

The performance data in Chapter 6 are applicable, except as modified by the following:

CAUTION: The CAFM must not be used for any SFO takeoff performance, except for the takeoff path corrections described below.

Should temperature or altitude be below the lowest value shown in the takeoff performance tables, use the performance at the lowest value shown.

For weights below 28,000 lb, use the performance data for a weight of 28,000 lb.

Takeoff performance data may be interpolated, or use the next higher weight, temperature and/or altitude. Instead of interpolating data between two runway gradients, the more limiting data (longest takeoff field length) may be used.

Engine thrust setting (N_1) are obtained from either the CAFM Thrust Settings calculator or from the tables in chapter 6, and are indicated by the N_1 bugs.

The takeoff performance presented in this supplement assumes that takeoff thrust is set prior to brake release. If a rolling takeoff procedure is desired, refer to Chapter 6 for the detailed procedure. The takeoff field length correction of 35 m (100 ft) remains applicable for SFO.

MINIMUM CONTROL SPEED GROUND, V_{MCG}

– Flaps 20° ..... 109 KIAS

ENGINE BLEED CONFIGURATIONS

Takeoff 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 and Wing Anti–Ice ON (ECS is ON, engine cowl and wing Anti–Ice devices are ON).

Three other engine bleed configurations are available for dispatch. For the following configurations, use the takeoff performance data from configuration 3 above:

- Engine Anti–Ice ON.
- Engine Bleed ON, Engine Anti–Ice ON.
- Engine Anti–Ice and Wing Anti–Ice ON.

SFO TAKEOFF PERFORMANCE

DETERMINATION OF THE TAKEOFF WEIGHT

The SFO takeoff weight is the lowest weight based on the most restrictive limitation:

1. Field Length Weight Limitation (TOFL limited by available runway length).
2. Takeoff Path Weight Limitation (Obstacle Clearance).
3. SFO Maximum Takeoff Weight of 38,000 lb.

The following performance limits are not restricting SFO takeoff performance:

1. Climb Weight Limitation (minimum climb requirements).
2. Maximum Brake Energy Limitation (V_{1MBE} limit on V_1).
3. Takeoff Weight Limited by maximum tire speed.

Once the scheduled SFO takeoff weight is set, the corresponding takeoff speeds (V_1, V_R, V_2, and V_{FTO}) can be determined.

TAKEOFF DISTANCE AND SPEEDS ON A DRY RUNWAY

Fig. 07–11A–01–2 to Fig. 07–11A–01–19 present the SFO takeoff performance data on a dry runway, for the specified engine bleed configuration and airport pressure altitude, as a function of airplane weight, ambient temperature and runway gradient. The following takeoff data is provided:

TOFL	=	Takeoff Field Length (ft)
V_1	=	Takeoff Decision Speed (KIAS)
V_R	=	Takeoff Rotation Speed (KIAS)
V_2	=	Takeoff Safety Speed (KIAS)
V_{FTO}	=	Final Takeoff Speed (KIAS)

Fig. 07–11A–01–20 provides corrections on TOFL and on V_1 speed for the effect of reported wind.

Example:

Determine the required runway length and takeoff speeds for the following conditions:

Aircraft Weight	=	33,000 lb
Engine Bleed	=	Engine Bleed On
Runway Surface	=	Dry
Rolling Takeoff	=	Yes
Runway gradient	=	+1.0% (Positive Uphill)
Airport pressure altitude	=	2,000 ft
Reported wind	=	–10 knots (Negative for tailwind)
Airport Temperature (OAT)	=	25 °C

Fig. 07–11A–01–11 is used to determine the uncorrected takeoff data:

Uncorrected TOFL	=	3890 ft + 100 ft for rolling takeoff 3990 ft
Uncorrected V_1	=	113 KIAS
V_R	=	115 KIAS
V_2	=	121 KIAS
V_{FTO}	=	147 KIAS

V_1 and TOFL are then corrected for reported wind using Fig. 07–11A–01–20:

Corrected V_1	=	113 KIAS (no change below 115 KIAS)
Corrected TOFL	=	3990 x 1.35 = 5387 ft

Finally, the available SFO takeoff performance data is as follows:

TOFL	=	5387 ft
V_1	=	113 KIAS
V_R	=	115 KIAS
V_2	=	121 KIAS
V_{FTO}	=	147 KIAS

For the specified conditions, the required runway length for an SFO takeoff is 5387 ft.

DRY RUNWAY TAKEOFF DATA
FLAPS 20° **ALTITUDE SEA LEVEL**
ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
28000 V_{FTO} = 136	-2	114 115 126 3205	114 115 126 3255	114 115 126 3305	114 115 126 3355	114 115 126 3405	114 115 126 3460	114 115 125 3550
	-1	114 115 125 3195	114 115 125 3245	114 115 125 3295	114 115 125 3345	114 115 125 3395	114 115 125 3445	114 115 125 3540
	0	114 115 125 3185	114 115 124 3235	114 115 124 3285	114 115 124 3335	114 115 124 3385	114 115 124 3435	113 115 124 3535
	1	114 115 124 3180	114 115 124 3230	114 115 124 3280	114 115 124 3330	114 115 123 3380	114 115 123 3430	113 115 123 3535
	2	114 115 123 3175	114 115 123 3225	114 115 123 3275	114 115 123 3325	113 115 123 3375	113 115 123 3430	113 115 122 3535
30000 V_{FTO} = 140	-2	114 115 125 3270	114 115 125 3325	114 115 125 3375	114 115 125 3430	114 115 125 3480	114 115 125 3535	113 115 124 3630
	-1	114 115 124 3265	114 115 124 3315	114 115 124 3370	114 115 124 3420	114 115 124 3470	114 115 124 3525	113 115 124 3630
	0	114 115 123 3260	114 115 123 3315	114 115 123 3365	114 115 123 3415	113 115 123 3470	113 115 123 3520	113 115 123 3625
	1	113 115 123 3260	113 115 123 3310	113 115 122 3360	113 115 122 3415	113 115 122 3465	113 115 122 3520	113 115 122 3630
	2	113 115 122 3260	113 115 122 3315	113 115 122 3365	113 115 122 3415	113 115 121 3470	113 115 121 3520	113 115 121 3635
32000 V_{FTO} = 145	-2	114 115 124 3340	114 115 124 3395	114 115 124 3450	114 115 124 3500	114 115 124 3555	114 115 124 3610	113 115 124 3715
	-1	114 115 123 3335	113 115 123 3390	113 115 123 3445	113 115 123 3500	113 115 123 3550	113 115 123 3605	113 115 123 3715
	0	113 115 122 3335	113 115 122 3390	113 115 122 3445	113 115 122 3500	113 115 122 3550	113 115 122 3605	113 115 122 3720
	1	113 115 122 3340	113 115 121 3395	113 115 121 3450	113 115 121 3500	113 115 121 3555	113 115 121 3610	113 115 121 3730
	2	113 115 121 3350	113 115 121 3405	113 115 121 3455	113 115 120 3510	113 115 120 3560	113 115 120 3615	113 115 120 3750
33000 V_{FTO} = 147	-2	114 115 124 3375	114 115 124 3430	114 115 123 3485	113 115 123 3540	113 115 123 3590	113 115 123 3645	113 115 123 3755
	-1	113 115 123 3375	113 115 123 3430	113 115 123 3485	113 115 123 3535	113 115 122 3590	113 115 122 3645	113 115 122 3760
	0	113 115 122 3375	113 115 122 3430	113 115 122 3485	113 115 122 3540	113 115 122 3595	113 115 122 3650	113 115 121 3770
	1	113 115 121 3385	113 115 121 3440	113 115 121 3490	113 115 121 3545	113 115 121 3600	113 115 121 3655	113 115 121 3780
	2	113 115 120 3420	113 115 120 3470	113 115 120 3520	113 115 120 3570	113 115 120 3625	113 115 120 3680	113 115 120 3850

TODATA_350SFO_IMP_F20_DRY_ZERO_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–2 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL** V_1 (KIAS) V_R (KIAS)

ENGINE BLEED OFF V_2 (KIAS) TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
34000 V_{FTO} = 149	-2	113 115 124 3410	113 115 124 3465	113 115 124 3520	113 115 124 3575	113 115 124 3630	113 115 124 3685	113 115 124 3800
	-1	113 115 123 3410	113 115 123 3470	113 115 123 3520	113 115 123 3575	113 116 123 3630	113 116 123 3685	113 116 123 3805
	0	113 116 122 3415	113 116 122 3475	113 116 122 3525	113 116 122 3580	113 116 122 3635	113 116 122 3695	113 116 122 3815
	1	114 116 122 3480	114 116 122 3540	114 116 122 3590	114 116 122 3645	114 116 122 3700	114 116 122 3755	114 116 122 3930
	2	116 117 122 3610	116 117 122 3670	116 117 122 3725	115 117 122 3780	115 117 122 3835	115 117 122 3895	116 117 122 4080
35000 V_{FTO} = 151	-2	113 117 125 3445	113 117 125 3505	113 117 125 3560	113 117 125 3615	113 117 125 3670	113 117 125 3725	113 117 125 3840
	-1	113 117 124 3450	113 117 124 3505	113 117 124 3560	113 117 124 3615	113 117 124 3670	113 117 124 3730	113 117 124 3870
	0	115 117 124 3550	114 117 124 3605	114 117 124 3660	114 117 124 3715	114 117 124 3770	114 117 124 3830	114 117 124 3995
	1	116 118 124 3675	116 118 124 3740	116 118 124 3795	116 118 124 3850	116 118 124 3910	116 118 124 3970	116 118 124 4155
	2	118 119 124 3815	118 119 124 3880	118 119 124 3935	118 119 124 3995	118 119 124 4055	118 119 124 4120	118 119 124 4315
36000 V_{FTO} = 153	-2	113 118 126 3500	113 119 126 3555	113 119 126 3610	113 119 126 3665	113 119 126 3720	113 119 126 3775	113 119 126 3925
	-1	115 119 126 3610	115 119 126 3670	115 119 126 3725	115 119 126 3780	115 119 126 3835	115 119 126 3895	115 119 126 4060
	0	117 119 125 3735	117 119 125 3800	117 119 125 3855	117 119 125 3915	117 119 125 3975	117 119 125 4035	117 120 125 4220
	1	119 120 125 3880	119 120 125 3945	119 120 125 4005	118 120 125 4065	118 120 125 4125	118 120 125 4190	119 120 125 4390
	2	120 121 125 4030	120 121 125 4100	120 121 125 4160	120 121 125 4225	120 121 125 4285	120 121 125 4355	120 121 125 4570
38000 V_{FTO} = 157	-2	117 122 129 3825	117 122 129 3890	117 122 129 3950	117 122 129 4010	117 122 129 4070	117 122 129 4130	117 122 129 4310
	-1	119 123 129 3980	119 123 129 4045	119 123 129 4105	119 123 129 4170	119 123 129 4235	119 123 129 4300	120 123 129 4495
	0	121 123 129 4135	121 123 129 4210	121 123 129 4270	121 124 129 4335	121 124 129 4405	121 124 129 4470	121 124 129 4685
	1	123 124 129 4300	123 124 129 4370	123 124 129 4435	123 124 129 4505	123 124 129 4575	123 124 129 4645	123 124 129 4880
	2	125 125 129 4565	125 125 129 4635	125 125 129 4690	125 125 129 4750	125 125 129 4810	125 125 129 4880	125 125 129 5125

TODATA_350SFO_IMP_F20_DRY_ZERO_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–2 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
28000 V_{FTO} = 136	-2	114 115 126 3255	114 115 126 3305	114 115 126 3355	114 115 126 3405	114 115 126 3460	114 115 125 3525	114 115 125 3605
	-1	114 115 125 3240	114 115 125 3295	114 115 125 3345	114 115 125 3395	114 115 125 3445	114 115 125 3515	114 115 125 3595
	0	114 115 124 3235	114 115 124 3285	114 115 124 3335	114 115 124 3385	114 115 124 3440	114 115 124 3505	113 115 124 3595
	1	114 115 124 3225	114 115 124 3280	114 115 124 3330	114 115 123 3380	114 115 123 3430	113 115 123 3500	113 115 123 3590
	2	114 115 123 3225	114 115 123 3275	114 115 123 3325	113 115 123 3375	113 115 123 3430	113 115 123 3500	113 115 122 3595
30000 V_{FTO} = 140	-2	114 115 125 3320	114 115 125 3375	114 115 125 3425	114 115 125 3480	114 115 125 3535	114 115 124 3605	113 115 124 3690
	-1	114 115 124 3315	114 115 124 3370	114 115 124 3420	114 115 124 3475	114 115 124 3525	114 115 124 3595	113 115 124 3685
	0	114 115 123 3310	114 115 123 3365	114 115 123 3415	113 115 123 3470	113 115 123 3520	113 115 123 3595	113 115 123 3690
	1	113 115 123 3310	113 115 122 3360	113 115 122 3415	113 115 122 3465	113 115 122 3520	113 115 122 3595	113 115 122 3695
	2	113 115 122 3310	113 115 122 3365	113 115 122 3415	113 115 121 3470	113 115 121 3520	113 115 121 3595	113 115 121 3700
32000 V_{FTO} = 145	-2	114 115 124 3390	114 115 124 3445	114 115 124 3500	114 115 124 3555	114 115 124 3610	113 115 124 3680	113 115 123 3775
	-1	113 115 123 3390	113 115 123 3445	113 115 123 3495	113 115 123 3550	113 115 123 3605	113 115 123 3680	113 115 123 3780
	0	113 115 122 3390	113 115 122 3445	113 115 122 3495	113 115 122 3550	113 115 122 3605	113 115 122 3680	113 115 122 3785
	1	113 115 121 3395	113 115 121 3450	113 115 121 3500	113 115 121 3555	113 115 121 3610	113 115 121 3690	113 115 121 3795
	2	113 115 121 3400	113 115 121 3455	113 115 120 3510	113 115 120 3565	113 115 120 3620	113 115 120 3695	113 115 120 3825
33000 V_{FTO} = 147	-2	114 115 124 3430	114 115 124 3485	113 115 123 3540	113 115 123 3595	113 115 123 3650	113 115 123 3720	113 115 123 3820
	-1	113 115 123 3425	113 115 123 3485	113 115 123 3535	113 115 122 3590	113 115 122 3650	113 115 122 3725	113 115 122 3825
	0	113 115 122 3430	113 115 122 3485	113 115 122 3540	113 115 122 3595	113 115 122 3650	113 115 122 3725	113 115 121 3835
	1	113 115 121 3435	113 115 121 3490	113 115 121 3545	113 115 121 3600	113 115 121 3655	113 115 121 3735	112 115 120 3850
	2	113 115 120 3465	113 115 120 3520	113 115 120 3570	113 115 120 3625	113 115 120 3680	113 115 120 3775	113 115 120 3935

TODATA_350SFO_IMP_F20_DRY_ZERO_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–3 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	30	34
34000 V_{FTO} = 149	-2	113 115 124 3465	113 115 124 3520	113 115 124 3575	113 115 124 3630	113 115 124 3690	113 115 124 3765	113 115 123 3865
	-1	113 115 123 3465	113 115 123 3520	113 115 123 3575	113 116 123 3635	113 116 123 3690	113 116 123 3765	113 116 123 3870
	0	113 116 122 3470	113 116 122 3525	113 116 122 3580	113 116 122 3640	113 116 122 3695	113 116 122 3775	113 116 122 3885
	1	114 116 122 3535	114 116 122 3590	114 116 122 3645	114 116 122 3700	114 116 122 3755	114 116 122 3850	114 116 122 4020
	2	116 117 122 3665	116 117 122 3725	115 117 122 3780	115 117 122 3835	115 117 122 3895	115 117 122 3995	116 117 122 4170
35000 V_{FTO} = 151	-2	113 117 125 3500	113 117 125 3555	113 117 125 3615	113 117 125 3670	113 117 125 3725	113 117 125 3805	113 117 125 3910
	-1	113 117 124 3505	113 117 124 3560	113 117 124 3615	113 117 124 3675	113 117 124 3730	113 117 124 3810	113 117 124 3950
	0	114 117 124 3600	114 117 124 3660	114 117 124 3715	114 117 124 3775	114 117 124 3830	114 117 124 3925	115 118 124 4085
	1	116 118 124 3730	116 118 124 3795	116 118 124 3850	116 118 124 3910	116 118 124 3970	116 118 124 4070	116 118 124 4250
	2	118 119 124 3870	118 119 124 3935	118 119 124 3995	118 119 124 4055	118 119 124 4120	118 119 124 4225	118 119 124 4415
36000 V_{FTO} = 153	-2	113 119 126 3550	113 119 126 3610	113 119 126 3665	113 119 126 3720	113 119 126 3780	113 119 126 3865	114 119 126 4005
	-1	115 119 126 3665	115 119 126 3725	115 119 126 3780	115 119 126 3840	115 119 126 3895	115 119 126 3990	115 119 125 4145
	0	117 119 125 3790	117 119 125 3855	117 119 125 3910	117 119 125 3975	117 119 125 4035	117 120 125 4135	117 120 125 4315
	1	119 120 125 3935	119 120 125 4000	118 120 125 4060	118 120 125 4125	118 120 125 4190	118 120 125 4300	119 120 125 4490
	2	120 121 125 4090	120 121 125 4160	120 121 125 4220	120 121 125 4285	120 121 125 4355	120 121 125 4465	121 121 125 4680
38000 V_{FTO} = 157	-2	117 122 129 3885	117 122 129 3950	117 122 129 4005	117 122 129 4070	117 122 129 4130	117 122 129 4235	118 122 129 4405
	-1	119 123 129 4040	119 123 129 4105	119 123 129 4170	119 123 129 4235	119 123 129 4300	119 123 129 4410	120 123 129 4595
	0	121 123 129 4200	121 123 129 4270	121 124 129 4335	121 124 129 4405	121 124 129 4475	121 124 129 4590	122 124 129 4790
	1	123 124 129 4365	123 124 129 4435	123 124 129 4505	123 124 129 4575	123 124 129 4645	123 124 129 4770	123 125 129 4995
	2	125 125 129 4620	125 125 129 4690	125 125 129 4745	125 125 129 4810	125 125 129 4880	125 125 129 5010	125 125 129 5265

TODATA_350SFO_IMP_F20_DRY_ZERO_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–3 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
28000 V_{FTO} = 136	-2	114 115 126 3300	114 115 126 3355	114 115 126 3405	114 115 126 3460	114 115 125 3510	114 115 125 3600	114 115 125 3660
	-1	114 115 125 3290	114 115 125 3340	114 115 125 3395	114 115 125 3445	114 115 125 3500	114 115 125 3590	113 115 124 3655
	0	114 115 124 3280	114 115 124 3335	114 115 124 3385	114 115 124 3440	114 115 124 3490	113 115 124 3580	113 115 124 3650
	1	114 115 124 3275	114 115 124 3325	114 115 124 3380	114 115 123 3430	114 115 123 3485	113 115 123 3580	113 115 123 3650
	2	114 115 123 3270	114 115 123 3325	113 115 123 3375	113 115 123 3430	113 115 123 3480	113 115 122 3580	113 115 122 3655
30000 V_{FTO} = 140	-2	114 115 125 3370	114 115 125 3425	114 115 125 3480	114 115 125 3535	114 115 124 3590	114 115 124 3680	113 115 124 3750
	-1	114 115 124 3365	114 115 124 3420	114 115 124 3470	114 115 124 3525	114 115 124 3580	113 115 124 3675	113 115 123 3750
	0	114 115 123 3360	114 115 123 3415	114 115 123 3465	113 115 123 3520	113 115 123 3575	113 115 123 3675	113 115 123 3750
	1	113 115 123 3360	113 115 122 3410	113 115 122 3465	113 115 122 3520	113 115 122 3575	113 115 122 3675	113 115 122 3755
	2	113 115 122 3360	113 115 122 3415	113 115 122 3465	113 115 121 3520	113 115 121 3575	113 115 121 3680	113 115 121 3765
32000 V_{FTO} = 145	-2	114 115 124 3445	114 115 124 3500	114 115 124 3555	114 115 124 3610	114 115 124 3665	113 115 124 3765	113 115 123 3840
	-1	113 115 123 3440	113 115 123 3495	113 115 123 3550	113 115 123 3605	113 115 123 3660	113 115 123 3765	113 115 122 3845
	0	113 115 122 3440	113 115 122 3495	113 115 122 3550	113 115 122 3605	113 115 122 3660	113 115 122 3770	113 115 122 3850
	1	113 115 121 3445	113 115 121 3500	113 115 121 3555	113 115 121 3610	113 115 121 3665	113 115 121 3775	113 115 121 3865
	2	113 115 121 3450	113 115 121 3505	113 115 120 3560	113 115 120 3615	113 115 120 3675	113 115 120 3790	113 115 120 3905
33000 V_{FTO} = 147	-2	114 115 124 3480	113 115 123 3535	113 115 123 3590	113 115 123 3650	113 115 123 3705	113 115 123 3805	113 115 123 3885
	-1	113 115 123 3480	113 115 123 3535	113 115 123 3590	113 115 122 3645	113 115 122 3705	113 115 122 3810	113 115 122 3890
	0	113 115 122 3480	113 115 122 3540	113 115 122 3595	113 115 122 3650	113 115 122 3705	113 115 121 3815	113 115 121 3900
	1	113 115 121 3485	113 115 121 3545	113 115 121 3600	113 115 121 3655	113 115 121 3715	113 115 121 3830	112 115 120 3920
	2	113 115 120 3515	113 115 120 3565	113 115 120 3620	113 115 120 3675	113 115 120 3735	113 115 120 3880	114 115 120 4025

TODATA_350SFO_IMP_F20_DRY_ZERO_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–4 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
34000 V_{FTO} = 149	-2	113 115 124 3515	113 115 124 3575	113 115 124 3630	113 115 124 3685	113 115 124 3745	113 115 124 3850	113 115 123 3930
	-1	113 115 123 3520	113 115 123 3575	113 116 123 3630	113 116 123 3690	113 116 123 3745	113 116 123 3855	113 116 123 3940
	0	113 116 123 3525	113 116 123 3580	113 116 123 3635	113 116 122 3695	113 116 122 3750	113 116 122 3865	113 116 122 3960
	1	114 116 122 3585	114 116 122 3640	114 116 122 3695	114 116 122 3755	114 116 122 3815	114 116 122 3960	114 116 122 4105
	2	115 117 122 3715	115 117 122 3775	115 117 122 3830	115 117 122 3890	115 117 122 3955	115 117 122 4110	116 117 122 4270
35000 V_{FTO} = 151	-2	113 117 125 3555	113 117 125 3610	113 117 125 3670	113 117 125 3725	113 117 125 3785	113 117 125 3890	113 117 125 3975
	-1	113 117 124 3555	113 117 124 3615	113 117 124 3670	113 117 124 3730	113 117 124 3790	113 117 124 3910	113 117 124 4030
	0	114 117 124 3655	114 117 124 3715	114 117 124 3770	114 117 124 3830	114 118 124 3890	114 118 124 4035	115 118 124 4180
	1	116 118 124 3785	116 118 124 3845	116 118 124 3905	116 118 124 3965	116 118 124 4030	116 118 124 4190	117 119 124 4345
	2	118 119 124 3925	118 119 124 3990	118 119 124 4050	118 119 124 4115	118 119 124 4180	118 119 124 4350	118 119 124 4515
36000 V_{FTO} = 153	-2	113 119 126 3605	113 119 126 3660	113 119 126 3715	113 119 126 3775	113 119 126 3835	113 119 126 3970	114 119 126 4090
	-1	115 119 126 3715	115 119 126 3775	115 119 126 3835	115 119 126 3895	115 119 126 3955	115 119 126 4100	115 119 125 4235
	0	117 119 125 3845	117 119 125 3905	117 119 125 3965	116 119 125 4030	116 120 125 4095	117 120 125 4255	117 120 125 4410
	1	118 120 125 3995	118 120 125 4055	118 120 125 4120	118 120 125 4185	118 120 125 4250	118 120 125 4425	119 121 125 4595
	2	120 121 125 4145	120 121 125 4215	120 121 125 4280	120 121 125 4345	120 121 125 4415	120 121 125 4600	121 121 125 4795
38000 V_{FTO} = 157	-2	117 122 129 3940	117 122 129 4005	117 122 129 4065	117 122 129 4130	117 122 129 4195	117 122 129 4350	118 122 129 4505
	-1	119 123 129 4095	119 123 129 4165	119 123 129 4230	119 123 129 4295	119 123 129 4365	119 123 129 4535	120 123 129 4700
	0	121 123 129 4260	121 124 129 4330	121 124 129 4395	121 124 129 4470	121 124 129 4540	121 124 129 4725	122 124 129 4905
	1	123 124 129 4425	123 124 129 4500	123 124 129 4570	123 124 129 4640	123 124 129 4715	123 124 129 4915	124 125 129 5120
	2	125 125 129 4670	125 125 129 4735	125 125 129 4795	125 125 129 4875	125 125 129 4950	125 125 129 5165	126 126 129 5415

TODATA_350SFO_IMP_F20_DRY_ZERO_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–4 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
28000 V_{FTO} = 136	-2	114 115 126 3405	114 115 126 3460	114 115 126 3510	114 115 125 3565	114 115 125 3640	114 115 125 3760	113 115 125 3780
	-1	114 115 125 3390	114 115 125 3445	114 115 125 3500	114 115 125 3555	114 115 125 3630	113 115 124 3750	113 115 124 3775
	0	114 115 124 3385	114 115 124 3435	114 115 124 3490	114 115 124 3545	114 115 124 3625	113 115 123 3750	113 115 123 3775
	1	114 115 124 3375	114 115 124 3430	114 115 123 3485	114 115 123 3540	113 115 123 3620	113 115 123 3750	113 115 123 3780
	2	114 115 123 3375	113 115 123 3425	113 115 123 3480	113 115 123 3535	113 115 122 3615	113 115 122 3755	113 115 122 3785
30000 V_{FTO} = 140	-2	114 115 125 3475	114 115 125 3530	114 115 125 3590	114 115 124 3645	114 115 124 3725	113 115 124 3850	113 115 124 3875
	-1	114 115 124 3470	114 115 124 3525	114 115 124 3580	114 115 124 3635	113 115 124 3720	113 115 123 3850	113 115 123 3875
	0	114 115 123 3465	114 115 123 3520	113 115 123 3575	113 115 123 3630	113 115 123 3715	113 115 122 3850	113 115 122 3880
	1	113 115 122 3460	113 115 122 3515	113 115 122 3575	113 115 122 3630	113 115 122 3715	113 115 122 3860	113 115 122 3890
	2	113 115 122 3465	113 115 122 3520	113 115 121 3575	113 115 121 3630	113 115 121 3720	113 115 121 3870	112 115 121 3905
32000 V_{FTO} = 145	-2	114 115 124 3550	114 115 124 3610	114 115 124 3665	113 115 124 3725	113 115 124 3810	113 115 123 3945	113 115 123 3970
	-1	113 115 123 3550	113 115 123 3605	113 115 123 3660	113 115 123 3720	113 115 123 3805	113 115 122 3950	113 115 122 3980
	0	113 115 122 3545	113 115 122 3605	113 115 122 3660	113 115 122 3720	113 115 122 3810	113 115 121 3955	113 115 121 3990
	1	113 115 121 3550	113 115 121 3605	113 115 121 3665	113 115 121 3725	113 115 121 3815	112 115 121 3970	112 115 121 4005
	2	113 115 121 3560	113 115 120 3615	113 115 120 3670	113 115 120 3730	113 115 120 3825	113 115 120 4020	113 115 120 4070
33000 V_{FTO} = 147	-2	113 115 123 3590	113 115 123 3645	113 115 123 3705	113 115 123 3765	113 115 123 3850	113 115 123 3990	113 115 123 4020
	-1	113 115 123 3590	113 115 123 3645	113 115 122 3705	113 115 122 3760	113 115 122 3850	113 115 122 4000	113 115 122 4030
	0	113 115 122 3590	113 115 122 3645	113 115 122 3705	113 115 122 3765	113 115 121 3855	112 115 121 4010	112 115 121 4045
	1	113 115 121 3595	113 115 121 3655	113 115 121 3710	113 115 121 3770	113 115 121 3865	112 115 120 4030	112 115 120 4060
	2	113 115 120 3610	113 115 120 3665	113 115 120 3725	113 115 120 3785	113 115 120 3900	114 115 120 4155	114 115 120 4215

TODATA_350SFO_IMP_F20_DRY_ZERO_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–5 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
34000 V_{FTO} = 149	-2	113 115 124 3625	113 115 124 3685	113 115 124 3745	113 115 124 3805	113 116 124 3895	113 115 123 4035	113 115 123 4070
	-1	113 116 123 3630	113 116 123 3685	113 116 123 3745	113 116 123 3805	113 116 123 3895	113 116 123 4050	112 116 122 4080
	0	113 116 123 3635	113 116 123 3690	113 116 123 3750	113 116 123 3810	113 116 123 3905	113 116 122 4080	113 116 122 4130
	1	114 116 122 3690	114 116 122 3745	113 116 122 3805	113 116 122 3865	114 116 122 3985	114 116 122 4240	115 117 122 4295
	2	115 117 122 3820	115 117 122 3880	115 117 122 3940	115 117 122 4005	115 117 122 4135	116 117 122 4405	116 117 122 4465
35000 V_{FTO} = 151	-2	113 117 125 3665	113 117 125 3725	113 117 125 3785	113 117 125 3845	113 117 125 3935	113 117 125 4085	113 117 124 4115
	-1	113 117 125 3670	113 117 125 3730	113 117 125 3785	113 117 124 3850	113 117 124 3940	113 117 124 4150	113 117 124 4200
	0	114 117 124 3760	114 118 124 3820	114 118 124 3880	114 118 124 3945	114 118 124 4060	115 118 124 4310	115 118 124 4365
	1	116 118 124 3890	116 118 124 3955	116 118 124 4015	116 118 124 4085	116 118 124 4210	117 119 124 4485	117 119 124 4550
	2	118 119 124 4035	118 119 124 4100	118 119 124 4165	118 119 124 4235	118 119 124 4375	118 119 124 4665	119 120 124 4735
36000 V_{FTO} = 153	-2	113 119 127 3710	113 119 126 3765	113 119 126 3825	113 119 126 3890	113 119 126 4000	114 119 126 4210	114 119 126 4260
	-1	115 119 126 3825	115 119 126 3885	115 119 126 3950	115 119 126 4010	115 119 126 4130	115 119 125 4370	116 119 125 4430
	0	116 119 125 3955	116 119 125 4015	116 119 125 4080	116 120 125 4150	116 120 125 4280	117 120 125 4555	118 120 125 4615
	1	118 120 125 4105	118 120 125 4170	118 120 125 4240	118 120 125 4310	118 120 125 4450	119 121 125 4745	119 121 125 4810
	2	120 121 125 4260	120 121 125 4325	120 121 125 4400	120 121 125 4470	120 121 125 4620	121 122 125 4955	121 122 125 5030
38000 V_{FTO} = 157	-2	117 122 129 4055	117 122 129 4120	117 122 129 4185	117 122 129 4255	117 122 129 4380	118 122 129 4650	118 123 129 4715
	-1	119 123 129 4215	119 123 129 4280	119 123 129 4350	119 123 129 4425	119 123 129 4565	120 123 129 4850	120 123 129 4920
	0	121 124 129 4385	121 124 129 4455	121 124 129 4525	121 124 129 4600	121 124 129 4750	122 124 129 5060	122 124 129 5135
	1	123 124 129 4555	123 124 129 4625	123 124 129 4700	123 124 129 4780	123 124 129 4940	124 125 129 5290	124 125 129 5375
	2	125 125 129 4775	125 125 129 4850	125 125 129 4930	125 125 129 5015	125 125 129 5185	126 126 129 5600	126 126 129 5725

TODATA_350SFO_IMP_F20_DRY_ZERO_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–5 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA
FLAPS 20° **ALTITUDE 3000 FT**
ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	29	
28000 V_{FTO} = 136	-2	114 115 126 3515	114 115 125 3570	114 115 125 3630	114 115 125 3695	114 115 125 3800	113 115 124 3905	
	-1	114 115 125 3500	114 115 125 3560	114 115 125 3615	114 115 125 3685	113 115 124 3795	113 115 124 3905	
	0	114 115 124 3495	114 115 124 3550	114 115 124 3605	114 115 124 3675	113 115 124 3790	113 115 123 3905	
	1	114 115 123 3485	114 115 123 3540	114 115 123 3600	113 115 123 3670	113 115 123 3790	113 115 122 3910	
	2	113 115 123 3485	113 115 123 3540	113 115 122 3595	113 115 122 3670	113 115 122 3790	113 115 121 3920	
30000 V_{FTO} = 140	-2	114 115 125 3590	114 115 124 3650	114 115 124 3705	114 115 124 3780	113 115 124 3890	113 115 123 4010	
	-1	114 115 124 3585	114 115 124 3640	114 115 124 3700	113 115 124 3775	113 115 123 3890	113 115 123 4010	
	0	113 115 123 3580	113 115 123 3635	113 115 123 3695	113 115 123 3770	113 115 123 3890	113 115 122 4020	
	1	113 115 122 3575	113 115 122 3635	113 115 122 3690	113 115 122 3770	113 115 122 3895	112 115 121 4030	
	2	113 115 121 3580	113 115 121 3635	113 115 121 3695	113 115 121 3775	113 115 121 3905	112 115 120 4045	
32000 V_{FTO} = 145	-2	114 115 124 3670	113 115 124 3730	113 115 124 3790	113 115 123 3865	113 115 123 3985	113 115 123 4110	
	-1	113 115 123 3665	113 115 123 3725	113 115 123 3785	113 115 123 3860	113 115 122 3990	113 115 122 4120	
	0	113 115 122 3665	113 115 122 3725	113 115 122 3785	113 115 122 3865	113 115 122 3995	112 115 121 4135	
	1	113 115 121 3670	113 115 121 3725	113 115 121 3790	113 115 121 3870	112 115 121 4005	112 115 120 4150	
	2	113 115 120 3675	113 115 120 3735	113 115 120 3795	113 115 120 3880	112 115 120 4035	113 115 119 4240	
33000 V_{FTO} = 147	-2	113 115 123 3710	113 115 123 3770	113 115 123 3830	113 115 123 3905	113 115 123 4030	113 115 122 4160	
	-1	113 115 122 3705	113 115 122 3765	113 115 122 3830	113 115 122 3910	113 115 122 4040	112 115 121 4175	
	0	113 115 122 3710	113 115 122 3770	113 115 121 3830	113 115 121 3910	113 115 121 4050	112 115 121 4190	
	1	113 115 121 3715	113 115 121 3775	113 115 121 3835	113 115 121 3920	112 115 120 4065	113 115 120 4245	
	2	113 115 120 3725	113 115 120 3785	113 115 120 3850	113 115 120 3945	113 115 120 4165	114 115 120 4415	

TODATA_350SFO_IMP_F20_DRY_ZERO_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–6 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	29	
34000 V_{FTO} = 149	-2	113 115 124 3745	113 116 124 3810	113 116 124 3870	113 116 124 3950	113 116 123 4080	113 115 123 4210	
	-1	113 116 123 3750	113 116 123 3810	113 116 123 3870	113 116 123 3955	113 116 123 4090	112 116 122 4230	
	0	113 116 123 3755	113 116 123 3815	113 116 123 3875	113 116 123 3960	112 116 122 4105	113 116 122 4325	
	1	113 116 122 3810	113 116 122 3870	113 116 122 3935	113 116 122 4030	114 116 122 4250	115 117 122 4505	
	2	115 117 122 3945	115 117 122 4010	115 117 122 4075	115 117 122 4180	116 117 122 4415	117 118 122 4680	
35000 V_{FTO} = 151	-2	113 117 125 3785	113 117 125 3850	113 117 125 3910	113 117 125 3995	113 117 125 4125	112 117 124 4265	
	-1	113 117 125 3790	113 117 125 3850	113 117 124 3915	113 117 124 4000	113 117 124 4175	114 118 124 4390	
	0	114 118 124 3885	114 118 124 3950	114 118 124 4015	114 118 124 4110	115 118 124 4325	116 118 124 4575	
	1	116 118 124 4020	116 118 124 4085	116 118 124 4155	116 118 124 4260	116 119 124 4500	117 119 124 4770	
	2	118 119 124 4170	117 119 124 4240	117 119 124 4310	118 119 124 4420	118 119 124 4675	119 120 124 4980	
36000 V_{FTO} = 153	-2	113 119 126 3830	113 119 126 3890	113 119 126 3955	113 119 126 4050	113 119 126 4240	114 119 125 4445	
	-1	115 119 126 3950	115 119 126 4015	115 119 126 4080	115 119 126 4180	115 119 125 4385	116 120 125 4640	
	0	116 119 125 4085	116 120 125 4150	116 120 125 4225	116 120 125 4330	117 120 125 4565	118 120 125 4835	
	1	118 120 125 4245	118 120 125 4310	118 120 125 4385	118 120 125 4500	119 121 125 4755	120 121 125 5040	
	2	120 121 125 4400	120 121 125 4475	120 121 125 4550	120 121 125 4670	121 122 125 4960	122 122 125 5290	
38000 V_{FTO} = 157	-2	117 122 129 4190	117 122 129 4260	117 122 129 4330	117 122 129 4435	118 122 129 4670	119 123 129 4935	
	-1	119 123 129 4355	119 123 129 4425	119 123 129 4505	119 123 129 4615	120 123 129 4870	121 124 129 5155	
	0	121 124 129 4530	121 124 129 4605	121 124 129 4685	121 124 129 4805	122 124 129 5075	122 124 129 5380	
	1	123 124 129 4705	123 124 129 4785	123 125 129 4865	123 125 129 4995	123 125 129 5295	124 125 129 5650	
	2	125 125 129 4935	125 125 129 5015	125 125 129 5100	125 125 129 5240	125 126 129 5570	126 126 129 6070	

TODATA_350SFO_IMP_F20_DRY_ZERO_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–6 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA
FLAPS 20° **ALTITUDE 4000 FT**
ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	27
28000 V_{FTO} = 136	-2	114 115 125 3630	114 115 125 3690	114 115 125 3755	114 115 125 3855	113 115 124 3980	113 115 124 4035
	-1	114 115 125 3620	114 115 124 3680	114 115 124 3745	113 115 124 3850	113 115 124 3975	113 115 123 4035
	0	114 115 124 3610	114 115 124 3670	114 115 124 3735	113 115 123 3845	113 115 123 3975	113 115 123 4040
	1	114 115 123 3605	113 115 123 3665	113 115 123 3730	113 115 123 3840	113 115 122 3980	113 115 122 4045
	2	113 115 122 3600	113 115 122 3660	113 115 122 3730	113 115 122 3845	113 115 121 3990	112 115 121 4060
30000 V_{FTO} = 140	-2	114 115 124 3710	114 115 124 3775	114 115 124 3840	113 115 124 3950	113 115 123 4080	113 115 123 4145
	-1	114 115 124 3705	114 115 124 3765	113 115 123 3835	113 115 123 3945	113 115 123 4085	113 115 122 4150
	0	113 115 123 3700	113 115 123 3760	113 115 123 3830	113 115 122 3945	113 115 122 4090	112 115 122 4160
	1	113 115 122 3700	113 115 122 3760	113 115 122 3830	113 115 122 3950	112 115 121 4100	112 115 121 4175
	2	113 115 121 3700	113 115 121 3760	113 115 121 3835	113 115 121 3960	112 115 120 4115	112 115 120 4200
32000 V_{FTO} = 145	-2	113 115 123 3795	113 115 123 3855	113 115 123 3930	113 115 123 4045	113 115 122 4185	113 115 122 4250
	-1	113 115 123 3790	113 115 123 3855	113 115 123 3925	113 115 122 4045	113 115 122 4195	112 115 121 4265
	0	113 115 122 3790	113 115 122 3855	113 115 122 3925	113 115 122 4050	112 115 121 4205	112 115 121 4280
	1	113 115 121 3795	113 115 121 3860	113 115 121 3930	113 115 121 4060	112 115 120 4225	112 115 120 4305
	2	113 115 120 3805	113 115 120 3865	113 115 120 3940	112 115 120 4075	113 115 119 4310	113 115 119 4440
33000 V_{FTO} = 147	-2	113 115 123 3835	113 115 123 3900	113 115 123 3970	113 115 123 4090	113 115 122 4235	112 115 122 4305
	-1	113 115 122 3835	113 115 122 3900	113 115 122 3970	113 115 122 4095	112 115 121 4250	112 115 121 4320
	0	113 115 121 3840	113 115 121 3900	113 115 121 3975	113 115 121 4105	112 115 120 4265	112 115 120 4345
	1	113 115 121 3845	113 115 121 3910	113 115 121 3985	112 115 120 4120	113 115 120 4325	113 115 120 4450
	2	113 115 120 3865	113 115 120 3930	113 115 120 4010	113 115 120 4205	114 116 120 4495	115 116 120 4630

TODATA_350SFO_IMP_F20_DRY_ZERO_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–7 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	27	
34000 V_{FTO} = 149	-2	113 116 124 3875	113 116 124 3940	113 116 124 4015	113 116 123 4135	113 116 123 4290	112 115 122 4360	
	-1	113 116 123 3880	113 116 123 3945	113 116 123 4020	113 116 123 4145	112 116 122 4305	112 116 122 4380	
	0	113 116 123 3885	113 116 123 3950	113 116 122 4025	112 116 122 4155	113 116 122 4410	114 116 122 4530	
	1	113 116 122 3950	113 116 122 4015	113 116 122 4095	114 116 122 4290	115 117 122 4585	115 117 122 4720	
	2	115 117 122 4095	115 117 122 4160	115 117 122 4250	116 117 122 4455	117 118 122 4765	117 118 122 4925	
35000 V_{FTO} = 151	-2	113 117 125 3920	113 117 125 3985	113 117 125 4060	113 117 125 4185	112 117 124 4340	112 117 124 4415	
	-1	113 117 124 3925	113 118 124 3990	113 118 124 4065	113 118 124 4220	114 118 124 4475	114 118 124 4605	
	0	114 118 124 4025	114 118 124 4095	114 118 124 4175	114 118 124 4365	116 118 124 4660	116 119 124 4800	
	1	116 118 124 4170	116 118 124 4240	116 118 124 4330	116 119 124 4540	117 119 124 4855	118 119 124 5000	
	2	118 119 124 4325	118 119 124 4400	118 119 124 4495	118 119 124 4715	119 120 124 5075	120 120 124 5240	
36000 V_{FTO} = 153	-2	113 119 126 3970	113 119 126 4035	113 119 126 4115	113 119 126 4285	114 119 126 4530	115 119 126 4660	
	-1	115 119 126 4095	115 119 126 4165	115 119 126 4245	115 119 126 4425	116 120 126 4730	117 120 126 4860	
	0	116 120 126 4240	116 120 126 4310	116 120 126 4400	117 120 126 4610	118 121 126 4925	118 121 126 5070	
	1	118 120 126 4405	118 120 126 4480	118 121 126 4575	119 121 126 4795	120 121 126 5135	120 121 126 5295	
	2	120 121 126 4570	120 121 126 4645	120 121 126 4745	120 122 126 5000	122 122 126 5385	122 122 126 5570	
38000 V_{FTO} = 157	-2	117 122 129 4345	117 122 129 4415	117 122 129 4510	117 123 129 4715	119 123 129 5030	119 123 129 5170	
	-1	119 123 129 4520	119 123 129 4600	119 123 129 4695	119 123 129 4915	121 124 129 5250	121 124 129 5405	
	0	121 124 129 4700	121 124 129 4780	121 124 129 4880	121 124 129 5120	122 125 129 5480	123 125 129 5645	
	1	123 125 129 4885	123 125 129 4970	123 125 129 5075	123 125 129 5335	124 125 129 5755	125 126 129 5940	
	2	125 125 129 5125	125 125 129 5210	125 125 129 5325	125 126 129 5610	126 126 129 6175	126 126 129 6450	

TODATA_350SFO_IMP_F20_DRY_ZERO_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–7 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
28000 V_{FTO} = 136	-2	114 115 126 3205	114 115 126 3255	114 115 126 3305	114 115 126 3355	114 115 126 3410	114 115 125 3465	114 115 125 3560
	-1	114 115 125 3195	114 115 125 3245	114 115 125 3295	114 115 125 3345	114 115 125 3395	114 115 125 3455	114 115 124 3555
	0	114 115 124 3185	114 115 124 3235	114 115 124 3285	114 115 124 3335	114 115 124 3385	114 115 124 3445	113 115 124 3550
	1	114 115 124 3180	114 115 124 3230	114 115 124 3280	114 115 124 3330	114 115 123 3380	114 115 123 3440	113 115 123 3550
	2	114 115 123 3175	114 115 123 3230	114 115 123 3275	113 115 123 3325	113 115 123 3380	113 115 123 3435	113 115 122 3550
30000 V_{FTO} = 140	-2	114 115 125 3270	114 115 125 3325	114 115 125 3375	114 115 125 3430	114 115 125 3480	114 115 125 3540	113 115 124 3645
	-1	114 115 124 3265	114 115 124 3320	114 115 124 3370	114 115 124 3420	114 115 124 3475	114 115 124 3535	113 115 124 3640
	0	114 115 123 3260	114 115 123 3315	114 115 123 3365	114 115 123 3415	113 115 123 3470	113 115 123 3530	113 115 123 3640
	1	113 115 123 3260	113 115 122 3315	113 115 122 3365	113 115 122 3415	113 115 122 3470	113 115 122 3530	113 115 122 3645
	2	113 115 122 3260	113 115 122 3315	113 115 122 3365	113 115 122 3415	113 115 121 3470	113 115 121 3530	113 115 121 3655
32000 V_{FTO} = 145	-2	114 115 124 3340	114 115 124 3395	114 115 124 3450	114 115 124 3500	114 115 124 3555	113 115 124 3615	113 115 123 3730
	-1	114 115 123 3340	113 115 123 3395	113 115 123 3445	113 115 123 3500	113 115 123 3555	113 115 123 3615	113 115 123 3730
	0	113 115 122 3340	113 115 122 3395	113 115 122 3445	113 115 122 3500	113 115 122 3555	113 115 122 3615	113 115 122 3740
	1	113 115 121 3340	113 115 121 3395	113 115 121 3450	113 115 121 3505	113 115 121 3555	113 115 121 3620	113 115 121 3750
	2	113 115 121 3350	113 115 121 3405	113 115 120 3455	113 115 120 3510	113 115 120 3565	113 115 120 3630	113 115 120 3790
33000 V_{FTO} = 147	-2	114 115 124 3375	114 115 124 3430	113 115 123 3485	113 115 123 3540	113 115 123 3595	113 115 123 3655	113 115 123 3770
	-1	113 115 123 3375	113 115 123 3430	113 115 123 3485	113 115 123 3540	113 115 122 3595	113 115 122 3655	113 115 122 3775
	0	113 115 122 3380	113 115 122 3435	113 115 122 3485	113 115 122 3540	113 115 122 3595	113 115 122 3660	113 115 121 3785
	1	113 115 121 3385	113 115 121 3440	113 115 121 3495	113 115 121 3550	113 115 121 3600	113 115 121 3665	112 115 120 3800
	2	113 115 120 3420	113 115 120 3475	113 115 120 3525	113 115 120 3575	113 115 120 3630	113 115 120 3700	114 115 120 3905

TODATA_350SFO_IMP_F20_DRY_ECS_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–8 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
34000 V_{FTO} = 149	-2	113 115 124 3410	113 115 124 3470	113 115 124 3520	113 115 124 3575	113 115 124 3630	113 115 124 3695	113 115 123 3815
	-1	113 115 123 3415	113 115 123 3470	113 115 123 3525	113 115 123 3580	113 116 123 3635	113 116 123 3695	113 115 123 3825
	0	113 116 122 3420	113 116 122 3475	113 116 122 3530	113 116 122 3585	113 116 122 3640	113 116 122 3705	113 116 122 3845
	1	114 116 122 3485	114 116 122 3545	114 116 122 3595	114 116 122 3650	114 116 122 3705	114 116 122 3775	114 116 122 3985
	2	116 117 122 3615	116 117 122 3675	116 117 122 3730	115 117 122 3785	115 117 122 3845	115 117 122 3915	116 117 122 4135
35000 V_{FTO} = 151	-2	113 117 125 3450	113 117 125 3505	113 117 125 3560	113 117 125 3615	113 117 125 3670	113 117 125 3735	113 117 125 3860
	-1	113 117 124 3450	113 117 124 3510	113 117 124 3565	113 117 124 3620	113 117 124 3675	113 117 124 3740	113 117 124 3910
	0	115 117 124 3550	115 117 124 3610	114 117 124 3665	114 117 124 3720	114 117 124 3775	114 117 124 3845	115 118 124 4055
	1	116 118 124 3680	116 118 124 3745	116 118 124 3800	116 118 124 3860	116 118 124 3915	116 118 124 3990	117 118 124 4215
	2	118 119 124 3820	118 119 124 3885	118 119 124 3940	118 119 124 4000	118 119 124 4060	118 119 124 4140	118 119 124 4375
36000 V_{FTO} = 153	-2	114 118 126 3505	114 119 126 3560	113 119 126 3615	113 119 126 3670	113 119 126 3725	113 119 126 3790	114 119 126 3970
	-1	115 119 126 3610	115 119 126 3675	115 119 126 3730	115 119 126 3785	115 119 126 3840	115 119 126 3910	115 119 125 4110
	0	117 119 125 3740	117 119 125 3805	117 119 125 3860	117 119 125 3920	117 119 125 3980	117 120 125 4055	117 120 125 4280
	1	119 120 125 3885	119 120 125 3950	119 120 125 4010	119 120 125 4070	118 120 125 4130	118 120 125 4210	119 121 125 4450
	2	121 121 125 4040	120 121 125 4110	120 121 125 4170	120 121 125 4230	120 121 125 4295	120 121 125 4380	121 121 125 4650
38000 V_{FTO} = 157	-2	118 122 129 3830	117 122 129 3895	117 122 129 3950	117 122 129 4010	117 122 129 4075	117 122 129 4150	118 122 129 4370
	-1	120 123 129 3985	120 123 129 4055	119 123 129 4115	119 123 129 4175	119 123 129 4240	119 123 129 4320	120 123 129 4560
	0	121 123 129 4145	121 123 129 4215	121 124 129 4280	121 124 129 4345	121 124 129 4410	121 124 129 4495	122 124 129 4750
	1	123 124 129 4305	123 124 129 4380	123 124 129 4445	123 124 129 4510	123 124 129 4580	123 124 129 4670	124 125 129 4960
	2	125 125 129 4580	125 125 129 4650	125 125 129 4705	125 125 129 4765	125 125 129 4825	125 125 129 4910	126 126 129 5285

TODATA_350SFO_IMP_F20_DRY_ECS_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–8 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
28000 V_{FTO} = 136	-2	114 115 126 3255	114 115 126 3305	114 115 126 3355	114 115 126 3410	114 115 125 3460	114 115 125 3535	114 115 125 3620
	-1	114 115 125 3245	114 115 125 3295	114 115 125 3345	114 115 125 3395	114 115 125 3450	114 115 125 3525	113 115 124 3610
	0	114 115 124 3235	114 115 124 3285	114 115 124 3335	114 115 124 3390	114 115 124 3440	114 115 124 3520	113 115 124 3610
	1	114 115 124 3230	114 115 124 3280	114 115 124 3330	114 115 123 3380	114 115 123 3435	113 115 123 3515	113 115 123 3610
	2	114 115 123 3225	114 115 123 3275	113 115 123 3325	113 115 123 3380	113 115 123 3430	113 115 122 3515	113 115 122 3610
30000 V_{FTO} = 140	-2	114 115 125 3325	114 115 125 3375	114 115 125 3430	114 115 125 3480	114 115 125 3535	114 115 124 3615	113 115 124 3705
	-1	114 115 124 3315	114 115 124 3370	114 115 124 3420	114 115 124 3475	114 115 124 3525	113 115 124 3610	113 115 123 3705
	0	114 115 123 3310	114 115 123 3365	114 115 123 3415	113 115 123 3470	113 115 123 3525	113 115 123 3610	113 115 123 3705
	1	113 115 123 3310	113 115 122 3365	113 115 122 3415	113 115 122 3470	113 115 122 3520	113 115 122 3610	113 115 122 3710
	2	113 115 122 3310	113 115 122 3365	113 115 122 3415	113 115 121 3470	113 115 121 3525	113 115 121 3615	113 115 121 3720
32000 V_{FTO} = 145	-2	114 115 124 3395	114 115 124 3450	114 115 124 3500	114 115 124 3555	114 115 124 3610	113 115 124 3695	113 115 123 3790
	-1	113 115 123 3390	113 115 123 3445	113 115 123 3500	113 115 123 3555	113 115 123 3610	113 115 123 3695	113 115 122 3795
	0	113 115 122 3390	113 115 122 3445	113 115 122 3500	113 115 122 3555	113 115 122 3610	113 115 122 3700	113 115 122 3805
	1	113 115 121 3395	113 115 121 3450	113 115 121 3505	113 115 121 3560	113 115 121 3610	113 115 121 3705	113 115 121 3815
	2	113 115 121 3400	113 115 120 3455	113 115 120 3510	113 115 120 3565	113 115 120 3620	113 115 120 3715	113 115 120 3870
33000 V_{FTO} = 147	-2	114 115 124 3430	113 115 123 3485	113 115 123 3540	113 115 123 3595	113 115 123 3650	113 115 123 3740	113 115 123 3835
	-1	113 115 123 3430	113 115 123 3485	113 115 123 3540	113 115 122 3595	113 115 122 3650	113 115 122 3740	113 115 122 3845
	0	113 115 122 3430	113 115 122 3485	113 115 122 3540	113 115 122 3595	113 115 122 3650	113 115 121 3745	113 115 121 3855
	1	113 115 121 3435	113 115 121 3495	113 115 121 3545	113 115 121 3605	113 115 121 3660	113 115 121 3755	112 115 120 3870
	2	113 115 120 3470	113 115 120 3525	113 115 120 3575	113 115 120 3630	113 115 120 3685	113 115 120 3805	114 115 120 3995

TODATA_350SFO_IMP_F20_DRY_ECS_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–9 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
34000 V_{FTO} = 149	-2	113 115 124 3465	113 115 124 3520	113 115 124 3575	113 115 124 3635	113 115 124 3690	113 115 124 3780	113 115 123 3880
	-1	113 115 123 3465	113 115 123 3525	113 115 123 3580	113 116 123 3635	113 116 123 3690	113 116 123 3785	113 116 122 3890
	0	113 116 122 3470	113 116 122 3530	113 116 122 3585	113 116 122 3640	113 116 122 3695	113 116 122 3790	113 116 122 3925
	1	114 116 122 3540	114 116 122 3595	114 116 122 3650	114 116 122 3705	114 116 122 3765	114 116 122 3885	115 116 122 4080
	2	116 117 122 3670	116 117 122 3730	115 117 122 3785	115 117 122 3845	115 117 122 3900	115 117 122 4030	116 117 122 4235
35000 V_{FTO} = 151	-2	113 117 125 3500	113 117 125 3560	113 117 125 3615	113 117 125 3670	113 117 125 3730	113 117 125 3820	113 117 124 3925
	-1	113 117 124 3505	113 117 124 3565	113 117 124 3620	113 117 124 3675	113 117 124 3730	113 117 124 3835	113 117 124 3995
	0	114 117 124 3605	114 117 124 3665	114 117 124 3720	114 117 124 3780	114 117 124 3835	114 117 124 3955	115 118 124 4150
	1	116 118 124 3740	116 118 124 3800	116 118 124 3855	116 118 124 3915	116 118 124 3975	116 118 124 4110	117 119 124 4315
	2	118 119 124 3875	118 119 124 3940	118 119 124 4000	118 119 124 4060	118 119 124 4125	118 119 124 4265	119 119 124 4490
36000 V_{FTO} = 153	-2	113 119 126 3555	113 119 126 3615	113 119 126 3670	113 119 126 3725	113 119 126 3780	113 119 126 3890	114 119 126 4055
	-1	115 119 126 3670	115 119 126 3730	115 119 126 3785	115 119 126 3840	115 119 126 3900	115 119 126 4020	116 119 125 4205
	0	117 119 125 3795	117 119 125 3860	117 119 125 3920	117 119 125 3980	117 120 125 4040	117 120 125 4170	117 120 125 4380
	1	119 120 125 3945	119 120 125 4010	119 120 125 4070	118 120 125 4135	118 120 125 4195	119 120 125 4335	119 121 125 4560
	2	120 121 125 4100	120 121 125 4170	120 121 125 4230	120 121 125 4295	120 121 125 4360	120 121 125 4510	121 122 125 4765
38000 V_{FTO} = 157	-2	117 122 129 3890	117 122 129 3950	117 122 129 4010	117 122 129 4075	117 122 129 4140	117 122 129 4265	118 122 129 4475
	-1	119 123 129 4045	119 123 129 4115	119 123 129 4175	119 123 129 4240	119 123 129 4305	119 123 129 4445	120 123 129 4665
	0	121 123 129 4210	121 124 129 4280	121 124 129 4340	121 124 129 4410	121 124 129 4480	121 124 129 4630	122 124 129 4865
	1	123 124 129 4370	123 124 129 4445	123 124 129 4510	123 124 129 4580	123 124 129 4655	123 124 129 4815	124 125 129 5085
	2	125 125 129 4635	125 125 129 4705	125 125 129 4760	125 125 129 4825	125 125 129 4890	125 125 129 5060	126 126 129 5445

TODATA_350SFO_IMP_F20_DRY_ECS_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–9 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
28000 V_{FTO} = 136	-2	114 115 126 3305	114 115 126 3355	114 115 126 3405	114 115 126 3460	114 115 125 3515	114 115 125 3610	114 115 125 3675
	-1	114 115 125 3290	114 115 125 3345	114 115 125 3395	114 115 125 3450	114 115 125 3500	114 115 124 3600	113 115 124 3670
	0	114 115 124 3285	114 115 124 3335	114 115 124 3385	114 115 124 3440	114 115 124 3490	113 115 124 3595	113 115 123 3670
	1	114 115 124 3275	114 115 124 3330	114 115 123 3380	114 115 123 3435	114 115 123 3485	113 115 123 3595	113 115 123 3670
	2	114 115 123 3275	114 115 123 3325	113 115 123 3375	113 115 123 3430	113 115 123 3480	113 115 122 3595	113 115 122 3675
30000 V_{FTO} = 140	-2	114 115 125 3375	114 115 125 3425	114 115 125 3480	114 115 125 3535	114 115 124 3590	113 115 124 3695	113 115 124 3765
	-1	114 115 124 3365	114 115 124 3420	114 115 124 3475	114 115 124 3525	114 115 124 3580	113 115 124 3690	113 115 123 3765
	0	114 115 123 3360	114 115 123 3415	114 115 123 3470	113 115 123 3520	113 115 123 3575	113 115 123 3690	113 115 122 3770
	1	113 115 122 3360	113 115 122 3415	113 115 122 3465	113 115 122 3520	113 115 122 3575	113 115 122 3695	113 115 122 3775
	2	113 115 122 3360	113 115 122 3415	113 115 121 3470	113 115 121 3525	113 115 121 3575	113 115 121 3700	113 115 121 3790
32000 V_{FTO} = 145	-2	114 115 124 3445	114 115 124 3500	114 115 124 3555	114 115 124 3610	114 115 124 3665	113 115 123 3780	113 115 123 3855
	-1	113 115 123 3440	113 115 123 3495	113 115 123 3550	113 115 123 3610	113 115 123 3665	113 115 123 3780	113 115 122 3860
	0	113 115 122 3440	113 115 122 3500	113 115 122 3550	113 115 122 3610	113 115 122 3665	113 115 122 3790	113 115 121 3870
	1	113 115 121 3445	113 115 121 3500	113 115 121 3555	113 115 121 3610	113 115 121 3670	113 115 121 3795	112 115 121 3885
	2	113 115 121 3455	113 115 120 3510	113 115 120 3565	113 115 120 3620	113 115 120 3675	113 115 120 3820	113 115 120 3950
33000 V_{FTO} = 147	-2	114 115 124 3480	113 115 123 3540	113 115 123 3595	113 115 123 3650	113 115 123 3705	113 115 123 3825	113 115 123 3905
	-1	113 115 123 3480	113 115 123 3535	113 115 122 3590	113 115 122 3650	113 115 122 3705	113 115 122 3830	113 115 122 3910
	0	113 115 122 3485	113 115 122 3540	113 115 122 3595	113 115 122 3650	113 115 122 3710	113 115 121 3835	113 115 121 3925
	1	113 115 121 3490	113 115 121 3545	113 115 121 3600	113 115 121 3660	113 115 121 3715	113 115 120 3850	112 115 120 3945
	2	113 115 120 3520	113 115 120 3570	113 115 120 3625	113 115 120 3680	113 115 120 3740	113 115 120 3930	114 115 120 4090

TODATA_350SFO_IMP_F20_DRY_ECS_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–10 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
34000 V_{FTO} = 149	-2	113 115 124 3520	113 115 124 3575	113 115 124 3630	113 115 124 3690	113 115 124 3745	113 115 123 3865	113 115 123 3950
	-1	113 115 123 3520	113 115 123 3575	113 116 123 3635	113 116 123 3690	113 116 123 3745	113 116 123 3875	113 116 122 3960
	0	113 116 122 3525	113 116 122 3580	113 116 122 3640	113 116 122 3695	113 116 122 3755	113 116 122 3885	113 116 122 4015
	1	114 116 122 3590	114 116 122 3645	114 116 122 3700	114 116 122 3760	114 116 122 3820	114 116 122 4015	115 117 122 4175
	2	116 117 122 3720	115 117 122 3780	115 117 122 3835	115 117 122 3900	115 117 122 3960	116 117 122 4165	116 117 122 4335
35000 V_{FTO} = 151	-2	113 117 125 3555	113 117 125 3615	113 117 125 3670	113 117 125 3730	113 117 125 3785	113 117 125 3910	113 117 124 3995
	-1	113 117 124 3560	113 117 124 3615	113 117 124 3675	113 117 124 3730	113 117 124 3790	113 117 124 3945	113 117 124 4080
	0	114 117 124 3660	114 117 124 3715	114 117 124 3775	114 117 124 3835	114 118 124 3895	115 118 124 4080	115 118 124 4245
	1	116 118 124 3790	116 118 124 3850	116 118 124 3910	116 118 124 3975	116 118 124 4035	116 118 124 4245	117 119 124 4420
	2	118 119 124 3930	118 119 124 3995	118 119 124 4055	118 119 124 4120	118 119 124 4185	118 119 124 4410	119 120 124 4605
36000 V_{FTO} = 153	-2	113 119 126 3610	113 119 126 3665	113 119 126 3720	113 119 126 3780	113 119 126 3840	113 119 126 4005	114 119 126 4140
	-1	115 119 126 3720	115 119 126 3780	115 119 126 3840	115 119 126 3900	115 119 126 3960	115 119 125 4140	116 119 125 4305
	0	117 119 125 3850	117 119 125 3915	117 119 125 3975	117 119 125 4035	117 120 125 4100	117 120 125 4310	118 120 125 4485
	1	119 120 125 4000	118 120 125 4065	118 120 125 4125	118 120 125 4190	118 120 125 4260	119 121 125 4485	119 121 125 4665
	2	120 121 125 4155	120 121 125 4225	120 121 125 4285	120 121 125 4355	120 121 125 4425	121 121 125 4675	121 122 125 4890
38000 V_{FTO} = 157	-2	117 122 129 3945	117 122 129 4010	117 122 129 4070	117 122 129 4135	117 122 129 4200	118 122 129 4405	118 123 129 4580
	-1	119 123 129 4105	119 123 129 4170	119 123 129 4235	119 123 129 4305	119 123 129 4370	120 123 129 4595	120 123 129 4775
	0	121 123 129 4270	121 124 129 4340	121 124 129 4405	121 124 129 4475	121 124 129 4545	122 124 129 4785	122 124 129 4980
	1	123 124 129 4435	123 124 129 4505	123 124 129 4575	123 124 129 4650	123 124 129 4725	123 125 129 4985	124 125 129 5215
	2	125 125 129 4685	125 125 129 4750	125 125 129 4810	125 125 129 4885	125 125 129 4960	125 125 129 5260	126 126 129 5610

TODATA_350SFO_IMP_F20_DRY_ECS_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–10 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
28000 V_{FTO} = 136	-2	114 115 126 3405	114 115 126 3460	114 115 125 3515	114 115 125 3570	114 115 125 3655	113 115 125 3775	113 115 124 3800
	-1	114 115 125 3395	114 115 125 3445	114 115 125 3500	114 115 125 3555	114 115 125 3645	113 115 124 3770	113 115 124 3795
	0	114 115 124 3385	114 115 124 3435	114 115 124 3490	114 115 124 3545	113 115 124 3640	113 115 123 3770	113 115 123 3795
	1	114 115 124 3380	114 115 123 3430	114 115 123 3485	114 115 123 3540	113 115 123 3640	113 115 122 3770	113 115 122 3800
	2	114 115 123 3375	113 115 123 3425	113 115 123 3480	113 115 123 3535	113 115 122 3640	113 115 122 3775	113 115 121 3805
30000 V_{FTO} = 140	-2	114 115 125 3480	114 115 125 3535	114 115 125 3590	114 115 124 3645	113 115 124 3740	113 115 124 3870	113 115 124 3895
	-1	114 115 124 3470	114 115 124 3525	114 115 124 3580	114 115 124 3640	113 115 124 3735	113 115 123 3870	113 115 123 3895
	0	114 115 123 3465	113 115 123 3520	113 115 123 3575	113 115 123 3635	113 115 123 3735	113 115 122 3875	113 115 122 3905
	1	113 115 122 3465	113 115 122 3520	113 115 122 3575	113 115 122 3630	113 115 122 3735	113 115 121 3885	113 115 121 3915
	2	113 115 122 3465	113 115 122 3520	113 115 121 3575	113 115 121 3635	113 115 121 3745	112 115 121 3895	112 115 120 3930
32000 V_{FTO} = 145	-2	114 115 124 3555	114 115 124 3610	114 115 124 3665	113 115 124 3725	113 115 123 3825	113 115 123 3965	113 115 123 3995
	-1	113 115 123 3550	113 115 123 3605	113 115 123 3665	113 115 123 3720	113 115 123 3825	113 115 122 3970	113 115 122 4000
	0	113 115 122 3550	113 115 122 3605	113 115 122 3665	113 115 122 3720	113 115 122 3830	113 115 121 3980	112 115 121 4015
	1	113 115 121 3555	113 115 121 3610	113 115 121 3665	113 115 121 3725	113 115 121 3840	112 115 120 3995	112 115 120 4030
	2	113 115 120 3560	113 115 120 3615	113 115 120 3675	113 115 120 3735	112 115 120 3850	113 115 120 4075	113 115 119 4125
33000 V_{FTO} = 147	-2	113 115 123 3590	113 115 123 3650	113 115 123 3705	113 115 123 3765	113 115 123 3870	113 115 122 4010	113 115 122 4040
	-1	113 115 123 3590	113 115 122 3645	113 115 122 3705	113 115 122 3765	113 115 122 3875	113 115 122 4020	113 115 121 4055
	0	113 115 122 3590	113 115 122 3650	113 115 122 3705	113 115 121 3765	113 115 121 3880	112 115 121 4035	112 115 121 4070
	1	113 115 121 3600	113 115 121 3655	113 115 121 3715	113 115 121 3775	113 115 121 3890	113 115 120 4075	113 115 120 4130
	2	113 115 120 3615	113 115 120 3670	113 115 120 3730	113 115 120 3790	113 115 120 3955	114 115 120 4230	114 116 120 4290

TODATA_350SFO_IMP_F20_DRY_ECS_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–11 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
34000 V_{FTO} = 149	-2	113 115 124 3630	113 115 124 3685	113 115 124 3745	113 115 124 3805	113 115 124 3915	113 115 123 4060	113 115 123 4090
	-1	113 116 123 3630	113 116 123 3690	113 116 123 3745	113 116 123 3805	113 116 123 3920	112 116 122 4075	112 116 122 4105
	0	113 116 123 3635	113 116 123 3695	113 116 123 3750	113 116 123 3810	113 116 122 3930	113 116 122 4150	113 116 122 4210
	1	114 116 122 3695	114 116 122 3750	113 116 122 3810	113 116 122 3870	114 116 122 4035	115 117 122 4320	115 117 122 4380
	2	115 117 122 3825	115 117 122 3885	115 117 122 3945	115 117 122 4010	115 117 122 4190	117 118 122 4485	117 118 122 4550
35000 V_{FTO} = 151	-2	113 117 125 3665	113 117 125 3725	113 117 125 3785	113 117 125 3845	113 117 125 3960	113 117 124 4110	113 117 124 4140
	-1	113 117 125 3670	113 117 125 3730	113 117 124 3790	113 117 124 3850	113 117 124 3980	114 117 124 4215	114 117 124 4275
	0	114 117 124 3765	114 118 124 3825	114 118 124 3885	114 118 124 3950	114 118 124 4105	116 118 124 4390	116 118 124 4450
	1	116 118 124 3900	116 118 124 3960	116 118 124 4025	116 118 124 4090	116 118 124 4265	117 119 124 4570	118 119 124 4635
	2	118 119 124 4045	118 119 124 4105	118 119 124 4175	118 119 124 4240	118 119 124 4430	119 120 124 4770	119 120 124 4845
36000 V_{FTO} = 153	-2	113 119 126 3715	113 119 126 3770	113 119 126 3830	113 119 126 3895	113 119 126 4040	114 119 126 4270	114 119 125 4325
	-1	115 119 126 3830	115 119 126 3890	115 119 126 3950	115 119 126 4015	115 119 126 4175	116 119 125 4455	116 120 125 4515
	0	116 119 125 3960	116 119 125 4025	116 120 125 4090	116 120 125 4155	117 120 125 4335	118 120 125 4640	118 120 125 4700
	1	118 120 125 4115	118 120 125 4180	118 120 125 4245	118 120 125 4315	119 120 125 4510	120 121 125 4830	120 121 125 4895
	2	120 121 125 4270	120 121 125 4335	120 121 125 4405	120 121 125 4480	120 121 125 4690	122 122 125 5065	122 122 125 5145
38000 V_{FTO} = 157	-2	117 122 129 4060	117 122 129 4125	117 122 129 4190	117 122 129 4260	117 122 129 4430	119 123 129 4735	119 123 129 4800
	-1	119 123 129 4220	119 123 129 4290	119 123 129 4360	119 123 129 4430	119 123 129 4620	121 124 129 4940	121 124 129 5010
	0	121 124 129 4390	121 124 129 4460	121 124 129 4535	121 124 129 4610	121 124 129 4810	122 124 129 5155	123 124 129 5225
	1	123 124 129 4560	123 124 129 4635	123 124 129 4710	123 124 129 4790	123 125 129 5010	124 125 129 5405	125 125 129 5490
	2	125 125 129 4785	125 125 129 4860	125 125 129 4940	125 125 129 5025	125 125 129 5265	126 126 129 5830	126 126 129 5955

TODATA_350SFO_IMP_F20_DRY_ECS_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–11 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	29
28000 V_{FTO} = 136	-2	114 115 125 3515	114 115 125 3570	114 115 125 3630	114 115 125 3715	113 115 125 3820	113 115 124 3925
	-1	114 115 125 3505	114 115 125 3560	114 115 125 3615	114 115 124 3700	113 115 124 3815	113 115 123 3925
	0	114 115 124 3495	114 115 124 3550	114 115 124 3605	113 115 124 3695	113 115 123 3810	113 115 123 3930
	1	114 115 123 3490	114 115 123 3545	114 115 123 3600	113 115 123 3690	113 115 122 3810	113 115 122 3935
	2	113 115 123 3485	113 115 123 3540	113 115 122 3595	113 115 122 3690	113 115 122 3815	112 115 121 3945
30000 V_{FTO} = 140	-2	114 115 125 3590	114 115 124 3650	114 115 124 3710	114 115 124 3800	113 115 124 3915	113 115 123 4030
	-1	114 115 124 3585	114 115 124 3640	114 115 124 3700	113 115 124 3790	113 115 123 3915	113 115 122 4035
	0	113 115 123 3580	113 115 123 3635	113 115 123 3695	113 115 123 3790	113 115 122 3915	113 115 122 4045
	1	113 115 122 3580	113 115 122 3635	113 115 122 3695	113 115 122 3790	113 115 121 3925	112 115 121 4060
	2	113 115 121 3580	113 115 121 3635	113 115 121 3695	113 115 121 3795	112 115 121 3935	112 115 120 4090
32000 V_{FTO} = 145	-2	114 115 124 3670	113 115 124 3730	113 115 123 3790	113 115 123 3885	113 115 123 4010	113 115 122 4135
	-1	113 115 123 3665	113 115 123 3725	113 115 123 3785	113 115 123 3885	113 115 122 4015	112 115 121 4145
	0	113 115 122 3665	113 115 122 3725	113 115 122 3785	113 115 122 3885	113 115 121 4025	112 115 121 4160
	1	113 115 121 3670	113 115 121 3730	113 115 121 3790	113 115 121 3895	112 115 120 4035	112 115 120 4195
	2	113 115 120 3680	113 115 120 3735	113 115 120 3800	113 115 120 3905	113 115 120 4095	113 115 119 4320
33000 V_{FTO} = 147	-2	113 115 123 3710	113 115 123 3770	113 115 123 3830	113 115 123 3930	113 115 122 4055	113 115 122 4185
	-1	113 115 122 3710	113 115 122 3770	113 115 122 3830	113 115 122 3930	113 115 122 4065	112 115 121 4200
	0	113 115 122 3710	113 115 122 3770	113 115 121 3830	113 115 121 3935	112 115 121 4075	112 115 120 4220
	1	113 115 121 3715	113 115 121 3775	113 115 121 3840	113 115 121 3945	112 115 120 4095	113 115 120 4335
	2	113 115 120 3735	113 115 120 3790	113 115 120 3855	113 115 120 3995	114 115 120 4250	115 116 120 4505

TODATA_350SFO_IMP_F20_DRY_ECS_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–12 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	29	
34000 V_{FTO} = 149	-2	113 115 124 3750	113 116 124 3810	113 116 124 3870	113 116 124 3975	113 116 123 4105	112 115 122 4240	
	-1	113 116 123 3750	113 116 123 3810	113 116 123 3875	113 116 123 3975	113 116 122 4115	112 116 122 4255	
	0	113 116 123 3755	113 116 123 3815	113 116 123 3880	113 116 122 3985	113 116 122 4170	114 116 122 4415	
	1	114 116 122 3815	113 116 122 3875	113 116 122 3940	114 116 122 4080	115 117 122 4340	116 117 122 4595	
	2	115 117 122 3950	115 117 122 4015	115 117 122 4085	115 117 122 4235	116 118 122 4505	117 118 122 4795	
35000 V_{FTO} = 151	-2	113 117 125 3790	113 117 125 3850	113 117 125 3915	113 117 125 4015	113 117 124 4155	112 117 124 4300	
	-1	113 117 125 3795	113 117 124 3855	113 117 124 3920	113 117 124 4025	113 117 124 4240	114 118 124 4485	
	0	114 118 124 3890	114 118 124 3955	114 118 124 4020	114 118 124 4150	115 118 124 4415	116 119 124 4670	
	1	116 118 124 4030	116 118 124 4095	116 118 124 4160	116 118 124 4310	117 119 124 4590	118 119 124 4865	
	2	118 119 124 4180	118 119 124 4245	118 119 124 4315	118 119 124 4480	119 120 124 4785	120 120 124 5100	
36000 V_{FTO} = 153	-2	113 119 126 3835	113 119 126 3895	113 119 126 3960	113 119 126 4090	114 119 126 4305	115 119 125 4535	
	-1	115 119 126 3955	115 119 126 4020	115 119 126 4085	115 119 126 4220	116 119 125 4475	117 120 125 4730	
	0	116 120 125 4095	116 120 125 4160	116 120 125 4230	117 120 125 4380	118 120 125 4660	119 121 125 4935	
	1	118 120 125 4250	118 120 125 4320	118 120 125 4395	118 121 125 4555	119 121 125 4850	120 121 125 5150	
	2	120 121 125 4410	120 121 125 4480	120 121 125 4560	120 121 125 4735	121 122 125 5080	122 122 125 5460	
38000 V_{FTO} = 157	-2	117 122 129 4195	117 122 129 4265	117 122 129 4335	117 122 129 4480	118 123 129 4765	119 123 129 5035	
	-1	119 123 129 4365	119 123 129 4435	119 123 129 4510	119 123 129 4670	120 124 129 4965	121 124 129 5255	
	0	121 124 129 4540	121 124 129 4610	121 124 129 4690	121 124 129 4860	122 124 129 5180	123 125 129 5485	
	1	123 124 129 4715	123 124 129 4790	123 125 129 4875	123 125 129 5060	124 125 129 5425	125 126 129 5780	
	2	125 125 129 4945	125 125 129 5025	125 125 129 5110	125 125 129 5310	126 126 129 5800	126 126 129 6330	

TODATA_350SFO_IMP_F20_DRY_ECS_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–12 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT** V_1 (KIAS) V_R (KIAS)

ENGINE BLEED ON V_2 (KIAS) TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	27
28000 V_{FTO} = 136	-2	114 115 125 3635	114 115 125 3690	114 115 125 3775	114 115 124 3875	113 115 124 4005	113 115 124 4060
	-1	114 115 125 3620	114 115 124 3680	114 115 124 3765	113 115 124 3870	113 115 123 4000	113 115 123 4065
	0	114 115 124 3610	114 115 124 3670	113 115 124 3755	113 115 123 3865	113 115 122 4005	113 115 122 4070
	1	114 115 123 3605	113 115 123 3665	113 115 123 3750	113 115 122 3865	113 115 122 4010	112 115 121 4075
	2	113 115 122 3605	113 115 122 3660	113 115 122 3750	113 115 122 3870	112 115 121 4020	112 115 121 4090
30000 V_{FTO} = 140	-2	114 115 124 3715	114 115 124 3775	114 115 124 3860	113 115 124 3970	113 115 123 4110	113 115 123 4170
	-1	114 115 124 3705	113 115 124 3765	113 115 123 3855	113 115 123 3970	113 115 122 4115	113 115 122 4180
	0	113 115 123 3700	113 115 123 3760	113 115 123 3850	113 115 122 3970	113 115 121 4120	112 115 121 4190
	1	113 115 122 3700	113 115 122 3760	113 115 122 3855	113 115 121 3975	112 115 121 4135	112 115 120 4210
	2	113 115 121 3705	113 115 121 3765	113 115 121 3860	113 115 121 3985	112 115 120 4165	113 115 120 4275
32000 V_{FTO} = 145	-2	113 115 123 3795	113 115 123 3860	113 115 123 3950	113 115 123 4065	113 115 122 4215	113 115 122 4280
	-1	113 115 123 3790	113 115 123 3855	113 115 123 3950	113 115 122 4070	112 115 121 4225	112 115 121 4295
	0	113 115 122 3795	113 115 122 3855	113 115 122 3950	113 115 121 4080	112 115 121 4240	112 115 120 4315
	1	113 115 121 3795	113 115 121 3860	113 115 121 3960	112 115 120 4090	112 115 120 4270	112 115 119 4380
	2	113 115 120 3805	113 115 120 3870	113 115 120 3970	113 115 120 4135	114 115 119 4405	114 115 119 4535
33000 V_{FTO} = 147	-2	113 115 123 3835	113 115 123 3900	113 115 123 3995	113 115 122 4115	113 115 122 4270	112 115 121 4340
	-1	113 115 122 3835	113 115 122 3900	113 115 122 3995	113 115 121 4120	112 115 121 4280	112 115 121 4355
	0	113 115 121 3840	113 115 121 3905	113 115 121 4000	113 115 121 4135	112 115 120 4300	112 115 120 4380
	1	113 115 121 3845	113 115 121 3910	113 115 120 4010	112 115 120 4150	113 115 120 4420	114 115 120 4550
	2	113 115 120 3870	113 115 120 3935	113 115 120 4060	114 115 120 4295	115 116 120 4595	115 116 120 4740

TODATA_350SFO_IMP_F20_DRY_ECS_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–13 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	27	
34000 V_{FTO} = 149	-2	113 116 124 3880	113 116 124 3945	113 116 124 4040	113 116 123 4165	112 115 122 4320	112 115 122 4395	
	-1	113 116 123 3880	113 116 123 3945	113 116 123 4045	113 116 122 4175	112 116 122 4340	113 116 122 4450	
	0	113 116 122 3885	113 116 122 3950	113 116 122 4050	113 116 122 4215	114 117 122 4505	114 117 122 4635	
	1	114 116 122 3955	113 116 122 4020	114 116 122 4140	115 117 122 4380	116 117 122 4690	116 118 122 4825	
	2	115 117 122 4100	115 117 122 4170	115 117 122 4300	116 118 122 4550	117 118 122 4895	118 118 122 5055	
35000 V_{FTO} = 151	-2	113 117 125 3920	113 117 125 3985	113 117 125 4085	113 117 124 4210	112 117 124 4385	113 117 124 4510	
	-1	113 117 124 3925	113 118 124 3990	113 118 124 4090	113 117 124 4285	114 118 124 4575	115 118 124 4705	
	0	114 118 124 4030	114 118 124 4100	114 118 124 4220	115 118 124 4460	116 119 124 4765	117 119 124 4905	
	1	116 118 124 4180	116 118 124 4250	116 118 124 4380	117 119 124 4635	118 119 124 4960	118 120 124 5115	
	2	118 119 124 4335	118 119 124 4405	118 119 124 4550	119 120 124 4825	120 120 124 5205	120 120 124 5390	
36000 V_{FTO} = 153	-2	113 119 126 3975	113 119 126 4040	113 119 126 4155	114 119 126 4350	115 119 126 4630	115 120 126 4765	
	-1	115 119 126 4100	115 119 126 4170	115 119 126 4290	116 120 126 4520	117 120 126 4830	117 120 126 4970	
	0	116 120 126 4245	116 120 126 4320	117 120 126 4450	117 120 126 4705	119 121 126 5035	119 121 126 5185	
	1	118 120 126 4410	118 121 126 4485	118 121 126 4625	119 121 126 4895	120 122 126 5260	121 122 126 5435	
	2	120 121 126 4580	120 121 126 4655	120 121 126 4810	121 122 126 5125	122 122 126 5575	123 123 126 5830	
38000 V_{FTO} = 157	-2	117 122 129 4350	117 122 129 4425	117 122 129 4555	118 123 129 4810	119 123 129 5140	120 124 129 5280	
	-1	119 123 129 4530	119 123 129 4605	119 123 129 4745	120 124 129 5015	121 124 129 5365	122 124 129 5520	
	0	121 124 129 4710	121 124 129 4790	121 124 129 4940	122 124 129 5225	123 125 129 5600	124 125 129 5790	
	1	123 125 129 4890	123 125 129 4975	123 125 129 5135	124 125 129 5470	125 126 129 5900	126 126 129 6105	
	2	125 125 129 5135	125 125 129 5220	125 125 129 5395	126 126 129 5820	126 126 129 6455	127 127 129 6735	

TODATA_350SFO_IMP_F20_DRY_ECS_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–13 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	115 115 126 3000	115 115 126 3050	114 115 126 3105	114 115 126 3155	114 115 126 3205	114 115 126 3255
	-1	114 115 126 2990	114 115 126 3040	114 115 125 3090	114 115 125 3145	114 115 125 3195	114 115 125 3245
	0	114 115 125 2980	114 115 125 3035	114 115 125 3085	114 115 125 3135	114 115 124 3185	114 115 124 3240
	1	114 115 124 2975	114 115 124 3030	114 115 124 3080	114 115 124 3130	114 115 124 3180	114 115 124 3235
	2	114 115 123 2975	114 115 123 3025	114 115 123 3075	114 115 123 3125	114 115 123 3180	114 115 123 3230
30000 V_{FTO} = 140	-2	114 115 125 3065	114 115 125 3115	114 115 125 3170	114 115 125 3220	114 115 125 3275	114 115 125 3325
	-1	114 115 125 3055	114 115 125 3110	114 115 124 3160	114 115 124 3215	114 115 124 3265	114 115 124 3320
	0	114 115 124 3050	114 115 124 3105	114 115 124 3155	114 115 123 3210	114 115 123 3265	114 115 123 3315
	1	114 115 123 3050	114 115 123 3105	114 115 123 3155	113 115 123 3210	113 115 123 3260	113 115 122 3315
	2	113 115 122 3050	113 115 122 3105	113 115 122 3155	113 115 122 3210	113 115 122 3265	113 115 122 3315
32000 V_{FTO} = 145	-2	114 115 124 3125	114 115 124 3180	114 115 124 3235	114 115 124 3290	114 115 124 3345	114 115 124 3400
	-1	114 115 124 3125	114 115 124 3180	114 115 123 3230	114 115 123 3285	114 115 123 3340	113 115 123 3395
	0	113 115 123 3125	113 115 123 3180	113 115 122 3230	113 115 122 3285	113 115 122 3340	113 115 122 3395
	1	113 115 122 3125	113 115 122 3180	113 115 122 3235	113 115 122 3290	113 115 121 3345	113 115 121 3400
	2	113 115 121 3135	113 115 121 3190	113 115 121 3245	113 115 121 3295	113 115 121 3350	113 115 120 3405
33000 V_{FTO} = 147	-2	114 115 124 3160	114 115 124 3215	114 115 124 3270	114 115 124 3325	114 115 124 3380	114 115 123 3435
	-1	114 115 123 3155	113 115 123 3215	113 115 123 3270	113 115 123 3325	113 115 123 3380	113 115 123 3435
	0	113 115 122 3160	113 115 122 3215	113 115 122 3270	113 115 122 3325	113 115 122 3380	113 115 122 3435
	1	113 115 121 3165	113 115 121 3220	113 115 121 3275	113 115 121 3330	113 115 121 3385	113 115 121 3445
	2	114 115 120 3210	114 115 120 3265	113 115 120 3320	113 115 120 3370	113 115 120 3425	113 115 120 3480

TODATA_350SFO_IMP_F20_DRY_ALL_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–14 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL** | V_1 (KIAS) | V_R (KIAS)

ENGINE BLEED ON, ENGINE & WING A/I ON | V_2 (KIAS) | TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3190	114 115 124 3245	114 115 124 3300	113 115 124 3360	113 115 124 3415	113 115 124 3470
	-1	113 115 123 3190	113 115 123 3250	113 115 123 3305	113 115 123 3360	113 115 123 3415	113 115 123 3470
	0	113 115 123 3195	113 115 122 3255	113 115 122 3310	113 115 122 3365	113 116 122 3420	113 116 122 3475
	1	114 116 122 3255	114 116 122 3315	114 116 122 3375	114 116 122 3435	114 116 122 3490	114 116 122 3550
	2	116 116 122 3375	116 116 122 3440	116 117 122 3500	116 117 122 3560	116 117 122 3620	116 117 122 3685
35000 V_{FTO} = 151	-2	113 117 125 3225	113 117 125 3280	113 117 125 3335	113 117 125 3395	113 117 125 3450	113 117 125 3505
	-1	113 117 124 3225	113 117 124 3285	113 117 124 3340	113 117 124 3395	113 117 124 3455	113 117 124 3510
	0	115 117 124 3320	115 117 124 3380	115 117 124 3440	115 117 124 3500	115 117 124 3555	115 117 124 3615
	1	116 118 124 3440	116 118 124 3505	116 118 124 3565	116 118 124 3625	116 118 124 3690	116 118 124 3750
	2	118 119 124 3565	118 119 124 3635	118 119 124 3695	118 119 124 3760	118 119 124 3825	118 119 124 3890
36000 V_{FTO} = 153	-2	114 118 126 3275	114 118 126 3335	114 118 126 3390	114 118 126 3450	114 118 126 3510	114 119 126 3565
	-1	115 118 126 3375	115 119 126 3440	115 119 126 3500	115 119 126 3560	115 119 126 3620	115 119 126 3680
	0	117 119 125 3495	117 119 125 3560	117 119 125 3620	117 119 125 3685	117 119 125 3750	117 119 125 3810
	1	119 120 125 3625	119 120 125 3695	119 120 125 3760	119 120 125 3825	119 120 125 3890	119 120 125 3960
	2	121 121 125 3770	121 121 125 3845	121 121 125 3915	121 121 125 3980	121 121 125 4050	121 121 125 4120
38000 V_{FTO} = 157	-2	118 122 129 3580	118 122 129 3645	118 122 129 3710	118 122 129 3770	118 122 129 3835	118 122 129 3900
	-1	120 122 129 3720	120 122 129 3790	120 122 129 3855	120 123 129 3925	120 123 129 3990	120 123 129 4060
	0	122 123 129 3865	122 123 129 3940	122 123 129 4010	122 123 129 4080	122 123 129 4150	121 124 129 4225
	1	123 124 129 4015	123 124 129 4095	123 124 129 4170	123 124 129 4240	123 124 129 4315	123 124 129 4390
	2	125 125 129 4315	125 125 129 4390	125 125 129 4460	125 125 129 4530	125 125 129 4605	125 125 129 4675

TODATA_350SFO_IMP_F20_DRY_ALL_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–14 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	115 115 126 3045	114 115 126 3100	114 115 126 3150	114 115 126 3200	114 115 126 3255	114 115 126 3305
	-1	114 115 126 3035	114 115 125 3090	114 115 125 3140	114 115 125 3190	114 115 125 3245	114 115 125 3295
	0	114 115 125 3025	114 115 125 3080	114 115 125 3130	114 115 124 3185	114 115 124 3235	114 115 124 3285
	1	114 115 124 3020	114 115 124 3075	114 115 124 3125	114 115 124 3180	114 115 124 3230	114 115 124 3280
	2	114 115 123 3020	114 115 123 3070	114 115 123 3125	114 115 123 3175	114 115 123 3225	114 115 123 3280
30000 V_{FTO} = 140	-2	114 115 125 3110	114 115 125 3165	114 115 125 3215	114 115 125 3270	114 115 125 3325	114 115 125 3380
	-1	114 115 125 3105	114 115 124 3155	114 115 124 3210	114 115 124 3265	114 115 124 3315	114 115 124 3370
	0	114 115 124 3100	114 115 124 3150	114 115 124 3205	114 115 123 3260	114 115 123 3315	114 115 123 3365
	1	114 115 123 3095	114 115 123 3150	113 115 123 3205	113 115 123 3260	113 115 122 3310	113 115 122 3365
	2	113 115 122 3100	113 115 122 3150	113 115 122 3205	113 115 122 3260	113 115 122 3315	113 115 122 3365
32000 V_{FTO} = 145	-2	114 115 124 3175	114 115 124 3230	114 115 124 3285	114 115 124 3340	114 115 124 3395	114 115 124 3450
	-1	114 115 124 3170	114 115 123 3225	114 115 123 3280	114 115 123 3335	113 115 123 3390	113 115 123 3445
	0	113 115 123 3170	113 115 123 3225	113 115 122 3280	113 115 122 3335	113 115 122 3395	113 115 122 3450
	1	113 115 122 3175	113 115 122 3230	113 115 122 3285	113 115 121 3340	113 115 121 3395	113 115 121 3450
	2	113 115 121 3180	113 115 121 3235	113 115 121 3290	113 115 121 3350	113 115 121 3405	113 115 120 3460
33000 V_{FTO} = 147	-2	114 115 124 3205	114 115 124 3265	114 115 124 3320	114 115 124 3375	114 115 124 3430	113 115 123 3485
	-1	114 115 123 3205	113 115 123 3265	113 115 123 3320	113 115 123 3375	113 115 123 3430	113 115 123 3485
	0	113 115 122 3210	113 115 122 3265	113 115 122 3320	113 115 122 3375	113 115 122 3435	113 115 122 3490
	1	113 115 121 3215	113 115 121 3270	113 115 121 3325	113 115 121 3385	113 115 121 3440	113 115 121 3495
	2	114 115 120 3255	113 115 120 3310	113 115 120 3365	113 115 120 3420	113 115 120 3475	113 115 120 3530

TODATA_350SFO_IMP_F20_DRY_ALL_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–15 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3240	114 115 124 3295	113 115 124 3355	113 115 124 3410	113 115 124 3465	113 115 124 3525
	-1	113 115 123 3240	113 115 123 3300	113 115 123 3355	113 115 123 3410	113 115 123 3470	113 115 123 3525
	0	113 115 123 3245	113 115 122 3305	113 115 122 3360	113 116 122 3415	113 116 122 3475	113 116 122 3530
	1	114 116 122 3305	114 116 122 3365	114 116 122 3425	114 116 122 3485	114 116 122 3545	114 116 122 3605
	2	116 116 122 3430	116 117 122 3490	116 117 122 3555	116 117 122 3615	116 117 122 3675	116 117 122 3735
35000 V_{FTO} = 151	-2	113 117 125 3275	113 117 125 3330	113 117 125 3390	113 117 125 3445	113 117 125 3505	113 117 125 3560
	-1	113 117 124 3275	113 117 124 3335	113 117 124 3390	113 117 124 3450	113 117 124 3510	113 117 124 3565
	0	115 117 124 3370	115 117 124 3435	115 117 124 3490	115 117 124 3550	115 117 124 3610	114 117 124 3670
	1	116 118 124 3495	116 118 124 3555	116 118 124 3620	116 118 124 3685	116 118 124 3745	116 118 124 3805
	2	118 119 124 3620	118 119 124 3690	118 119 124 3755	118 119 124 3820	118 119 124 3885	118 119 124 3950
36000 V_{FTO} = 153	-2	114 118 126 3325	114 118 126 3385	114 118 126 3445	114 118 126 3505	114 119 126 3560	113 119 126 3620
	-1	115 119 126 3430	115 119 126 3490	115 119 126 3550	115 119 126 3610	115 119 126 3675	115 119 126 3735
	0	117 119 125 3545	117 119 125 3615	117 119 125 3675	117 119 125 3740	117 119 125 3805	117 119 125 3870
	1	119 120 125 3685	119 120 125 3750	119 120 125 3820	119 120 125 3885	119 120 125 3950	119 120 125 4015
	2	121 121 125 3830	121 121 125 3900	121 121 125 3970	121 121 125 4040	121 121 125 4110	120 121 125 4180
38000 V_{FTO} = 157	-2	118 122 129 3635	118 122 129 3700	118 122 129 3765	118 122 129 3830	117 122 129 3895	117 122 129 3960
	-1	120 122 129 3780	120 122 129 3850	120 123 129 3915	120 123 129 3985	120 123 129 4055	120 123 129 4120
	0	122 123 129 3930	122 123 129 4000	121 123 129 4070	121 123 129 4145	121 123 129 4215	121 124 129 4285
	1	123 124 129 4080	123 124 129 4155	123 124 129 4230	123 124 129 4305	123 124 129 4380	123 124 129 4455
	2	125 125 129 4370	125 125 129 4445	125 125 129 4515	125 125 129 4585	125 125 129 4655	125 125 129 4720

TODATA_350SFO_IMP_F20_DRY_ALL_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–15 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) -15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3090	114 115 126 3145	114 115 126 3200	114 115 126 3250	114 115 126 3305	114 115 126 3355
	-1	114 115 126 3080	114 115 125 3135	114 115 125 3185	114 115 125 3240	114 115 125 3295	114 115 125 3345
	0	114 115 125 3075	114 115 125 3125	114 115 125 3180	114 115 124 3230	114 115 124 3285	114 115 124 3335
	1	114 115 124 3065	114 115 124 3120	114 115 124 3175	114 115 124 3225	114 115 124 3280	114 115 124 3330
	2	114 115 123 3065	114 115 123 3115	114 115 123 3170	114 115 123 3225	114 115 123 3275	113 115 123 3325
30000 V_{FTO} = 140	-2	114 115 125 3155	114 115 125 3210	114 115 125 3265	114 115 125 3320	114 115 125 3375	114 115 125 3430
	-1	114 115 124 3150	114 115 124 3205	114 115 124 3260	114 115 124 3315	114 115 124 3365	114 115 124 3420
	0	114 115 124 3145	114 115 124 3200	114 115 123 3255	114 115 123 3310	114 115 123 3365	114 115 123 3415
	1	114 115 123 3145	114 115 123 3200	113 115 123 3255	113 115 123 3305	113 115 122 3360	113 115 122 3415
	2	113 115 122 3145	113 115 122 3200	113 115 122 3255	113 115 122 3310	113 115 122 3365	113 115 122 3420
32000 V_{FTO} = 145	-2	114 115 124 3225	114 115 124 3280	114 115 124 3335	114 115 124 3390	114 115 124 3445	114 115 124 3500
	-1	114 115 123 3220	114 115 123 3275	114 115 123 3330	113 115 123 3390	113 115 123 3445	113 115 123 3500
	0	113 115 123 3220	113 115 122 3275	113 115 122 3330	113 115 122 3390	113 115 122 3445	113 115 122 3500
	1	113 115 122 3225	113 115 122 3280	113 115 122 3335	113 115 121 3390	113 115 121 3450	113 115 121 3505
	2	113 115 121 3230	113 115 121 3285	113 115 121 3340	113 115 121 3400	113 115 120 3455	113 115 120 3510
33000 V_{FTO} = 147	-2	114 115 124 3255	114 115 124 3315	114 115 124 3370	114 115 124 3425	114 115 123 3485	113 115 123 3540
	-1	113 115 123 3255	113 115 123 3310	113 115 123 3370	113 115 123 3425	113 115 123 3485	113 115 123 3540
	0	113 115 122 3260	113 115 122 3315	113 115 122 3370	113 115 122 3430	113 115 122 3485	113 115 122 3540
	1	113 115 121 3265	113 115 121 3320	113 115 121 3375	113 115 121 3435	113 115 121 3490	113 115 121 3550
	2	113 115 120 3300	113 115 120 3360	113 115 120 3415	113 115 120 3470	113 115 120 3525	113 115 120 3580

TODATA_350SFO_IMP_F20_DRY_ALL_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–16 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT** | V_1 (KIAS) | V_R (KIAS)

ENGINE BLEED ON, ENGINE & WING A/I ON | V_2 (KIAS) | TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3290	114 115 124 3350	113 115 124 3405	113 115 124 3465	113 115 124 3520	113 115 124 3575
	-1	113 115 123 3290	113 115 123 3350	113 115 123 3405	113 115 123 3465	113 115 123 3520	113 115 123 3580
	0	113 115 123 3295	113 115 123 3355	113 116 122 3410	113 116 122 3470	113 116 122 3525	113 116 122 3585
	1	114 116 122 3355	114 116 122 3415	114 116 122 3475	114 116 122 3535	114 116 122 3595	114 116 122 3650
	2	116 116 122 3480	116 117 122 3540	116 117 122 3605	116 117 122 3665	116 117 122 3730	116 117 122 3790
35000 V_{FTO} = 151	-2	113 117 125 3325	113 117 125 3385	113 117 125 3440	113 117 125 3500	113 117 125 3555	113 117 125 3615
	-1	113 117 125 3330	113 117 124 3385	113 117 124 3445	113 117 124 3505	113 117 124 3560	113 117 124 3620
	0	115 117 124 3425	115 117 124 3485	115 117 124 3545	115 117 124 3605	114 117 124 3665	114 117 124 3725
	1	116 118 124 3545	116 118 124 3610	116 118 124 3670	116 118 124 3735	116 118 124 3800	116 118 124 3860
	2	118 119 124 3675	118 119 124 3740	118 119 124 3810	118 119 124 3875	118 119 124 3940	118 119 124 4005
36000 V_{FTO} = 153	-2	114 118 126 3375	114 118 126 3435	114 118 126 3495	113 119 126 3555	113 119 126 3615	113 119 126 3670
	-1	115 119 126 3480	115 119 126 3545	115 119 126 3605	115 119 126 3665	115 119 126 3725	115 119 126 3785
	0	117 119 125 3600	117 119 125 3665	117 119 125 3730	117 119 125 3795	117 119 125 3860	117 119 125 3920
	1	119 120 125 3740	119 120 125 3805	119 120 125 3875	119 120 125 3940	119 120 125 4005	119 120 125 4070
	2	121 121 125 3885	120 121 125 3955	120 121 125 4025	120 121 125 4095	120 121 125 4165	120 121 125 4235
38000 V_{FTO} = 157	-2	118 122 129 3690	118 122 129 3755	118 122 129 3820	117 122 129 3885	117 122 129 3950	117 122 129 4015
	-1	120 122 129 3835	120 122 129 3905	120 123 129 3975	119 123 129 4040	119 123 129 4110	119 123 129 4180
	0	121 123 129 3985	121 123 129 4060	121 123 129 4130	121 123 129 4205	121 124 129 4275	121 124 129 4345
	1	123 124 129 4140	123 124 129 4215	123 124 129 4290	123 124 129 4365	123 124 129 4440	123 124 129 4515
	2	125 125 129 4420	125 125 129 4490	125 125 129 4565	125 125 129 4630	125 125 129 4700	125 125 129 4770

TODATA_350SFO_IMP_F20_DRY_ALL_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–16 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3190	114 115 126 3240	114 115 126 3295	114 115 126 3350	114 115 126 3405	114 115 125 3470
	-1	114 115 125 3175	114 115 125 3230	114 115 125 3285	114 115 125 3340	114 115 125 3395	114 115 125 3460
	0	114 115 125 3170	114 115 125 3225	114 115 124 3275	114 115 124 3330	114 115 124 3385	114 115 124 3450
	1	114 115 124 3160	114 115 124 3215	114 115 124 3270	114 115 124 3325	114 115 124 3380	114 115 123 3445
	2	114 115 123 3160	114 115 123 3215	114 115 123 3270	114 115 123 3320	113 115 123 3375	113 115 122 3440
30000 V_{FTO} = 140	-2	114 115 125 3255	114 115 125 3310	114 115 125 3365	114 115 125 3425	114 115 125 3480	114 115 124 3545
	-1	114 115 124 3250	114 115 124 3305	114 115 124 3360	114 115 124 3415	114 115 124 3470	114 115 124 3540
	0	114 115 124 3245	114 115 123 3300	114 115 123 3355	114 115 123 3410	114 115 123 3465	113 115 123 3535
	1	114 115 123 3240	113 115 123 3300	113 115 123 3355	113 115 122 3410	113 115 122 3465	113 115 122 3535
	2	113 115 122 3245	113 115 122 3300	113 115 122 3355	113 115 122 3410	113 115 122 3470	113 115 121 3535
32000 V_{FTO} = 145	-2	114 115 124 3325	114 115 124 3380	114 115 124 3440	114 115 124 3495	114 115 124 3555	113 115 124 3625
	-1	114 115 123 3320	114 115 123 3380	113 115 123 3435	113 115 123 3495	113 115 123 3550	113 115 123 3620
	0	113 115 123 3320	113 115 122 3380	113 115 122 3435	113 115 122 3495	113 115 122 3550	113 115 122 3620
	1	113 115 122 3325	113 115 122 3380	113 115 121 3440	113 115 121 3495	113 115 121 3555	113 115 121 3625
	2	113 115 121 3330	113 115 121 3390	113 115 121 3445	113 115 121 3505	113 115 120 3560	113 115 120 3635
33000 V_{FTO} = 147	-2	114 115 124 3360	114 115 124 3415	114 115 124 3475	113 115 123 3535	113 115 123 3595	113 115 123 3660
	-1	113 115 123 3360	113 115 123 3415	113 115 123 3475	113 115 123 3535	113 115 123 3590	113 115 122 3660
	0	113 115 122 3360	113 115 122 3420	113 115 122 3475	113 115 122 3535	113 115 122 3595	113 115 121 3665
	1	113 115 121 3365	113 115 121 3425	113 115 121 3485	113 115 121 3540	113 115 121 3600	113 115 121 3675
	2	113 115 120 3395	113 115 120 3450	113 115 120 3510	113 115 120 3565	113 115 120 3620	113 115 120 3715

TODATA_350SFO_IMP_F20_DRY_ALL_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–17 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 3395	113 115 124 3455	113 115 124 3510	113 115 124 3570	113 115 124 3630	113 115 124 3700
	-1	113 115 123 3395	113 115 123 3455	113 115 123 3515	113 115 123 3575	113 116 123 3630	113 116 123 3705
	0	113 116 123 3400	113 116 123 3460	113 116 123 3520	113 116 123 3580	113 116 123 3635	113 116 122 3710
	1	114 116 122 3460	114 116 122 3520	114 116 122 3580	114 116 122 3640	114 116 122 3700	114 116 122 3795
	2	116 117 122 3580	115 117 122 3645	115 117 122 3710	115 117 122 3770	115 117 122 3835	116 117 122 3935
35000 V_{FTO} = 151	-2	113 117 125 3430	113 117 125 3490	113 117 125 3550	113 117 125 3610	113 117 125 3670	113 117 125 3740
	-1	113 117 125 3435	113 117 125 3495	113 117 125 3555	113 117 124 3615	113 117 124 3675	113 117 124 3750
	0	114 117 124 3525	114 117 124 3585	114 117 124 3650	114 117 124 3710	114 117 124 3770	114 117 124 3860
	1	116 118 124 3650	116 118 124 3715	116 118 124 3780	116 118 124 3840	116 118 124 3905	116 118 124 4010
	2	118 119 124 3785	118 119 124 3850	118 119 124 3920	118 119 124 3985	118 119 124 4050	118 119 124 4160
36000 V_{FTO} = 153	-2	113 118 127 3475	113 119 127 3540	113 119 126 3600	113 119 126 3660	113 119 126 3720	113 119 126 3810
	-1	115 119 126 3585	115 119 126 3650	115 119 126 3710	115 119 126 3775	115 119 126 3835	115 119 126 3930
	0	117 119 125 3705	117 119 125 3770	117 119 125 3840	117 119 125 3905	117 119 125 3970	117 120 125 4075
	1	119 120 125 3850	119 120 125 3915	118 120 125 3985	118 120 125 4055	118 120 125 4120	119 120 125 4230
	2	120 121 125 3995	120 121 125 4070	120 121 125 4140	120 121 125 4210	120 121 125 4280	120 121 125 4405
38000 V_{FTO} = 157	-2	117 122 129 3800	117 122 129 3870	117 122 129 3935	117 122 129 4000	117 122 129 4070	117 122 129 4170
	-1	119 122 129 3950	119 123 129 4020	119 123 129 4090	119 123 129 4160	119 123 129 4230	119 123 129 4345
	0	121 123 129 4105	121 123 129 4180	121 123 129 4250	121 124 129 4325	121 124 129 4400	121 124 129 4515
	1	123 124 129 4265	123 124 129 4340	123 124 129 4415	123 124 129 4495	123 124 129 4570	123 125 129 4695
	2	125 125 129 4515	125 125 129 4590	125 125 129 4660	125 125 129 4730	125 125 129 4800	125 125 129 4955

TODATA_350SFO_IMP_F20_DRY_ALL_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–17 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3290	114 115 126 3345	114 115 126 3405	114 115 126 3460	114 115 125 3520	114 115 125 3620
	-1	114 115 125 3280	114 115 125 3335	114 115 125 3390	114 115 125 3450	114 115 125 3510	114 115 124 3615
	0	114 115 124 3270	114 115 124 3325	114 115 124 3385	114 115 124 3440	114 115 124 3500	113 115 123 3610
	1	114 115 124 3265	114 115 124 3320	114 115 124 3375	114 115 123 3435	114 115 123 3495	113 115 122 3605
	2	114 115 123 3260	114 115 123 3320	113 115 123 3375	113 115 123 3430	113 115 122 3495	113 115 122 3610
30000 V_{FTO} = 140	-2	114 115 125 3360	114 115 125 3420	114 115 125 3475	114 115 125 3535	114 115 124 3600	113 115 124 3705
	-1	114 115 124 3355	114 115 124 3410	114 115 124 3470	114 115 124 3530	114 115 124 3590	113 115 123 3705
	0	114 115 123 3350	114 115 123 3410	114 115 123 3465	113 115 123 3525	113 115 123 3590	113 115 122 3705
	1	113 115 123 3350	113 115 122 3405	113 115 122 3465	113 115 122 3520	113 115 122 3585	113 115 121 3710
	2	113 115 122 3350	113 115 122 3410	113 115 122 3465	113 115 121 3525	113 115 121 3590	113 115 121 3715
32000 V_{FTO} = 145	-2	114 115 124 3435	114 115 124 3495	114 115 124 3555	114 115 124 3610	113 115 124 3680	113 115 123 3795
	-1	113 115 123 3430	113 115 123 3490	113 115 123 3550	113 115 123 3610	113 115 123 3675	113 115 122 3795
	0	113 115 122 3430	113 115 122 3490	113 115 122 3550	113 115 122 3610	113 115 122 3675	113 115 121 3800
	1	113 115 121 3435	113 115 121 3495	113 115 121 3555	113 115 121 3615	113 115 121 3680	113 115 120 3810
	2	113 115 121 3440	113 115 121 3500	113 115 120 3560	113 115 120 3620	113 115 120 3690	113 115 120 3860
33000 V_{FTO} = 147	-2	114 115 124 3470	113 115 123 3530	113 115 123 3590	113 115 123 3650	113 115 123 3720	113 115 122 3835
	-1	113 115 123 3470	113 115 123 3530	113 115 123 3590	113 115 122 3650	113 115 122 3720	113 115 122 3840
	0	113 115 122 3470	113 115 122 3530	113 115 122 3590	113 115 122 3655	113 115 121 3720	113 115 121 3850
	1	113 115 121 3475	113 115 121 3540	113 115 121 3600	113 115 121 3660	113 115 121 3730	113 115 120 3865
	2	113 115 120 3505	113 115 120 3560	113 115 120 3620	113 115 120 3680	113 115 120 3760	114 115 120 4005

TODATA_350SFO_IMP_F20_DRY_ALL_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–18 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 3505	113 115 124 3570	113 115 124 3630	113 115 124 3690	113 115 124 3760	113 115 123 3880
	-1	113 115 123 3510	113 115 123 3570	113 116 123 3630	113 116 123 3690	113 116 123 3760	113 116 122 3890
	0	113 116 123 3515	113 116 123 3575	113 116 123 3635	113 116 123 3695	113 116 122 3765	113 116 122 3935
	1	114 116 122 3575	114 116 122 3635	114 116 122 3700	114 116 122 3760	114 116 122 3840	115 117 122 4085
	2	115 117 122 3705	115 117 122 3770	115 117 122 3835	115 117 122 3900	115 117 122 3980	117 118 122 4240
35000 V_{FTO} = 151	-2	113 117 125 3545	113 117 125 3605	113 117 125 3665	113 117 125 3730	113 117 125 3800	113 117 124 3925
	-1	113 117 125 3545	113 117 125 3610	113 117 124 3670	113 117 124 3735	113 117 124 3805	114 117 124 4000
	0	114 117 124 3645	114 117 124 3710	114 117 124 3770	114 118 124 3835	114 118 124 3915	116 118 124 4160
	1	116 118 124 3775	116 118 124 3840	116 118 124 3905	116 118 124 3970	116 118 124 4060	117 119 124 4320
	2	118 119 124 3915	118 119 124 3985	118 119 124 4050	118 119 124 4120	118 119 124 4210	119 120 124 4510
36000 V_{FTO} = 153	-2	113 119 127 3595	113 119 126 3655	113 119 126 3720	113 119 126 3780	113 119 126 3860	114 119 126 4060
	-1	115 119 126 3705	115 119 126 3770	115 119 126 3835	115 119 126 3900	115 119 126 3980	116 119 125 4220
	0	117 119 125 3835	117 119 125 3900	117 119 125 3970	117 119 125 4035	117 120 125 4125	118 120 125 4390
	1	118 120 125 3980	118 120 125 4050	118 120 125 4120	118 120 125 4190	118 120 125 4280	120 121 125 4560
	2	120 121 125 4130	120 121 125 4205	120 121 125 4280	120 121 125 4350	120 121 125 4450	122 122 125 4785
38000 V_{FTO} = 157	-2	117 122 129 3930	117 122 129 4000	117 122 129 4065	117 122 129 4135	117 122 129 4225	119 123 129 4490
	-1	119 123 129 4085	119 123 129 4155	119 123 129 4230	119 123 129 4300	119 123 129 4395	121 124 129 4675
	0	121 123 129 4245	121 124 129 4325	121 124 129 4400	121 124 129 4475	121 124 129 4570	122 124 129 4865
	1	123 124 129 4410	123 124 129 4490	123 124 129 4570	123 124 129 4645	123 125 129 4750	124 125 129 5100
	2	125 125 129 4650	125 125 129 4725	125 125 129 4795	125 125 129 4880	125 125 129 4990	126 126 129 5535

TODATA_350SFO_IMP_F20_DRY_ALL_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–18 (Sheet 2 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3400	114 115 126 3460	114 115 125 3515	114 115 125 3580	114 115 125 3680	113 115 124 3795
	-1	114 115 125 3390	114 115 125 3445	114 115 125 3505	114 115 125 3565	114 115 124 3670	113 115 123 3790
	0	114 115 124 3380	114 115 124 3440	114 115 124 3495	114 115 124 3560	113 115 123 3665	113 115 122 3790
	1	114 115 123 3375	114 115 123 3435	114 115 123 3490	114 115 123 3550	113 115 122 3665	113 115 122 3795
	2	113 115 123 3370	113 115 123 3430	113 115 122 3490	113 115 122 3550	113 115 122 3665	113 115 121 3800
30000 V_{FTO} = 140	-2	114 115 125 3475	114 115 125 3535	114 115 124 3595	114 115 124 3655	113 115 124 3765	113 115 123 3890
	-1	114 115 124 3465	114 115 124 3525	114 115 124 3590	114 115 124 3650	113 115 123 3760	113 115 122 3890
	0	114 115 123 3465	113 115 123 3525	113 115 123 3585	113 115 123 3645	113 115 122 3760	113 115 121 3895
	1	113 115 122 3460	113 115 122 3520	113 115 122 3585	113 115 122 3645	113 115 121 3765	113 115 121 3905
	2	113 115 122 3465	113 115 121 3525	113 115 121 3585	113 115 121 3645	113 115 121 3775	113 115 120 3940
32000 V_{FTO} = 145	-2	114 115 124 3550	114 115 124 3610	113 115 124 3675	113 115 124 3740	113 115 123 3855	113 115 122 3985
	-1	113 115 123 3545	113 115 123 3610	113 115 123 3670	113 115 123 3735	113 115 122 3855	113 115 121 3995
	0	113 115 122 3545	113 115 122 3610	113 115 122 3670	113 115 122 3735	113 115 121 3860	113 115 120 4005
	1	113 115 121 3550	113 115 121 3615	113 115 121 3675	113 115 121 3740	113 115 120 3870	113 115 120 4035
	2	113 115 120 3560	113 115 120 3620	113 115 120 3685	113 115 120 3750	113 115 120 3910	114 115 119 4165
33000 V_{FTO} = 147	-2	113 115 123 3590	113 115 123 3650	113 115 123 3715	113 115 123 3780	113 115 122 3900	113 115 122 4035
	-1	113 115 123 3585	113 115 122 3650	113 115 122 3715	113 115 122 3780	113 115 122 3900	113 115 121 4045
	0	113 115 122 3590	113 115 122 3655	113 115 121 3715	113 115 121 3780	113 115 121 3910	112 115 120 4060
	1	113 115 121 3595	113 115 121 3660	113 115 121 3725	113 115 121 3790	113 115 120 3925	114 115 120 4180
	2	113 115 120 3625	113 115 120 3690	113 115 120 3755	113 115 120 3820	114 115 120 4055	115 116 120 4350

TODATA_350SFO_IMP_F20_DRY_ALL_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–19 (Sheet 1 of 2)

DRY RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 3625	113 115 124 3690	113 115 124 3755	113 116 124 3820	113 115 123 3940	113 115 122 4085
	-1	113 116 123 3630	113 116 123 3690	113 116 123 3755	113 116 123 3820	113 116 122 3950	112 116 122 4100
	0	113 116 123 3635	113 116 122 3700	113 116 122 3760	113 116 122 3830	113 116 122 3990	114 117 122 4260
	1	114 116 122 3700	114 116 122 3770	114 116 122 3835	114 116 122 3900	115 117 122 4140	116 117 122 4425
	2	115 117 122 3840	115 117 122 3910	115 117 122 3975	115 117 122 4045	116 118 122 4295	118 118 122 4635
35000 V_{FTO} = 151	-2	113 117 125 3665	113 117 125 3730	113 117 125 3795	113 117 125 3860	113 117 124 3985	113 117 124 4160
	-1	113 117 124 3670	113 117 124 3735	113 117 124 3800	113 117 124 3865	113 117 124 4055	115 118 124 4330
	0	114 117 124 3775	114 118 124 3840	114 118 124 3905	114 118 124 3975	115 118 124 4215	117 119 124 4505
	1	116 118 124 3910	116 118 124 3980	116 118 124 4050	116 118 124 4120	117 119 124 4375	118 120 124 4685
	2	118 119 124 4060	118 119 124 4130	118 119 124 4200	118 119 124 4275	119 120 124 4565	120 120 124 4970
36000 V_{FTO} = 153	-2	113 119 126 3720	113 119 126 3790	113 119 126 3855	113 119 126 3920	114 119 126 4120	115 119 126 4385
	-1	115 119 126 3840	115 119 126 3905	115 119 126 3975	115 119 126 4045	116 119 126 4275	117 120 126 4565
	0	117 119 126 3975	117 120 126 4045	117 120 126 4115	117 120 126 4190	118 120 126 4445	119 121 126 4750
	1	119 120 126 4130	118 120 126 4200	118 120 126 4275	118 120 126 4350	119 121 126 4620	121 122 126 4975
	2	120 121 126 4290	120 121 126 4365	120 121 126 4440	120 121 126 4520	122 122 126 4845	122 122 126 5375
38000 V_{FTO} = 157	-2	117 122 129 4070	117 122 129 4145	117 122 129 4215	117 122 129 4290	118 123 129 4550	120 123 129 4855
	-1	119 123 129 4235	119 123 129 4315	119 123 129 4390	119 123 129 4465	120 124 129 4740	122 124 129 5060
	0	121 124 129 4405	121 124 129 4485	121 124 129 4565	121 124 129 4645	122 124 129 4930	124 125 129 5290
	1	123 124 129 4575	123 124 129 4660	123 125 129 4740	123 125 129 4825	124 125 129 5165	126 126 129 5600
	2	125 125 129 4810	125 125 129 4895	125 125 129 4980	125 125 129 5065	126 126 129 5565	127 127 129 6200

TODATA_350SFO_IMP_F20_DRY_ALL_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–19 (Sheet 2 of 2)

DRY RUNWAY WIND CORRECTIONS

	WIND (KNOTS)	UNCORRECTED V_1 (KIAS)					
		110	115	116	120	125	130
CORRECTED V_1 (KIAS)	-10	110	115	118	122	127	132
	0	110	115	116	120	125	130
	10	110	115	115	119	124	129
	20	110	115	114	118	123	128
	30	110	115	113	117	122	127

	WIND (KNOTS)	UNCORRECTED V_1 (KIAS)					
		110	115	116	120	125	130
TOFL FACTOR	-10	1.35	1.35	1.35	1.35	1.35	1.35
	0	1.00	1.00	1.00	1.00	1.00	1.00
	10	0.95	0.95	0.95	0.95	0.95	0.95
	20	0.90	0.90	0.90	0.90	0.90	0.90
	30	0.85	0.85	0.85	0.85	0.85	0.85

TODATA_350SFO_F20_DRY_WIND_CORR_22FEB19

NOTES:

1. In the tables, tailwinds are shown as negative values and headwinds as positive values.
2. If the corrected V_1 exceeds V_R for the appropriate conditions, use $V_1 = V_R$.

Figure 07–11A–01–20

TAKEOFF DISTANCE AND SPEED ON A WET RUNWAY

A runway is considered to be wet when it has a shiny appearance due to a thin layer of water, 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 types of wet runway performance. For wet smooth runways, the Wet Runway tables must be used. For wet runways that have been grooved or treated with porous friction course material, use the Wet Grooved Runway tables.

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

Wet runway takeoff performance accounts for the use of thrust reversers down to 40 KIAS, followed by idle reverse down to a complete stop.

Fig. 07–11A–01–21 to Fig. 07–11A–01–38 present the SFO takeoff performance data on a wet runway, for the specified engine bleed configuration and airport pressure altitude, as a function of airplane weight, ambient temperature and runway gradient. Fig. 07–11A–01–39 provides corrections on TOFL and on V_1 speed for the effect of reported wind and for dispatch with one thrust reverser inoperative, as permitted by the applicable MEL (Minimum Equipment List).

Fig. 07–11A–01–40 to Fig. 07–11A–01–57 present the SFO takeoff performance data on a wet grooved runway, for the specified engine bleed configuration and airport pressure altitude, as a function of airplane weight, ambient temperature and runway gradient. Fig. 07–11A–01–58 provides corrections on TOFL and on V_1 speed for the effect of reported wind and for dispatch with one thrust reverser inoperative, as permitted by the applicable MEL.

NOTE:

1. If the takeoff weight obtained for a wet runway or for a wet grooved 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 or wet grooved runway condition (as applicable) at the limiting weight.
2. If corrections for reported wind and one thrust reverser inoperative are both required, apply the wind corrections first, and then apply the thrust reverser corrections on the wind corrected values.

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
28000 V_{FTO} = 136	-2	114 115 126 3780	114 115 126 3850	114 115 126 3915	114 115 126 3980	114 115 126 4045	114 115 126 4115	114 115 125 4220
	-1	114 115 125 3745	114 115 125 3810	114 115 125 3875	114 115 125 3940	114 115 125 4005	114 115 125 4070	114 115 125 4185
	0	114 115 125 3720	114 115 124 3785	114 115 124 3845	114 115 124 3905	114 115 124 3970	114 115 124 4035	113 115 124 4150
	1	114 115 124 3700	114 115 124 3760	114 115 124 3820	114 115 124 3880	114 115 123 3940	114 115 123 4005	113 115 123 4120
	2	114 115 123 3680	114 115 123 3740	114 115 123 3800	114 115 123 3860	113 115 123 3920	113 115 123 3985	113 115 122 4100
30000 V_{FTO} = 140	-2	114 115 125 3885	114 115 125 3950	114 115 125 4020	114 115 125 4085	114 115 125 4155	114 115 125 4225	113 115 124 4340
	-1	114 115 124 3845	114 115 124 3915	114 115 124 3980	114 115 124 4050	114 115 124 4115	114 115 124 4185	113 115 124 4305
	0	114 115 123 3820	114 115 123 3885	114 115 123 3950	114 115 123 4015	113 115 123 4080	113 115 123 4150	113 115 123 4275
	1	113 115 123 3800	113 115 123 3865	113 115 122 3930	113 115 122 3990	113 115 122 4055	113 115 122 4120	113 115 122 4250
	2	113 115 122 3785	113 115 122 3850	113 115 122 3910	113 115 122 3975	113 115 121 4035	113 115 121 4100	113 115 121 4230
32000 V_{FTO} = 145	-2	114 115 124 3980	114 115 124 4050	114 115 124 4120	114 115 124 4190	114 115 124 4260	114 115 124 4335	113 115 124 4460
	-1	114 115 123 3950	113 115 123 4020	113 115 123 4085	113 115 123 4155	113 115 123 4225	113 115 123 4295	113 115 123 4425
	0	113 115 122 3925	113 115 122 3990	113 115 122 4055	113 115 122 4125	113 115 122 4195	113 115 122 4265	113 115 122 4395
	1	113 115 122 3905	113 115 121 3970	113 115 121 4035	113 115 121 4100	113 115 121 4170	113 115 121 4240	113 115 121 4375
	2	113 115 121 3890	113 115 121 3955	113 115 121 4020	113 115 120 4085	113 115 120 4155	113 115 120 4220	112 115 120 4365
33000 V_{FTO} = 147	-2	114 115 124 4030	114 115 124 4100	114 115 123 4175	113 115 123 4245	113 115 123 4315	113 115 123 4390	113 115 123 4515
	-1	113 115 123 4000	113 115 123 4070	113 115 123 4140	113 115 123 4210	113 115 122 4280	113 115 122 4350	113 115 122 4485
	0	113 115 122 3970	113 115 122 4040	113 115 122 4110	113 115 122 4180	113 115 122 4250	113 115 122 4320	113 115 121 4460
	1	113 115 121 3955	113 115 121 4025	113 115 121 4090	113 115 121 4160	113 115 121 4225	113 115 121 4295	113 115 121 4440
	2	113 115 120 3945	113 115 120 4010	113 115 120 4080	113 115 120 4145	113 115 120 4210	113 115 120 4280	112 115 120 4430

TODATA_350SFO_IMP_F20_WET_ZERO_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–21 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
34000 V_{FTO} = 149	-2	113 115 124 4080	113 115 124 4150	113 115 124 4225	113 115 124 4295	113 115 124 4370	113 115 124 4440	113 115 124 4575
	-1	113 115 123 4050	113 115 123 4120	113 115 123 4190	113 115 123 4260	113 116 123 4335	113 116 123 4405	113 116 123 4545
	0	113 116 122 4025	113 116 122 4095	113 116 122 4165	113 116 122 4235	113 116 122 4305	113 116 122 4380	113 116 122 4520
	1	113 116 122 4010	113 116 122 4080	113 116 122 4145	113 116 122 4215	113 116 122 4285	113 116 122 4355	112 116 122 4505
	2	113 117 122 4000	113 117 122 4070	113 117 122 4135	113 117 122 4200	113 117 122 4270	113 117 122 4340	112 117 122 4495
35000 V_{FTO} = 151	-2	113 117 125 4125	113 117 125 4200	113 117 125 4275	113 117 125 4345	113 117 125 4420	113 117 125 4495	113 117 125 4630
	-1	113 117 124 4095	113 117 124 4170	113 117 124 4240	113 117 124 4315	113 117 124 4390	113 117 124 4460	113 117 124 4600
	0	113 117 124 4075	113 117 124 4145	113 117 124 4220	113 117 124 4290	113 117 124 4360	113 117 124 4435	112 117 124 4580
	1	113 118 124 4060	113 118 124 4130	113 118 124 4200	113 118 124 4270	113 118 124 4340	113 118 124 4415	112 118 124 4570
	2	113 119 124 4055	113 119 124 4125	112 119 124 4190	112 119 124 4260	112 119 124 4330	112 119 124 4405	112 119 124 4560
36000 V_{FTO} = 153	-2	113 118 126 4175	113 119 126 4250	113 119 126 4325	113 119 126 4395	113 119 126 4470	113 119 126 4550	113 119 126 4690
	-1	113 119 126 4145	113 119 126 4220	113 119 126 4295	113 119 126 4365	113 119 126 4440	113 119 126 4515	113 119 126 4660
	0	113 119 125 4125	113 119 125 4200	113 119 125 4270	113 119 125 4345	113 119 125 4415	113 119 125 4490	112 120 125 4640
	1	113 120 125 4110	113 120 125 4185	113 120 125 4255	113 120 125 4325	113 120 125 4400	112 120 125 4475	112 120 125 4630
	2	113 121 125 4170	113 121 125 4245	113 121 125 4310	113 121 125 4380	113 121 125 4450	113 121 125 4520	113 121 125 4730
38000 V_{FTO} = 157	-2	113 122 129 4270	113 122 129 4345	113 122 129 4420	113 122 129 4500	113 122 129 4575	113 122 129 4655	113 122 129 4800
	-1	113 123 129 4245	113 123 129 4320	113 123 129 4395	113 123 129 4470	113 123 129 4550	113 123 129 4625	112 123 129 4780
	0	113 123 129 4275	113 123 129 4355	113 123 129 4425	113 124 129 4495	113 124 129 4570	113 124 129 4645	113 124 129 4840
	1	116 124 129 4465	116 124 129 4545	116 124 129 4620	116 124 129 4695	115 124 129 4770	115 124 129 4845	116 124 129 5065
	2	118 125 129 4670	118 125 129 4755	118 125 129 4830	118 125 129 4910	118 125 129 4990	118 125 129 5070	118 125 129 5310

TODATA_350SFO_IMP_F20_WET_ZERO_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–21 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
28000 V_{FTO} = 136	-2	114 115 126 3850	114 115 126 3915	114 115 126 3985	114 115 126 4050	114 115 126 4120	114 115 125 4200	114 115 125 4295
	-1	114 115 125 3810	114 115 125 3880	114 115 125 3945	114 115 125 4010	114 115 125 4075	114 115 125 4160	114 115 125 4255
	0	114 115 124 3785	114 115 124 3845	114 115 124 3910	114 115 124 3975	114 115 124 4040	114 115 124 4125	113 115 124 4225
	1	114 115 124 3760	114 115 124 3825	114 115 124 3885	114 115 123 3945	114 115 123 4010	113 115 123 4090	113 115 123 4195
	2	114 115 123 3740	114 115 123 3805	114 115 123 3865	113 115 123 3925	113 115 123 3990	113 115 123 4070	113 115 122 4175
30000 V_{FTO} = 140	-2	114 115 125 3950	114 115 125 4020	114 115 125 4090	114 115 125 4160	114 115 125 4230	114 115 124 4315	113 115 124 4420
	-1	114 115 124 3915	114 115 124 3985	114 115 124 4050	114 115 124 4120	114 115 124 4190	114 115 124 4275	113 115 124 4385
	0	114 115 123 3885	114 115 123 3955	114 115 123 4020	113 115 123 4085	113 115 123 4155	113 115 123 4240	113 115 123 4350
	1	113 115 123 3865	113 115 122 3930	113 115 122 3995	113 115 122 4060	113 115 122 4125	113 115 122 4215	113 115 122 4325
	2	113 115 122 3850	113 115 122 3915	113 115 122 3975	113 115 121 4040	113 115 121 4105	113 115 121 4190	113 115 121 4310
32000 V_{FTO} = 145	-2	114 115 124 4050	114 115 124 4125	114 115 124 4195	114 115 124 4265	114 115 124 4340	113 115 124 4430	113 115 123 4540
	-1	113 115 123 4020	113 115 123 4090	113 115 123 4160	113 115 123 4230	113 115 123 4300	113 115 123 4395	113 115 123 4505
	0	113 115 122 3990	113 115 122 4060	113 115 122 4130	113 115 122 4200	113 115 122 4270	113 115 122 4360	113 115 122 4480
	1	113 115 121 3970	113 115 121 4040	113 115 121 4105	113 115 121 4175	113 115 121 4245	113 115 121 4335	113 115 121 4460
	2	113 115 121 3955	113 115 121 4025	113 115 120 4090	113 115 120 4160	113 115 120 4225	113 115 120 4320	112 115 120 4445
33000 V_{FTO} = 147	-2	114 115 124 4100	114 115 124 4175	113 115 123 4250	113 115 123 4320	113 115 123 4395	113 115 123 4485	113 115 123 4600
	-1	113 115 123 4070	113 115 123 4140	113 115 123 4210	113 115 122 4285	113 115 122 4355	113 115 122 4450	113 115 122 4565
	0	113 115 122 4040	113 115 122 4115	113 115 122 4185	113 115 122 4255	113 115 122 4325	113 115 122 4420	113 115 121 4540
	1	113 115 121 4025	113 115 121 4095	113 115 121 4160	113 115 121 4230	113 115 121 4300	113 115 121 4400	112 115 120 4525
	2	113 115 120 4010	113 115 120 4080	113 115 120 4150	113 115 120 4215	113 115 120 4285	113 115 120 4380	112 115 120 4515

TODATA_350SFO_IMP_F20_WET_ZERO_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–22 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
34000 V_{FTO} = 149	-2	113 115 124 4150	113 115 124 4225	113 115 124 4300	113 115 124 4375	113 115 124 4450	113 115 124 4540	113 115 123 4660
	-1	113 115 123 4120	113 115 123 4195	113 115 123 4265	113 116 123 4340	113 116 123 4415	113 116 123 4505	113 116 123 4630
	0	113 116 122 4095	113 116 122 4165	113 116 122 4240	113 116 122 4310	113 116 122 4385	113 116 122 4480	113 116 122 4605
	1	113 116 122 4080	113 116 122 4145	113 116 122 4215	113 116 122 4290	113 116 122 4360	113 116 122 4460	112 116 122 4590
	2	113 117 122 4070	113 117 122 4140	113 117 122 4205	113 117 122 4275	113 117 122 4345	112 117 122 4445	112 117 122 4580
35000 V_{FTO} = 151	-2	113 117 125 4200	113 117 125 4275	113 117 125 4350	113 117 125 4425	113 117 125 4500	113 117 125 4600	113 117 125 4715
	-1	113 117 124 4170	113 117 124 4245	113 117 124 4320	113 117 124 4395	113 117 124 4465	113 117 124 4565	113 117 124 4690
	0	113 117 124 4145	113 117 124 4220	113 117 124 4295	113 117 124 4365	113 117 124 4440	113 117 124 4540	112 118 124 4670
	1	113 118 124 4130	113 118 124 4205	113 118 124 4275	113 118 124 4345	113 118 124 4420	112 118 124 4520	112 118 124 4655
	2	113 119 124 4125	112 119 124 4195	112 119 124 4265	112 119 124 4335	112 119 124 4405	112 119 124 4510	112 119 124 4650
36000 V_{FTO} = 153	-2	113 119 126 4250	113 119 126 4325	113 119 126 4400	113 119 126 4480	113 119 126 4555	113 119 126 4650	113 119 126 4775
	-1	113 119 126 4220	113 119 126 4295	113 119 126 4370	113 119 126 4445	113 119 126 4520	113 119 126 4620	113 119 125 4750
	0	113 119 125 4200	113 119 125 4275	113 119 125 4345	113 119 125 4420	113 119 125 4495	113 120 125 4595	112 120 125 4730
	1	113 120 125 4185	113 120 125 4260	113 120 125 4330	113 120 125 4405	112 120 125 4480	112 120 125 4580	112 120 125 4720
	2	113 121 125 4235	113 121 125 4310	113 121 125 4380	113 121 125 4450	113 121 125 4525	113 121 125 4640	113 121 125 4845
38000 V_{FTO} = 157	-2	113 122 129 4345	113 122 129 4425	113 122 129 4500	113 122 129 4580	113 122 129 4660	113 122 129 4760	112 122 129 4890
	-1	113 123 129 4320	113 123 129 4400	113 123 129 4475	113 123 129 4550	113 123 129 4630	113 123 129 4735	112 123 129 4870
	0	113 123 129 4350	113 123 129 4425	113 124 129 4495	113 124 129 4570	113 124 129 4645	113 124 129 4760	113 124 129 4960
	1	116 124 129 4540	116 124 129 4620	116 124 129 4690	115 124 129 4770	115 124 129 4850	115 124 129 4975	116 125 129 5190
	2	118 125 129 4745	118 125 129 4830	118 125 129 4905	118 125 129 4990	118 125 129 5070	118 125 129 5205	118 125 129 5445

TODATA_350SFO_IMP_F20_WET_ZERO_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–22 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
28000 V_{FTO} = 136	-2	114 115 126 3915	114 115 126 3985	114 115 126 4055	114 115 126 4125	114 115 125 4190	114 115 125 4295	114 115 125 4370
	-1	114 115 125 3880	114 115 125 3945	114 115 125 4010	114 115 125 4080	114 115 125 4150	114 115 125 4255	113 115 124 4335
	0	114 115 124 3850	114 115 124 3910	114 115 124 3975	114 115 124 4045	114 115 124 4110	113 115 124 4220	113 115 124 4300
	1	114 115 124 3825	114 115 124 3890	114 115 124 3950	114 115 123 4015	114 115 123 4080	113 115 123 4190	113 115 123 4270
	2	114 115 123 3805	114 115 123 3865	113 115 123 3930	113 115 123 3990	113 115 123 4055	113 115 122 4165	113 115 122 4250
30000 V_{FTO} = 140	-2	114 115 125 4020	114 115 125 4095	114 115 125 4165	114 115 125 4235	114 115 124 4305	114 115 124 4415	113 115 124 4500
	-1	114 115 124 3985	114 115 124 4055	114 115 124 4125	114 115 124 4195	114 115 124 4265	113 115 124 4380	113 115 123 4460
	0	114 115 123 3955	114 115 123 4020	114 115 123 4090	113 115 123 4160	113 115 123 4230	113 115 123 4345	113 115 123 4430
	1	113 115 123 3930	113 115 122 3995	113 115 122 4060	113 115 122 4130	113 115 122 4200	113 115 122 4315	113 115 122 4410
	2	113 115 122 3915	113 115 122 3980	113 115 122 4045	113 115 121 4110	113 115 121 4175	113 115 121 4295	113 115 121 4390
32000 V_{FTO} = 145	-2	114 115 124 4125	114 115 124 4200	114 115 124 4270	114 115 124 4345	114 115 124 4420	113 115 124 4535	113 115 123 4625
	-1	113 115 123 4090	113 115 123 4160	113 115 123 4230	113 115 123 4305	113 115 123 4375	113 115 123 4500	113 115 122 4590
	0	113 115 122 4060	113 115 122 4130	113 115 122 4200	113 115 122 4270	113 115 122 4345	113 115 122 4470	113 115 122 4565
	1	113 115 121 4040	113 115 121 4105	113 115 121 4175	113 115 121 4245	113 115 121 4320	113 115 121 4445	113 115 121 4545
	2	113 115 121 4025	113 115 121 4095	113 115 120 4160	113 115 120 4230	113 115 120 4295	113 115 120 4430	112 115 120 4530
33000 V_{FTO} = 147	-2	114 115 124 4175	113 115 123 4250	113 115 123 4325	113 115 123 4400	113 115 123 4475	113 115 123 4595	113 115 123 4685
	-1	113 115 123 4140	113 115 123 4215	113 115 123 4285	113 115 122 4360	113 115 122 4435	113 115 122 4560	113 115 122 4650
	0	113 115 122 4110	113 115 122 4185	113 115 122 4255	113 115 122 4330	113 115 122 4405	113 115 121 4530	113 115 121 4630
	1	113 115 121 4090	113 115 121 4160	113 115 121 4230	113 115 121 4305	113 115 121 4380	113 115 121 4510	112 115 120 4610
	2	113 115 120 4080	113 115 120 4150	113 115 120 4215	113 115 120 4285	113 115 120 4360	112 115 120 4495	112 115 120 4600

TODATA_350SFO_IMP_F20_WET_ZERO_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–23 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
34000 V_{FTO} = 149	-2	113 115 124 4225	113 115 124 4300	113 115 124 4375	113 115 124 4450	113 115 124 4530	113 115 124 4650	113 115 123 4745
	-1	113 115 123 4190	113 115 123 4265	113 116 123 4340	113 116 123 4415	113 116 123 4490	113 116 123 4620	113 116 123 4715
	0	113 116 123 4165	113 116 123 4240	113 116 123 4310	113 116 122 4385	113 116 122 4460	113 116 122 4595	112 116 122 4695
	1	113 116 122 4145	113 116 122 4220	113 116 122 4290	113 116 122 4365	113 116 122 4440	112 116 122 4575	112 116 122 4680
	2	113 117 122 4135	113 117 122 4210	113 117 122 4275	113 117 122 4350	113 117 122 4420	112 117 122 4560	112 117 122 4670
35000 V_{FTO} = 151	-2	113 117 125 4275	113 117 125 4350	113 117 125 4430	113 117 125 4505	113 117 125 4580	113 117 125 4710	113 117 125 4805
	-1	113 117 124 4245	113 117 124 4320	113 117 124 4395	113 117 124 4470	113 117 124 4545	113 117 124 4680	113 117 124 4775
	0	113 117 124 4220	113 117 124 4295	113 117 124 4365	113 117 124 4445	113 118 124 4520	113 118 124 4655	112 118 124 4760
	1	113 118 124 4200	113 118 124 4275	113 118 124 4350	113 118 124 4425	113 118 124 4495	112 118 124 4635	112 119 124 4745
	2	113 119 124 4195	112 119 124 4265	112 119 124 4335	112 119 124 4410	112 119 124 4485	112 119 124 4630	112 119 124 4745
36000 V_{FTO} = 153	-2	113 119 126 4325	113 119 126 4405	113 119 126 4480	113 119 126 4560	113 119 126 4635	113 119 126 4770	113 119 126 4865
	-1	113 119 126 4295	113 119 126 4370	113 119 126 4450	113 119 126 4525	113 119 126 4600	113 119 126 4740	112 119 125 4840
	0	113 119 125 4270	113 119 125 4350	113 119 125 4420	113 119 125 4500	113 120 125 4575	112 120 125 4715	112 120 125 4820
	1	113 120 125 4255	113 120 125 4330	113 120 125 4405	113 120 125 4480	112 120 125 4555	112 120 125 4700	112 121 125 4815
	2	113 121 125 4300	113 121 125 4375	113 121 125 4445	113 121 125 4520	113 121 125 4595	113 121 125 4775	114 121 125 4970
38000 V_{FTO} = 157	-2	113 122 129 4425	113 122 129 4505	113 122 129 4585	113 122 129 4665	113 122 129 4745	113 122 129 4880	112 122 129 4985
	-1	113 123 129 4395	113 123 129 4475	113 123 129 4555	113 123 129 4635	113 123 129 4715	112 123 129 4855	112 123 129 4965
	0	113 123 129 4415	113 124 129 4490	113 124 129 4565	113 124 129 4645	113 124 129 4720	113 124 129 4895	114 124 129 5080
	1	116 124 129 4605	115 124 129 4685	115 124 129 4765	115 124 129 4845	115 124 129 4925	115 124 129 5115	116 125 129 5320
	2	118 125 129 4820	118 125 129 4900	118 125 129 4980	118 125 129 5065	118 125 129 5150	118 125 129 5365	119 126 129 5590

TODATA_350SFO_IMP_F20_WET_ZERO_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–23 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
28000 V_{FTO} = 136	-2	114 115 126 4060	114 115 126 4130	114 115 126 4200	114 115 125 4275	114 115 125 4365	114 115 125 4500	113 115 125 4530
	-1	114 115 125 4015	114 115 125 4085	114 115 125 4155	114 115 125 4230	114 115 125 4320	113 115 124 4460	113 115 124 4490
	0	114 115 124 3985	114 115 124 4050	114 115 124 4120	114 115 124 4190	114 115 124 4285	113 115 123 4430	113 115 123 4460
	1	114 115 124 3955	114 115 124 4020	114 115 123 4085	114 115 123 4155	113 115 123 4250	113 115 123 4400	113 115 123 4430
	2	114 115 123 3935	113 115 123 4000	113 115 123 4065	113 115 123 4130	113 115 122 4220	113 115 122 4375	113 115 122 4410
30000 V_{FTO} = 140	-2	114 115 125 4170	114 115 125 4240	114 115 125 4315	114 115 124 4390	114 115 124 4485	113 115 124 4635	113 115 124 4665
	-1	114 115 124 4125	114 115 124 4200	114 115 124 4275	114 115 124 4345	113 115 124 4445	113 115 123 4595	113 115 123 4630
	0	114 115 123 4095	114 115 123 4165	113 115 123 4235	113 115 123 4310	113 115 123 4410	113 115 122 4565	113 115 122 4600
	1	113 115 122 4070	113 115 122 4135	113 115 122 4205	113 115 122 4275	113 115 122 4380	113 115 122 4540	113 115 122 4575
	2	113 115 122 4050	113 115 122 4115	113 115 121 4185	113 115 121 4250	113 115 121 4355	113 115 121 4525	112 115 121 4560
32000 V_{FTO} = 145	-2	114 115 124 4275	114 115 124 4350	114 115 124 4425	113 115 124 4505	113 115 124 4605	113 115 123 4765	113 115 123 4795
	-1	113 115 123 4235	113 115 123 4310	113 115 123 4385	113 115 123 4460	113 115 123 4565	113 115 122 4730	113 115 122 4765
	0	113 115 122 4205	113 115 122 4275	113 115 122 4350	113 115 122 4425	113 115 122 4535	113 115 121 4700	113 115 121 4735
	1	113 115 121 4180	113 115 121 4250	113 115 121 4325	113 115 121 4400	113 115 121 4505	112 115 121 4680	112 115 121 4720
	2	113 115 121 4165	113 115 120 4235	113 115 120 4305	113 115 120 4375	113 115 120 4490	112 115 120 4670	112 115 120 4710
33000 V_{FTO} = 147	-2	113 115 123 4325	113 115 123 4405	113 115 123 4480	113 115 123 4560	113 115 123 4665	113 115 123 4825	113 115 123 4860
	-1	113 115 123 4290	113 115 123 4365	113 115 122 4440	113 115 122 4520	113 115 122 4630	113 115 122 4795	113 115 122 4830
	0	113 115 122 4260	113 115 122 4335	113 115 122 4410	113 115 122 4485	113 115 121 4595	112 115 121 4770	112 115 121 4805
	1	113 115 121 4235	113 115 121 4310	113 115 121 4385	113 115 121 4460	113 115 121 4570	112 115 120 4755	112 115 120 4790
	2	113 115 120 4220	113 115 120 4295	113 115 120 4365	113 115 120 4440	112 115 120 4555	112 115 120 4745	112 115 120 4785

TODATA_350SFO_IMP_F20_WET_ZERO_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–24 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
34000 V_{FTO} = 149	-2	113 115 124 4380	113 115 124 4460	113 115 124 4535	113 115 124 4615	113 116 124 4725	113 115 123 4890	113 115 123 4925
	-1	113 116 123 4345	113 116 123 4420	113 116 123 4500	113 116 123 4575	113 116 123 4690	113 116 123 4860	112 116 122 4895
	0	113 116 123 4315	113 116 123 4390	113 116 123 4470	113 116 123 4545	113 116 123 4660	112 116 122 4835	112 116 122 4875
	1	113 116 122 4295	113 116 122 4365	113 116 122 4445	113 116 122 4520	113 116 122 4635	112 116 122 4825	112 117 122 4865
	2	113 117 122 4280	113 117 122 4350	113 117 122 4425	113 117 122 4505	112 117 122 4620	112 117 122 4820	112 117 122 4860
35000 V_{FTO} = 151	-2	113 117 125 4430	113 117 125 4510	113 117 125 4590	113 117 125 4670	113 117 125 4785	113 117 125 4955	113 117 124 4990
	-1	113 117 125 4400	113 117 125 4475	113 117 125 4555	113 117 124 4635	113 117 124 4750	112 117 124 4925	112 117 124 4960
	0	113 117 124 4370	113 118 124 4445	113 118 124 4525	113 118 124 4605	113 118 124 4720	112 118 124 4905	112 118 124 4945
	1	113 118 124 4350	113 118 124 4425	113 118 124 4505	113 118 124 4580	112 118 124 4700	112 119 124 4895	112 119 124 4935
	2	112 119 124 4340	112 119 124 4410	112 119 124 4490	112 119 124 4565	112 119 124 4690	112 119 124 4890	112 120 124 4935
36000 V_{FTO} = 153	-2	113 119 127 4485	113 119 126 4565	113 119 126 4645	113 119 126 4725	113 119 126 4840	113 119 126 5015	112 119 126 5055
	-1	113 119 126 4450	113 119 126 4530	113 119 126 4610	113 119 126 4690	113 119 126 4805	112 119 125 4990	112 119 125 5030
	0	113 119 125 4425	113 119 125 4505	113 119 125 4585	113 120 125 4660	112 120 125 4780	112 120 125 4970	112 120 125 5010
	1	113 120 125 4405	113 120 125 4485	112 120 125 4560	112 120 125 4640	112 120 125 4765	112 121 125 4965	112 121 125 5005
	2	113 121 125 4430	113 121 125 4505	113 121 125 4580	113 121 125 4660	113 121 125 4805	114 122 125 5140	114 122 125 5220
38000 V_{FTO} = 157	-2	113 122 129 4585	113 122 129 4670	113 122 129 4750	113 122 129 4835	113 122 129 4955	112 122 129 5140	112 123 129 5180
	-1	113 123 129 4555	113 123 129 4640	113 123 129 4720	113 123 129 4805	112 123 129 4925	112 123 129 5120	112 123 129 5160
	0	113 124 129 4550	113 124 129 4630	113 124 129 4710	113 124 129 4790	113 124 129 4935	114 124 129 5250	114 124 129 5325
	1	115 124 129 4750	115 124 129 4830	115 124 129 4915	115 124 129 5000	115 124 129 5155	116 125 129 5505	116 125 129 5585
	2	118 125 129 4965	118 125 129 5050	118 125 129 5135	118 125 129 5225	118 125 129 5395	119 126 129 5790	119 126 129 5885

TODATA_350SFO_IMP_F20_WET_ZERO_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–24 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	29	
28000 V_{FTO} = 136	-2	114 115 126 4210	114 115 125 4285	114 115 125 4360	114 115 125 4445	114 115 125 4570	113 115 124 4695	
	-1	114 115 125 4165	114 115 125 4240	114 115 125 4315	114 115 125 4400	113 115 124 4530	113 115 124 4655	
	0	114 115 124 4125	114 115 124 4200	114 115 124 4270	114 115 124 4360	113 115 124 4490	113 115 123 4625	
	1	114 115 123 4100	114 115 123 4165	114 115 123 4235	113 115 123 4325	113 115 123 4460	113 115 122 4595	
	2	113 115 123 4075	113 115 123 4140	113 115 122 4210	113 115 122 4295	113 115 122 4435	113 115 121 4580	
30000 V_{FTO} = 140	-2	114 115 125 4325	114 115 124 4400	114 115 124 4480	114 115 124 4570	113 115 124 4705	113 115 123 4840	
	-1	114 115 124 4285	114 115 124 4355	114 115 124 4435	113 115 124 4525	113 115 123 4665	113 115 123 4800	
	0	113 115 123 4245	113 115 123 4320	113 115 123 4395	113 115 123 4485	113 115 123 4630	113 115 122 4770	
	1	113 115 122 4215	113 115 122 4285	113 115 122 4360	113 115 122 4455	113 115 122 4600	112 115 121 4750	
	2	113 115 121 4195	113 115 121 4265	113 115 121 4335	113 115 121 4430	113 115 121 4580	112 115 120 4735	
32000 V_{FTO} = 145	-2	114 115 124 4435	113 115 124 4515	113 115 124 4595	113 115 123 4695	113 115 123 4835	113 115 123 4975	
	-1	113 115 123 4395	113 115 123 4475	113 115 123 4555	113 115 123 4650	113 115 122 4795	113 115 122 4945	
	0	113 115 122 4360	113 115 122 4440	113 115 122 4515	113 115 122 4615	113 115 122 4765	112 115 121 4920	
	1	113 115 121 4335	113 115 121 4410	113 115 121 4485	113 115 121 4585	112 115 121 4745	112 115 120 4905	
	2	113 115 120 4315	113 115 120 4385	113 115 120 4465	113 115 120 4565	112 115 120 4725	112 115 119 4895	
33000 V_{FTO} = 147	-2	113 115 123 4495	113 115 123 4570	113 115 123 4655	113 115 123 4755	113 115 123 4900	113 115 122 5045	
	-1	113 115 122 4450	113 115 122 4530	113 115 122 4615	113 115 122 4710	113 115 122 4860	112 115 121 5015	
	0	113 115 122 4420	113 115 122 4500	113 115 121 4575	113 115 121 4675	113 115 121 4835	112 115 121 4995	
	1	113 115 121 4395	113 115 121 4470	113 115 121 4550	113 115 121 4650	112 115 120 4815	112 115 120 4980	
	2	113 115 120 4375	113 115 120 4450	113 115 120 4530	112 115 120 4630	112 115 120 4800	112 115 120 4975	

TODATA_350SFO_IMP_F20_WET_ZERO_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–25 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	29	
34000 V_{FTO} = 149	-2	113 115 124 4545	113 116 124 4630	113 116 124 4710	113 116 124 4815	113 116 123 4965	113 115 123 5115	
	-1	113 116 123 4510	113 116 123 4590	113 116 123 4670	113 116 123 4770	113 116 123 4930	112 116 122 5085	
	0	113 116 123 4480	113 116 123 4555	113 116 123 4640	113 116 123 4740	112 116 122 4900	112 116 122 5065	
	1	113 116 122 4455	113 116 122 4530	113 116 122 4610	113 116 122 4715	112 116 122 4885	112 117 122 5055	
	2	113 117 122 4440	113 117 122 4515	112 117 122 4595	112 117 122 4700	112 117 122 4875	112 118 122 5055	
35000 V_{FTO} = 151	-2	113 117 125 4600	113 117 125 4685	113 117 125 4770	113 117 125 4870	113 117 125 5025	112 117 124 5180	
	-1	113 117 125 4565	113 117 125 4645	113 117 124 4730	113 117 124 4835	113 117 124 4995	112 118 124 5155	
	0	113 118 124 4535	113 118 124 4615	113 118 124 4700	113 118 124 4805	112 118 124 4970	112 118 124 5140	
	1	113 118 124 4515	113 118 124 4590	113 118 124 4675	112 118 124 4780	112 119 124 4955	112 119 124 5130	
	2	112 119 124 4500	112 119 124 4575	112 119 124 4660	112 119 124 4765	112 119 124 4945	112 120 124 5165	
36000 V_{FTO} = 153	-2	113 119 126 4655	113 119 126 4740	113 119 126 4825	113 119 126 4930	113 119 126 5090	112 119 125 5250	
	-1	113 119 126 4620	113 119 126 4705	113 119 126 4785	113 119 126 4895	112 119 125 5060	112 120 125 5225	
	0	113 119 125 4595	113 120 125 4675	113 120 125 4760	113 120 125 4865	112 120 125 5035	112 120 125 5210	
	1	112 120 125 4575	112 120 125 4655	112 120 125 4735	112 120 125 4845	112 121 125 5025	112 121 125 5235	
	2	113 121 125 4590	113 121 125 4665	113 121 125 4750	113 121 125 4875	113 122 125 5155	115 122 125 5485	
38000 V_{FTO} = 157	-2	113 122 129 4765	113 122 129 4850	113 122 129 4935	113 122 129 5045	112 122 129 5215	112 123 129 5385	
	-1	113 123 129 4730	113 123 129 4815	113 123 129 4905	112 123 129 5015	112 123 129 5190	112 124 129 5365	
	0	113 124 129 4715	112 124 129 4795	112 124 129 4885	112 124 129 5005	113 124 129 5275	114 124 129 5595	
	1	115 124 129 4920	115 124 129 5005	115 125 129 5095	115 125 129 5225	116 125 129 5525	117 125 129 5880	
	2	118 125 129 5145	117 125 129 5230	117 125 129 5325	118 125 129 5470	118 126 129 5795	120 126 129 6210	

TODATA_350SFO_IMP_F20_WET_ZERO_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–25 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	27	
28000 V_{FTO} = 136	-2	114 115 125 4375	114 115 125 4450	114 115 125 4535	114 115 125 4655	113 115 124 4800	113 115 124 4870	
	-1	114 115 125 4325	114 115 124 4405	114 115 124 4485	113 115 124 4610	113 115 124 4760	113 115 123 4830	
	0	114 115 124 4285	114 115 124 4360	114 115 124 4445	113 115 123 4570	113 115 123 4725	113 115 123 4795	
	1	114 115 123 4250	113 115 123 4325	113 115 123 4405	113 115 123 4535	113 115 122 4695	113 115 122 4770	
	2	113 115 122 4225	113 115 122 4295	113 115 122 4375	113 115 122 4510	113 115 121 4675	112 115 121 4750	
30000 V_{FTO} = 140	-2	114 115 124 4490	114 115 124 4575	114 115 124 4660	113 115 124 4790	113 115 123 4945	113 115 123 5015	
	-1	114 115 124 4450	114 115 124 4525	113 115 123 4615	113 115 123 4745	113 115 123 4905	113 115 122 4980	
	0	113 115 123 4410	113 115 123 4485	113 115 123 4575	113 115 122 4710	113 115 122 4875	112 115 122 4955	
	1	113 115 122 4375	113 115 122 4455	113 115 122 4540	113 115 122 4680	112 115 121 4850	112 115 121 4930	
	2	113 115 121 4350	113 115 121 4425	113 115 121 4510	113 115 121 4655	112 115 120 4835	112 115 120 4920	
32000 V_{FTO} = 145	-2	113 115 123 4610	113 115 123 4695	113 115 123 4785	113 115 123 4925	113 115 122 5090	113 115 122 5165	
	-1	113 115 123 4570	113 115 123 4650	113 115 123 4740	113 115 122 4880	113 115 122 5055	112 115 121 5130	
	0	113 115 122 4530	113 115 122 4610	113 115 122 4705	113 115 122 4850	112 115 121 5025	112 115 121 5110	
	1	113 115 121 4500	113 115 121 4580	113 115 121 4670	113 115 121 4820	112 115 120 5005	112 115 120 5095	
	2	113 115 120 4480	113 115 120 4555	113 115 120 4650	112 115 120 4805	112 115 119 4995	112 115 119 5085	
33000 V_{FTO} = 147	-2	113 115 123 4670	113 115 123 4755	113 115 123 4845	113 115 123 4990	113 115 122 5160	112 115 122 5235	
	-1	113 115 122 4625	113 115 122 4710	113 115 122 4805	113 115 122 4950	112 115 121 5125	112 115 121 5205	
	0	113 115 121 4590	113 115 121 4675	113 115 121 4770	113 115 121 4915	112 115 120 5100	112 115 120 5185	
	1	113 115 121 4565	113 115 121 4645	113 115 121 4740	112 115 120 4890	112 115 120 5085	112 115 120 5175	
	2	113 115 120 4545	113 115 120 4625	112 115 120 4720	112 115 120 4875	112 116 120 5080	112 116 120 5170	

TODATA_350SFO_IMP_F20_WET_ZERO_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–26 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	27	
34000 V_{FTO} = 149	-2	113 116 124 4725	113 116 124 4810	113 116 124 4910	113 116 123 5055	113 116 123 5230	112 115 122 5310	
	-1	113 116 123 4685	113 116 123 4770	113 116 123 4865	113 116 123 5015	112 116 122 5195	112 116 122 5280	
	0	113 116 123 4650	113 116 123 4735	113 116 122 4830	112 116 122 4985	112 116 122 5175	112 116 122 5265	
	1	113 116 122 4625	113 116 122 4710	113 116 122 4805	112 116 122 4965	112 117 122 5160	112 117 122 5255	
	2	112 117 122 4605	112 117 122 4690	112 117 122 4785	112 117 122 4950	112 118 122 5160	112 118 122 5255	
35000 V_{FTO} = 151	-2	113 117 125 4785	113 117 125 4870	113 117 125 4970	113 117 125 5115	112 117 124 5300	112 117 124 5380	
	-1	113 117 124 4745	113 118 124 4830	113 118 124 4930	113 118 124 5080	112 118 124 5270	112 118 124 5355	
	0	113 118 124 4715	113 118 124 4800	113 118 124 4895	112 118 124 5055	112 118 124 5250	112 119 124 5340	
	1	113 118 124 4690	112 118 124 4775	112 118 124 4870	112 119 124 5035	112 119 124 5240	112 119 124 5335	
	2	112 119 124 4675	112 119 124 4755	112 119 124 4855	112 119 124 5025	112 120 124 5275	113 120 124 5445	
36000 V_{FTO} = 153	-2	113 119 126 4840	113 119 126 4930	113 119 126 5030	113 119 126 5180	112 119 126 5365	112 119 126 5450	
	-1	113 119 126 4805	113 119 126 4890	113 119 126 4990	112 119 126 5145	112 120 126 5340	112 120 126 5430	
	0	113 120 126 4775	113 120 126 4860	113 120 126 4960	112 120 126 5120	112 121 126 5325	112 121 126 5415	
	1	112 120 126 4750	112 120 126 4840	112 121 126 4935	112 121 126 5105	112 121 126 5345	113 121 126 5510	
	2	113 121 126 4775	113 121 126 4860	113 121 126 4965	113 122 126 5210	115 122 126 5605	115 122 126 5785	
38000 V_{FTO} = 157	-2	113 122 129 4955	113 122 129 5045	113 122 129 5150	112 123 129 5310	112 123 129 5500	112 123 129 5595	
	-1	113 123 129 4920	113 123 129 5010	112 123 129 5110	112 123 129 5275	112 124 129 5480	112 124 129 5615	
	0	113 124 129 4905	112 124 129 4995	112 124 129 5100	113 124 129 5335	114 125 129 5715	115 125 129 5890	
	1	115 125 129 5120	115 125 129 5210	115 125 129 5325	115 125 129 5580	117 125 129 6000	117 126 129 6185	
	2	118 125 129 5350	118 125 129 5450	118 125 129 5570	118 126 129 5855	120 126 129 6340	120 126 129 6565	

TODATA_350SFO_IMP_F20_WET_ZERO_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–26 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
28000 V_{FTO} = 136	-2	114 115 126 3785	114 115 126 3850	114 115 126 3915	114 115 126 3980	114 115 126 4045	114 115 125 4120	114 115 125 4235
	-1	114 115 125 3745	114 115 125 3810	114 115 125 3875	114 115 125 3940	114 115 125 4005	114 115 125 4080	114 115 124 4195
	0	114 115 124 3720	114 115 124 3785	114 115 124 3845	114 115 124 3905	114 115 124 3970	114 115 124 4045	113 115 124 4165
	1	114 115 124 3700	114 115 124 3760	114 115 124 3820	114 115 124 3885	114 115 123 3940	114 115 123 4010	113 115 123 4140
	2	114 115 123 3680	114 115 123 3740	114 115 123 3800	113 115 123 3860	113 115 123 3920	113 115 123 3990	113 115 122 4115
30000 V_{FTO} = 140	-2	114 115 125 3885	114 115 125 3955	114 115 125 4020	114 115 125 4090	114 115 125 4155	114 115 125 4230	113 115 124 4355
	-1	114 115 124 3850	114 115 124 3915	114 115 124 3985	114 115 124 4050	114 115 124 4115	114 115 124 4190	113 115 124 4320
	0	114 115 123 3825	114 115 123 3885	114 115 123 3950	114 115 123 4015	113 115 123 4085	113 115 123 4160	113 115 123 4290
	1	113 115 123 3800	113 115 122 3865	113 115 122 3930	113 115 122 3995	113 115 122 4055	113 115 122 4130	113 115 122 4265
	2	113 115 122 3785	113 115 122 3850	113 115 122 3910	113 115 122 3975	113 115 121 4040	113 115 121 4110	113 115 121 4250
32000 V_{FTO} = 145	-2	114 115 124 3985	114 115 124 4055	114 115 124 4125	114 115 124 4195	114 115 124 4265	113 115 124 4340	113 115 123 4475
	-1	114 115 123 3950	113 115 123 4020	113 115 123 4090	113 115 123 4155	113 115 123 4225	113 115 123 4305	113 115 123 4440
	0	113 115 122 3925	113 115 122 3990	113 115 122 4060	113 115 122 4125	113 115 122 4195	113 115 122 4275	113 115 122 4415
	1	113 115 121 3905	113 115 121 3975	113 115 121 4040	113 115 121 4105	113 115 121 4170	113 115 121 4250	113 115 121 4395
	2	113 115 121 3895	113 115 121 3960	113 115 120 4025	113 115 120 4090	113 115 120 4155	113 115 120 4230	112 115 120 4385
33000 V_{FTO} = 147	-2	114 115 124 4030	114 115 124 4105	113 115 123 4175	113 115 123 4245	113 115 123 4315	113 115 123 4395	113 115 123 4530
	-1	113 115 123 4000	113 115 123 4070	113 115 123 4140	113 115 123 4210	113 115 122 4280	113 115 122 4360	113 115 122 4500
	0	113 115 122 3975	113 115 122 4045	113 115 122 4110	113 115 122 4180	113 115 122 4250	113 115 122 4330	113 115 121 4475
	1	113 115 121 3960	113 115 121 4025	113 115 121 4090	113 115 121 4160	113 115 121 4230	113 115 121 4310	112 115 120 4460
	2	113 115 120 3945	113 115 120 4015	113 115 120 4080	113 115 120 4145	113 115 120 4215	113 115 120 4295	112 115 120 4450

TODATA_350SFO_IMP_F20_WET_ECS_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–27 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
34000 V_{FTO} = 149	-2	113 115 124 4080	113 115 124 4155	113 115 124 4225	113 115 124 4295	113 115 124 4370	113 115 124 4450	113 115 123 4590
	-1	113 115 123 4050	113 115 123 4120	113 115 123 4190	113 115 123 4265	113 116 123 4335	113 116 123 4415	113 115 123 4560
	0	113 116 122 4025	113 116 122 4095	113 116 122 4165	113 116 122 4235	113 116 122 4310	113 116 122 4390	113 116 122 4540
	1	113 116 122 4010	113 116 122 4080	113 116 122 4145	113 116 122 4215	113 116 122 4285	113 116 122 4370	112 116 122 4525
	2	113 117 122 4000	113 117 122 4070	113 117 122 4135	113 117 122 4205	113 117 122 4270	113 117 122 4355	112 117 122 4520
35000 V_{FTO} = 151	-2	113 117 125 4130	113 117 125 4205	113 117 125 4275	113 117 125 4350	113 117 125 4420	113 117 125 4505	113 117 125 4650
	-1	113 117 124 4100	113 117 124 4175	113 117 124 4245	113 117 124 4315	113 117 124 4390	113 117 124 4470	113 117 124 4620
	0	113 117 124 4075	113 117 124 4150	113 117 124 4220	113 117 124 4290	113 117 124 4365	113 117 124 4445	112 118 124 4600
	1	113 118 124 4060	113 118 124 4135	113 118 124 4205	113 118 124 4275	113 118 124 4345	113 118 124 4430	112 118 124 4590
	2	113 119 124 4055	113 119 124 4125	112 119 124 4195	112 119 124 4260	112 119 124 4335	112 119 124 4415	112 119 124 4585
36000 V_{FTO} = 153	-2	113 118 126 4175	113 119 126 4250	113 119 126 4325	113 119 126 4400	113 119 126 4475	113 119 126 4560	113 119 126 4705
	-1	113 119 126 4150	113 119 126 4225	113 119 126 4295	113 119 126 4370	113 119 126 4445	113 119 126 4525	113 119 125 4680
	0	113 119 125 4130	113 119 125 4200	113 119 125 4275	113 119 125 4345	113 119 125 4420	113 120 125 4505	112 120 125 4665
	1	113 120 125 4115	113 120 125 4185	113 120 125 4260	113 120 125 4330	113 120 125 4400	112 120 125 4485	112 121 125 4655
	2	113 121 125 4175	113 121 125 4250	113 121 125 4320	113 121 125 4385	113 121 125 4455	113 121 125 4545	114 121 125 4810
38000 V_{FTO} = 157	-2	113 122 129 4270	113 122 129 4350	113 122 129 4425	113 122 129 4500	113 122 129 4580	113 122 129 4665	113 122 129 4820
	-1	113 123 129 4245	113 123 129 4325	113 123 129 4400	113 123 129 4475	113 123 129 4550	113 123 129 4635	112 123 129 4800
	0	113 123 129 4285	113 123 129 4365	113 124 129 4430	113 124 129 4505	113 124 129 4575	113 124 129 4665	114 124 129 4920
	1	116 124 129 4475	116 124 129 4555	116 124 129 4625	116 124 129 4700	116 124 129 4775	116 124 129 4870	116 125 129 5150
	2	118 125 129 4680	118 125 129 4765	118 125 129 4840	118 125 129 4915	118 125 129 4995	118 125 129 5095	119 126 129 5415

TODATA_350SFO_IMP_F20_WET_ECS_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–27 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
28000 V_{FTO} = 136	-2	114 115 126 3850	114 115 126 3920	114 115 126 3985	114 115 126 4050	114 115 125 4120	114 115 125 4210	114 115 125 4310
	-1	114 115 125 3815	114 115 125 3880	114 115 125 3945	114 115 125 4010	114 115 125 4075	114 115 125 4170	113 115 124 4270
	0	114 115 124 3785	114 115 124 3850	114 115 124 3910	114 115 124 3975	114 115 124 4040	114 115 124 4135	113 115 124 4240
	1	114 115 124 3760	114 115 124 3825	114 115 124 3885	114 115 123 3950	114 115 123 4010	113 115 123 4105	113 115 123 4215
	2	114 115 123 3740	114 115 123 3805	113 115 123 3865	113 115 123 3925	113 115 123 3990	113 115 122 4080	113 115 122 4190
30000 V_{FTO} = 140	-2	114 115 125 3955	114 115 125 4025	114 115 125 4090	114 115 125 4160	114 115 125 4230	114 115 124 4330	113 115 124 4435
	-1	114 115 124 3915	114 115 124 3985	114 115 124 4055	114 115 124 4120	114 115 124 4190	113 115 124 4290	113 115 123 4400
	0	114 115 123 3890	114 115 123 3955	114 115 123 4020	113 115 123 4090	113 115 123 4155	113 115 123 4255	113 115 123 4370
	1	113 115 123 3870	113 115 122 3935	113 115 122 3995	113 115 122 4060	113 115 122 4125	113 115 122 4230	113 115 122 4345
	2	113 115 122 3850	113 115 122 3915	113 115 122 3980	113 115 121 4045	113 115 121 4110	113 115 121 4210	113 115 121 4330
32000 V_{FTO} = 145	-2	114 115 124 4055	114 115 124 4125	114 115 124 4195	114 115 124 4270	114 115 124 4340	113 115 124 4445	113 115 123 4555
	-1	113 115 123 4020	113 115 123 4090	113 115 123 4160	113 115 123 4230	113 115 123 4305	113 115 123 4410	113 115 122 4525
	0	113 115 122 3990	113 115 122 4060	113 115 122 4130	113 115 122 4200	113 115 122 4270	113 115 122 4380	113 115 122 4500
	1	113 115 121 3975	113 115 121 4040	113 115 121 4105	113 115 121 4175	113 115 121 4245	113 115 121 4355	113 115 121 4480
	2	113 115 121 3960	113 115 120 4025	113 115 120 4095	113 115 120 4160	113 115 120 4225	113 115 120 4340	112 115 120 4465
33000 V_{FTO} = 147	-2	114 115 124 4105	113 115 123 4175	113 115 123 4250	113 115 123 4320	113 115 123 4395	113 115 123 4500	113 115 123 4615
	-1	113 115 123 4070	113 115 123 4145	113 115 123 4215	113 115 122 4285	113 115 122 4360	113 115 122 4465	113 115 122 4585
	0	113 115 122 4045	113 115 122 4115	113 115 122 4185	113 115 122 4255	113 115 122 4330	113 115 121 4440	113 115 121 4560
	1	113 115 121 4025	113 115 121 4095	113 115 121 4165	113 115 121 4235	113 115 121 4305	113 115 121 4415	112 115 120 4545
	2	113 115 120 4015	113 115 120 4085	113 115 120 4150	113 115 120 4215	113 115 120 4285	112 115 120 4400	112 115 120 4535

TODATA_350SFO_IMP_F20_WET_ECS_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–28 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
34000 V_{FTO} = 149	-2	113 115 124 4155	113 115 124 4230	113 115 124 4300	113 115 124 4375	113 115 124 4450	113 115 124 4560	113 115 123 4675
	-1	113 115 123 4120	113 115 123 4195	113 115 123 4265	113 116 123 4340	113 116 123 4415	113 116 123 4525	113 116 122 4645
	0	113 116 122 4095	113 116 122 4170	113 116 122 4240	113 116 122 4310	113 116 122 4385	113 116 122 4500	112 116 122 4625
	1	113 116 122 4080	113 116 122 4150	113 116 122 4220	113 116 122 4290	113 116 122 4365	113 116 122 4480	112 116 122 4615
	2	113 117 122 4070	113 117 122 4140	113 117 122 4210	113 117 122 4275	113 117 122 4350	112 117 122 4465	112 117 122 4605
35000 V_{FTO} = 151	-2	113 117 125 4205	113 117 125 4280	113 117 125 4350	113 117 125 4425	113 117 125 4505	113 117 125 4615	113 117 124 4735
	-1	113 117 124 4175	113 117 124 4245	113 117 124 4320	113 117 124 4395	113 117 124 4470	113 117 124 4580	113 117 124 4710
	0	113 117 124 4150	113 117 124 4225	113 117 124 4295	113 117 124 4370	113 117 124 4440	113 117 124 4560	112 118 124 4690
	1	113 118 124 4135	113 118 124 4205	113 118 124 4275	113 118 124 4350	113 118 124 4420	112 118 124 4540	112 119 124 4680
	2	113 119 124 4125	112 119 124 4195	112 119 124 4265	112 119 124 4335	112 119 124 4410	112 119 124 4530	112 119 124 4675
36000 V_{FTO} = 153	-2	113 119 126 4250	113 119 126 4330	113 119 126 4405	113 119 126 4480	113 119 126 4555	113 119 126 4670	113 119 126 4795
	-1	113 119 126 4225	113 119 126 4300	113 119 126 4370	113 119 126 4450	113 119 126 4525	113 119 126 4640	112 119 125 4770
	0	113 119 125 4200	113 119 125 4275	113 119 125 4350	113 119 125 4425	113 120 125 4500	113 120 125 4620	112 120 125 4755
	1	113 120 125 4185	113 120 125 4260	113 120 125 4330	113 120 125 4405	112 120 125 4480	112 120 125 4605	112 121 125 4745
	2	113 121 125 4245	113 121 125 4320	113 121 125 4385	113 121 125 4460	113 121 125 4530	113 121 125 4680	114 122 125 4935
38000 V_{FTO} = 157	-2	113 122 129 4350	113 122 129 4425	113 122 129 4505	113 122 129 4585	113 122 129 4660	113 122 129 4780	112 122 129 4915
	-1	113 123 129 4325	113 123 129 4400	113 123 129 4475	113 123 129 4555	113 123 129 4630	112 123 129 4755	112 123 129 4890
	0	113 123 129 4355	113 124 129 4435	113 124 129 4505	113 124 129 4580	113 124 129 4655	113 124 129 4800	114 124 129 5045
	1	116 124 129 4545	116 124 129 4625	116 124 129 4700	116 124 129 4780	115 124 129 4860	116 124 129 5015	117 125 129 5285
	2	118 125 129 4755	118 125 129 4840	118 125 129 4915	118 125 129 5000	118 125 129 5080	118 125 129 5250	119 126 129 5565

TODATA_350SFO_IMP_F20_WET_ECS_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–28 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
28000 V_{FTO} = 136	-2	114 115 126 3920	114 115 126 3985	114 115 126 4055	114 115 126 4125	114 115 125 4190	114 115 125 4310	114 115 125 4385
	-1	114 115 125 3880	114 115 125 3945	114 115 125 4015	114 115 125 4080	114 115 125 4150	114 115 124 4270	113 115 124 4350
	0	114 115 124 3850	114 115 124 3915	114 115 124 3975	114 115 124 4045	114 115 124 4110	113 115 124 4235	113 115 123 4315
	1	114 115 124 3825	114 115 124 3890	114 115 123 3950	114 115 123 4015	114 115 123 4080	113 115 123 4205	113 115 123 4290
	2	114 115 123 3805	114 115 123 3865	113 115 123 3930	113 115 123 3995	113 115 123 4055	113 115 122 4180	113 115 122 4270
30000 V_{FTO} = 140	-2	114 115 125 4025	114 115 125 4095	114 115 125 4165	114 115 125 4235	114 115 124 4305	113 115 124 4430	113 115 124 4515
	-1	114 115 124 3985	114 115 124 4055	114 115 124 4125	114 115 124 4195	114 115 124 4265	113 115 124 4395	113 115 123 4480
	0	114 115 123 3955	114 115 123 4020	114 115 123 4090	113 115 123 4160	113 115 123 4230	113 115 123 4360	113 115 122 4450
	1	113 115 122 3935	113 115 122 4000	113 115 122 4065	113 115 122 4130	113 115 122 4200	113 115 122 4335	113 115 122 4430
	2	113 115 122 3915	113 115 122 3980	113 115 121 4045	113 115 121 4110	113 115 121 4175	113 115 121 4315	113 115 121 4410
32000 V_{FTO} = 145	-2	114 115 124 4125	114 115 124 4200	114 115 124 4270	114 115 124 4345	114 115 124 4420	113 115 123 4555	113 115 123 4640
	-1	113 115 123 4090	113 115 123 4160	113 115 123 4235	113 115 123 4305	113 115 123 4380	113 115 123 4515	113 115 122 4610
	0	113 115 122 4060	113 115 122 4130	113 115 122 4205	113 115 122 4275	113 115 122 4345	113 115 122 4490	113 115 121 4585
	1	113 115 121 4040	113 115 121 4110	113 115 121 4175	113 115 121 4250	113 115 121 4320	113 115 121 4465	112 115 121 4565
	2	113 115 121 4025	113 115 120 4095	113 115 120 4160	113 115 120 4230	113 115 120 4300	112 115 120 4450	112 115 120 4555
33000 V_{FTO} = 147	-2	114 115 124 4175	113 115 123 4250	113 115 123 4325	113 115 123 4400	113 115 123 4475	113 115 123 4610	113 115 123 4705
	-1	113 115 123 4140	113 115 123 4215	113 115 122 4290	113 115 122 4360	113 115 122 4435	113 115 122 4580	113 115 122 4670
	0	113 115 122 4115	113 115 122 4185	113 115 122 4260	113 115 122 4330	113 115 122 4405	113 115 121 4550	113 115 121 4650
	1	113 115 121 4095	113 115 121 4165	113 115 121 4235	113 115 121 4305	113 115 121 4380	113 115 120 4530	112 115 120 4635
	2	113 115 120 4080	113 115 120 4150	113 115 120 4220	113 115 120 4290	113 115 120 4360	112 115 120 4520	112 115 120 4625

TODATA_350SFO_IMP_F20_WET_ECS_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–29 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
34000 V_{FTO} = 149	-2	113 115 124 4230	113 115 124 4300	113 115 124 4375	113 115 124 4455	113 115 124 4530	113 115 123 4670	113 115 123 4765
	-1	113 115 123 4195	113 115 123 4270	113 116 123 4340	113 116 123 4420	113 116 123 4490	113 116 123 4640	113 116 122 4735
	0	113 116 122 4170	113 116 122 4240	113 116 122 4315	113 116 122 4390	113 116 122 4465	113 116 122 4615	112 116 122 4715
	1	113 116 122 4150	113 116 122 4220	113 116 122 4290	113 116 122 4365	113 116 122 4440	112 116 122 4595	112 117 122 4705
	2	113 117 122 4140	113 117 122 4210	113 117 122 4280	113 117 122 4350	113 117 122 4425	112 117 122 4585	112 117 122 4700
35000 V_{FTO} = 151	-2	113 117 125 4280	113 117 125 4355	113 117 125 4430	113 117 125 4505	113 117 125 4585	113 117 125 4730	113 117 124 4825
	-1	113 117 124 4245	113 117 124 4320	113 117 124 4395	113 117 124 4470	113 117 124 4550	113 117 124 4700	112 117 124 4800
	0	113 117 124 4220	113 117 124 4295	113 117 124 4370	113 117 124 4445	113 118 124 4520	112 118 124 4675	112 118 124 4780
	1	113 118 124 4205	113 118 124 4275	113 118 124 4350	113 118 124 4425	113 118 124 4500	112 118 124 4660	112 119 124 4770
	2	113 119 124 4195	112 119 124 4265	112 119 124 4340	112 119 124 4410	112 119 124 4485	112 119 124 4655	112 120 124 4770
36000 V_{FTO} = 153	-2	113 119 126 4330	113 119 126 4405	113 119 126 4480	113 119 126 4560	113 119 126 4640	113 119 126 4790	113 119 126 4885
	-1	113 119 126 4295	113 119 126 4375	113 119 126 4450	113 119 126 4525	113 119 126 4605	113 119 125 4760	112 119 125 4865
	0	113 119 125 4275	113 119 125 4350	113 119 125 4425	113 119 125 4500	113 120 125 4580	112 120 125 4740	112 120 125 4850
	1	113 120 125 4260	113 120 125 4335	113 120 125 4410	112 120 125 4485	112 120 125 4560	112 121 125 4725	112 121 125 4840
	2	113 121 125 4310	113 121 125 4380	113 121 125 4450	113 121 125 4530	113 121 125 4605	113 121 125 4845	114 122 125 5065
38000 V_{FTO} = 157	-2	113 122 129 4425	113 122 129 4505	113 122 129 4585	113 122 129 4665	113 122 129 4745	113 122 129 4905	112 123 129 5010
	-1	113 123 129 4400	113 123 129 4480	113 123 129 4555	113 123 129 4635	113 123 129 4715	112 123 129 4880	112 123 129 4990
	0	113 123 129 4425	113 124 129 4500	113 124 129 4575	113 124 129 4650	113 124 129 4730	113 124 129 4960	114 124 129 5170
	1	116 124 129 4615	116 124 129 4695	115 124 129 4770	115 124 129 4855	115 124 129 4935	116 125 129 5190	117 125 129 5420
	2	118 125 129 4830	118 125 129 4910	118 125 129 4990	118 125 129 5075	118 125 129 5160	118 125 129 5445	119 126 129 5715

TODATA_350SFO_IMP_F20_WET_ECS_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–29 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
28000 V_{FTO} = 136	-2	114 115 126 4060	114 115 126 4130	114 115 125 4200	114 115 125 4275	114 115 125 4380	113 115 125 4520	113 115 124 4550
	-1	114 115 125 4020	114 115 125 4090	114 115 125 4160	114 115 125 4230	114 115 125 4340	113 115 124 4480	113 115 124 4510
	0	114 115 124 3985	114 115 124 4050	114 115 124 4120	114 115 124 4190	113 115 124 4300	113 115 123 4450	113 115 123 4480
	1	114 115 124 3955	114 115 123 4025	114 115 123 4090	114 115 123 4155	113 115 123 4270	113 115 122 4420	113 115 122 4455
	2	114 115 123 3935	113 115 123 4000	113 115 123 4065	113 115 123 4130	113 115 122 4245	113 115 122 4400	113 115 121 4435
30000 V_{FTO} = 140	-2	114 115 125 4170	114 115 125 4240	114 115 125 4315	114 115 124 4390	113 115 124 4505	113 115 124 4650	113 115 124 4685
	-1	114 115 124 4130	114 115 124 4200	114 115 124 4275	114 115 124 4345	113 115 124 4465	113 115 123 4615	113 115 123 4650
	0	114 115 123 4095	113 115 123 4165	113 115 123 4235	113 115 123 4310	113 115 123 4430	113 115 122 4590	113 115 122 4620
	1	113 115 122 4070	113 115 122 4140	113 115 122 4205	113 115 122 4280	113 115 122 4400	113 115 121 4565	113 115 121 4600
	2	113 115 122 4050	113 115 122 4115	113 115 121 4185	113 115 121 4255	113 115 121 4380	112 115 121 4550	112 115 120 4585
32000 V_{FTO} = 145	-2	114 115 124 4275	114 115 124 4350	114 115 124 4430	113 115 124 4505	113 115 123 4625	113 115 123 4785	113 115 123 4815
	-1	113 115 123 4240	113 115 123 4315	113 115 123 4385	113 115 123 4465	113 115 123 4590	113 115 122 4750	113 115 122 4785
	0	113 115 122 4205	113 115 122 4280	113 115 122 4355	113 115 122 4430	113 115 122 4560	113 115 121 4725	112 115 121 4760
	1	113 115 121 4180	113 115 121 4255	113 115 121 4325	113 115 121 4400	113 115 121 4530	112 115 120 4710	112 115 120 4745
	2	113 115 120 4165	113 115 120 4235	113 115 120 4305	113 115 120 4380	112 115 120 4515	112 115 120 4700	112 115 119 4740
33000 V_{FTO} = 147	-2	113 115 123 4330	113 115 123 4405	113 115 123 4485	113 115 123 4560	113 115 123 4685	113 115 122 4850	113 115 122 4885
	-1	113 115 123 4290	113 115 122 4370	113 115 122 4445	113 115 122 4520	113 115 122 4650	113 115 122 4820	113 115 121 4855
	0	113 115 122 4260	113 115 122 4335	113 115 122 4410	113 115 121 4490	113 115 121 4620	112 115 121 4795	112 115 121 4830
	1	113 115 121 4240	113 115 121 4310	113 115 121 4385	113 115 121 4460	113 115 121 4600	112 115 120 4780	112 115 120 4820
	2	113 115 120 4225	113 115 120 4295	113 115 120 4365	113 115 120 4440	112 115 120 4585	112 115 120 4775	112 116 120 4815

TODATA_350SFO_IMP_F20_WET_ECS_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–30 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
34000 V_{FTO} = 149	-2	113 115 124 4380	113 115 124 4460	113 115 124 4540	113 115 124 4615	113 115 124 4745	113 115 123 4915	113 115 123 4950
	-1	113 116 123 4345	113 116 123 4420	113 116 123 4500	113 116 123 4580	113 116 123 4710	112 116 122 4885	112 116 122 4920
	0	113 116 123 4315	113 116 123 4390	113 116 123 4470	113 116 123 4545	113 116 122 4685	112 116 122 4865	112 116 122 4900
	1	113 116 122 4295	113 116 122 4370	113 116 122 4445	113 116 122 4520	112 116 122 4665	112 117 122 4855	112 117 122 4895
	2	113 117 122 4280	113 117 122 4355	113 117 122 4430	113 117 122 4505	112 117 122 4650	112 118 122 4850	112 118 122 4890
35000 V_{FTO} = 151	-2	113 117 125 4435	113 117 125 4515	113 117 125 4590	113 117 125 4675	113 117 125 4805	113 117 124 4980	113 117 124 5015
	-1	113 117 125 4400	113 117 125 4475	113 117 124 4555	113 117 124 4635	113 117 124 4775	112 117 124 4950	112 117 124 4990
	0	113 117 124 4370	113 118 124 4450	113 118 124 4525	113 118 124 4605	113 118 124 4745	112 118 124 4935	112 118 124 4975
	1	113 118 124 4350	113 118 124 4430	113 118 124 4505	113 118 124 4585	112 118 124 4730	112 119 124 4925	112 119 124 4965
	2	112 119 124 4340	112 119 124 4415	112 119 124 4490	112 119 124 4570	112 119 124 4720	112 120 124 4945	112 120 124 5020
36000 V_{FTO} = 153	-2	113 119 126 4485	113 119 126 4565	113 119 126 4645	113 119 126 4730	113 119 126 4865	112 119 126 5040	112 119 125 5080
	-1	113 119 126 4455	113 119 126 4530	113 119 126 4610	113 119 126 4695	113 119 126 4835	112 119 125 5015	112 120 125 5055
	0	113 119 125 4425	113 119 125 4505	113 120 125 4585	113 120 125 4665	112 120 125 4810	112 120 125 5000	112 120 125 5045
	1	113 120 125 4410	113 120 125 4485	112 120 125 4565	112 120 125 4645	112 120 125 4795	112 121 125 5015	112 121 125 5090
	2	113 121 125 4440	113 121 125 4510	113 121 125 4590	113 121 125 4670	113 121 125 4875	115 122 125 5255	115 122 125 5330
38000 V_{FTO} = 157	-2	113 122 129 4590	113 122 129 4670	113 122 129 4755	113 122 129 4840	113 122 129 4980	112 123 129 5170	112 123 129 5210
	-1	113 123 129 4560	113 123 129 4640	113 123 129 4725	113 123 129 4805	112 123 129 4955	112 124 129 5150	112 124 129 5195
	0	113 124 129 4560	113 124 129 4635	113 124 129 4715	113 124 129 4800	113 124 129 5000	114 124 129 5365	115 124 129 5440
	1	115 124 129 4760	115 124 129 4840	115 124 129 4920	115 124 129 5010	115 125 129 5225	117 125 129 5625	117 125 129 5710
	2	118 125 129 4975	118 125 129 5060	118 125 129 5145	118 125 129 5235	118 125 129 5475	120 126 129 5940	120 126 129 6040

TODATA_350SFO_IMP_F20_WET_ECS_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–30 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	29	
28000 V_{FTO} = 136	-2	114 115 125 4210	114 115 125 4285	114 115 125 4360	114 115 125 4465	113 115 125 4590	113 115 124 4715	
	-1	114 115 125 4170	114 115 125 4240	114 115 125 4315	114 115 124 4420	113 115 124 4550	113 115 123 4680	
	0	114 115 124 4130	114 115 124 4200	114 115 124 4275	113 115 124 4380	113 115 123 4515	113 115 123 4650	
	1	114 115 123 4100	114 115 123 4165	114 115 123 4235	113 115 123 4345	113 115 122 4485	113 115 122 4625	
	2	113 115 123 4075	113 115 123 4145	113 115 122 4210	113 115 122 4315	113 115 122 4460	112 115 121 4605	
30000 V_{FTO} = 140	-2	114 115 125 4325	114 115 124 4405	114 115 124 4480	114 115 124 4590	113 115 124 4725	113 115 123 4860	
	-1	114 115 124 4285	114 115 124 4360	114 115 124 4435	113 115 124 4545	113 115 123 4690	113 115 122 4825	
	0	113 115 123 4245	113 115 123 4320	113 115 123 4395	113 115 123 4510	113 115 122 4655	113 115 122 4800	
	1	113 115 122 4215	113 115 122 4290	113 115 122 4365	113 115 122 4480	113 115 121 4630	112 115 121 4780	
	2	113 115 121 4195	113 115 121 4265	113 115 121 4335	113 115 121 4455	112 115 121 4610	112 115 120 4770	
32000 V_{FTO} = 145	-2	114 115 124 4440	113 115 124 4515	113 115 123 4600	113 115 123 4715	113 115 123 4860	113 115 122 5000	
	-1	113 115 123 4395	113 115 123 4475	113 115 123 4555	113 115 123 4670	113 115 122 4820	112 115 121 4970	
	0	113 115 122 4365	113 115 122 4440	113 115 122 4520	113 115 122 4640	113 115 121 4795	112 115 121 4950	
	1	113 115 121 4335	113 115 121 4410	113 115 121 4490	113 115 121 4610	112 115 120 4775	112 115 120 4935	
	2	113 115 120 4320	113 115 120 4390	113 115 120 4465	113 115 120 4590	112 115 120 4760	112 115 119 4930	
33000 V_{FTO} = 147	-2	113 115 123 4495	113 115 123 4575	113 115 123 4655	113 115 123 4775	113 115 122 4925	113 115 122 5075	
	-1	113 115 122 4455	113 115 122 4535	113 115 122 4615	113 115 122 4735	113 115 122 4890	112 115 121 5045	
	0	113 115 122 4420	113 115 122 4500	113 115 121 4580	113 115 121 4705	112 115 121 4865	112 115 120 5025	
	1	113 115 121 4395	113 115 121 4470	113 115 121 4550	113 115 121 4680	112 115 120 4845	112 115 120 5015	
	2	113 115 120 4380	113 115 120 4450	113 115 120 4530	112 115 120 4660	112 115 120 4835	112 116 120 5010	

TODATA_350SFO_IMP_F20_WET_ECS_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–31 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	29	
34000 V_{FTO} = 149	-2	113 115 124 4550	113 116 124 4630	113 116 124 4715	113 116 124 4835	113 116 123 4990	112 115 122 5140	
	-1	113 116 123 4510	113 116 123 4590	113 116 123 4670	113 116 123 4795	113 116 122 4955	112 116 122 5115	
	0	113 116 123 4480	113 116 123 4560	113 116 123 4640	113 116 122 4765	112 116 122 4935	112 116 122 5100	
	1	113 116 122 4455	113 116 122 4535	113 116 122 4615	112 116 122 4745	112 117 122 4915	112 117 122 5090	
	2	113 117 122 4440	113 117 122 4515	112 117 122 4595	112 117 122 4730	112 118 122 4910	112 118 122 5095	
35000 V_{FTO} = 151	-2	113 117 125 4605	113 117 125 4685	113 117 125 4770	113 117 125 4895	113 117 124 5055	112 117 124 5210	
	-1	113 117 125 4565	113 117 124 4650	113 117 124 4730	113 117 124 4860	112 117 124 5025	112 118 124 5185	
	0	113 118 124 4535	113 118 124 4615	113 118 124 4700	113 118 124 4830	112 118 124 5000	112 119 124 5175	
	1	113 118 124 4515	113 118 124 4595	113 118 124 4675	112 118 124 4810	112 119 124 4990	112 119 124 5170	
	2	112 119 124 4500	112 119 124 4580	112 119 124 4660	112 119 124 4800	112 120 124 4985	113 120 124 5295	
36000 V_{FTO} = 153	-2	113 119 126 4660	113 119 126 4740	113 119 126 4830	113 119 126 4955	113 119 126 5120	112 119 125 5280	
	-1	113 119 126 4620	113 119 126 4705	113 119 126 4790	113 119 126 4920	112 119 125 5090	112 120 125 5260	
	0	113 120 125 4595	113 120 125 4675	113 120 125 4760	112 120 125 4895	112 120 125 5070	112 121 125 5245	
	1	112 120 125 4575	112 120 125 4655	112 120 125 4740	112 121 125 4875	112 121 125 5060	113 121 125 5360	
	2	113 121 125 4595	113 121 125 4675	113 121 125 4760	113 121 125 4935	114 122 125 5285	116 122 125 5635	
38000 V_{FTO} = 157	-2	113 122 129 4765	113 122 129 4850	113 122 129 4940	113 122 129 5075	112 123 129 5245	112 123 129 5415	
	-1	113 123 129 4735	113 123 129 4820	113 123 129 4905	112 123 129 5045	112 124 129 5220	113 124 129 5460	
	0	113 124 129 4725	113 124 129 4805	113 124 129 4890	113 124 129 5060	114 124 129 5400	115 125 129 5725	
	1	115 124 129 4930	115 124 129 5015	115 125 129 5105	115 125 129 5290	117 125 129 5660	118 126 129 6015	
	2	118 125 129 5155	118 125 129 5240	118 125 129 5335	118 125 129 5535	119 126 129 5960	121 126 129 6385	

TODATA_350SFO_IMP_F20_WET_ECS_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–31 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA
FLAPS 20° **ALTITUDE 4000 FT**
ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	27
28000 V_{FTO} = 136	-2	114 115 125 4375	114 115 125 4450	114 115 125 4555	114 115 124 4675	113 115 124 4825	113 115 124 4895
	-1	114 115 125 4325	114 115 124 4405	114 115 124 4505	113 115 124 4630	113 115 123 4785	113 115 123 4855
	0	114 115 124 4285	114 115 124 4360	113 115 124 4465	113 115 123 4595	113 115 122 4755	113 115 122 4825
	1	114 115 123 4250	113 115 123 4325	113 115 123 4430	113 115 122 4560	113 115 122 4725	112 115 121 4800
	2	113 115 122 4225	113 115 122 4295	113 115 122 4400	113 115 122 4535	112 115 121 4705	112 115 121 4785
30000 V_{FTO} = 140	-2	114 115 124 4495	114 115 124 4575	114 115 124 4680	113 115 124 4815	113 115 123 4970	113 115 123 5045
	-1	114 115 124 4450	113 115 124 4530	113 115 123 4635	113 115 123 4770	113 115 122 4935	113 115 122 5010
	0	113 115 123 4410	113 115 123 4490	113 115 123 4595	113 115 122 4735	113 115 121 4905	112 115 121 4985
	1	113 115 122 4375	113 115 122 4455	113 115 122 4565	113 115 121 4710	112 115 121 4885	112 115 120 4965
	2	113 115 121 4350	113 115 121 4425	113 115 121 4540	113 115 121 4685	112 115 120 4870	112 115 120 4955
32000 V_{FTO} = 145	-2	113 115 123 4610	113 115 123 4695	113 115 123 4805	113 115 123 4945	113 115 122 5120	113 115 122 5195
	-1	113 115 123 4570	113 115 123 4650	113 115 123 4765	113 115 122 4910	112 115 121 5085	112 115 121 5165
	0	113 115 122 4530	113 115 122 4615	113 115 122 4730	113 115 121 4875	112 115 121 5060	112 115 120 5145
	1	113 115 121 4505	113 115 121 4585	113 115 121 4700	112 115 120 4850	112 115 120 5045	112 115 119 5130
	2	113 115 120 4480	113 115 120 4560	113 115 120 4680	112 115 120 4835	112 115 119 5040	112 115 119 5130
33000 V_{FTO} = 147	-2	113 115 123 4670	113 115 123 4755	113 115 123 4870	113 115 122 5015	113 115 122 5190	112 115 121 5270
	-1	113 115 122 4630	113 115 122 4710	113 115 122 4830	113 115 121 4975	112 115 121 5160	112 115 121 5240
	0	113 115 121 4595	113 115 121 4675	113 115 121 4795	113 115 121 4945	112 115 120 5135	112 115 120 5225
	1	113 115 121 4565	113 115 121 4650	113 115 120 4765	112 115 120 4925	112 115 120 5125	112 115 120 5215
	2	113 115 120 4545	113 115 120 4625	112 115 120 4750	112 115 120 4910	112 116 120 5120	112 116 120 5215

TODATA_350SFO_IMP_F20_WET_ECS_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–32 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	27	
34000 V_{FTO} = 149	-2	113 116 124 4730	113 116 124 4815	113 116 124 4930	113 116 123 5080	112 115 122 5260	112 115 122 5340	
	-1	113 116 123 4685	113 116 123 4770	113 116 123 4890	113 116 122 5045	112 116 122 5230	112 116 122 5320	
	0	113 116 122 4655	113 116 122 4740	113 116 122 4860	112 116 122 5015	112 117 122 5215	112 117 122 5300	
	1	113 116 122 4630	113 116 122 4710	112 116 122 4835	112 117 122 5000	112 117 122 5205	112 118 122 5300	
	2	112 117 122 4610	112 117 122 4695	112 117 122 4820	112 118 122 4990	112 118 122 5205	112 118 122 5305	
35000 V_{FTO} = 151	-2	113 117 125 4785	113 117 125 4875	113 117 125 4995	113 117 124 5145	112 117 124 5330	112 117 124 5415	
	-1	113 117 124 4745	113 118 124 4830	113 118 124 4955	112 117 124 5110	112 118 124 5305	112 118 124 5390	
	0	113 118 124 4715	113 118 124 4800	113 118 124 4925	112 118 124 5085	112 119 124 5290	112 119 124 5380	
	1	113 118 124 4690	112 118 124 4775	112 118 124 4900	112 119 124 5070	112 119 124 5285	112 120 124 5380	
	2	112 119 124 4675	112 119 124 4760	112 119 124 4890	112 120 124 5065	113 120 124 5415	114 120 124 5590	
36000 V_{FTO} = 153	-2	113 119 126 4845	113 119 126 4930	113 119 126 5055	113 119 126 5210	112 119 126 5400	112 120 126 5490	
	-1	113 119 126 4805	113 119 126 4895	113 119 126 5015	112 120 126 5180	112 120 126 5375	112 120 126 5470	
	0	113 120 126 4775	113 120 126 4865	112 120 126 4990	112 120 126 5155	112 121 126 5365	112 121 126 5460	
	1	112 120 126 4755	112 121 126 4840	112 121 126 4970	112 121 126 5145	113 122 126 5485	114 122 126 5660	
	2	113 121 126 4785	113 121 126 4870	113 121 126 5020	114 122 126 5345	116 122 126 5765	116 123 126 5970	
38000 V_{FTO} = 157	-2	113 122 129 4955	113 122 129 5045	113 122 129 5175	112 123 129 5340	112 123 129 5540	112 124 129 5630	
	-1	113 123 129 4920	113 123 129 5010	112 123 129 5140	112 124 129 5310	113 124 129 5590	113 124 129 5755	
	0	113 124 129 4915	113 124 129 5005	113 124 129 5155	114 124 129 5465	115 125 129 5860	116 125 129 6040	
	1	115 125 129 5130	115 125 129 5220	115 125 129 5380	116 125 129 5720	118 126 129 6155	119 126 129 6370	
	2	118 125 129 5360	118 125 129 5460	118 125 129 5635	119 126 129 6025	121 126 129 6530	121 127 129 6760	

TODATA_350SFO_IMP_F20_WET_ECS_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–32 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	115 115 126 3525	115 115 126 3590	114 115 126 3655	114 115 126 3720	114 115 126 3785	114 115 126 3850
	-1	114 115 126 3500	114 115 126 3560	114 115 125 3625	114 115 125 3685	114 115 125 3750	114 115 125 3815
	0	114 115 125 3475	114 115 125 3535	114 115 125 3600	114 115 125 3660	114 115 124 3725	114 115 124 3785
	1	114 115 124 3455	114 115 124 3515	114 115 124 3575	114 115 124 3640	114 115 124 3700	114 115 124 3760
	2	114 115 123 3435	114 115 123 3495	114 115 123 3560	114 115 123 3620	114 115 123 3680	114 115 123 3745
30000 V_{FTO} = 140	-2	114 115 125 3615	114 115 125 3680	114 115 125 3750	114 115 125 3815	114 115 125 3885	114 115 125 3955
	-1	114 115 125 3590	114 115 125 3655	114 115 124 3720	114 115 124 3785	114 115 124 3850	114 115 124 3920
	0	114 115 124 3565	114 115 124 3630	114 115 124 3695	114 115 123 3760	114 115 123 3825	114 115 123 3890
	1	114 115 123 3545	114 115 123 3610	114 115 123 3675	113 115 123 3740	113 115 123 3805	113 115 122 3870
	2	113 115 122 3530	113 115 122 3595	113 115 122 3660	113 115 122 3725	113 115 122 3790	113 115 122 3850
32000 V_{FTO} = 145	-2	114 115 124 3700	114 115 124 3770	114 115 124 3840	114 115 124 3915	114 115 124 3985	114 115 124 4055
	-1	114 115 124 3680	114 115 124 3745	114 115 123 3815	114 115 123 3880	114 115 123 3950	113 115 123 4020
	0	113 115 123 3660	113 115 123 3725	113 115 122 3790	113 115 122 3860	113 115 122 3925	113 115 122 3995
	1	113 115 122 3640	113 115 122 3710	113 115 122 3775	113 115 122 3840	113 115 121 3905	113 115 121 3975
	2	113 115 121 3630	113 115 121 3695	113 115 121 3760	113 115 121 3830	113 115 121 3895	113 115 120 3960
33000 V_{FTO} = 147	-2	114 115 124 3745	114 115 124 3815	114 115 124 3890	114 115 124 3960	114 115 124 4030	114 115 123 4105
	-1	114 115 123 3720	113 115 123 3790	113 115 123 3860	113 115 123 3930	113 115 123 4000	113 115 123 4075
	0	113 115 122 3705	113 115 122 3770	113 115 122 3840	113 115 122 3910	113 115 122 3975	113 115 122 4045
	1	113 115 121 3690	113 115 121 3755	113 115 121 3825	113 115 121 3890	113 115 121 3960	113 115 121 4030
	2	113 115 120 3680	113 115 120 3745	113 115 120 3815	113 115 120 3880	113 115 120 3950	113 115 120 4015

TODATA_350SFO_IMP_F20_WET_ALL_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–33 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3790	114 115 124 3865	114 115 124 3935	113 115 124 4010	113 115 124 4080	113 115 124 4155
	-1	113 115 123 3765	113 115 123 3835	113 115 123 3905	113 115 123 3980	113 115 123 4050	113 115 123 4125
	0	113 115 123 3750	113 115 122 3820	113 115 122 3885	113 115 122 3955	113 116 122 4025	113 116 122 4100
	1	113 116 122 3735	113 116 122 3805	113 116 122 3875	113 116 122 3940	113 116 122 4010	113 116 122 4080
	2	113 116 122 3730	113 116 122 3795	113 117 122 3865	113 117 122 3935	113 117 122 4005	113 117 122 4070
35000 V_{FTO} = 151	-2	113 117 125 3835	113 117 125 3910	113 117 125 3980	113 117 125 4055	113 117 125 4130	113 117 125 4205
	-1	113 117 124 3810	113 117 124 3880	113 117 124 3955	113 117 124 4025	113 117 124 4100	113 117 124 4175
	0	113 117 124 3795	113 117 124 3865	113 117 124 3935	113 117 124 4005	113 117 124 4080	113 117 124 4150
	1	113 118 124 3785	113 118 124 3855	113 118 124 3925	113 118 124 3995	113 118 124 4065	113 118 124 4135
	2	113 119 124 3780	113 119 124 3850	113 119 124 3920	113 119 124 3990	113 119 124 4055	113 119 124 4130
36000 V_{FTO} = 153	-2	113 118 126 3875	113 118 126 3955	113 118 126 4030	113 118 126 4100	113 118 126 4180	113 119 126 4255
	-1	113 118 126 3855	113 119 126 3930	113 119 126 4000	113 119 126 4075	113 119 126 4150	113 119 126 4225
	0	113 119 125 3840	113 119 125 3910	113 119 125 3985	113 119 125 4055	113 119 125 4130	113 119 125 4205
	1	113 120 125 3830	113 120 125 3905	113 120 125 3975	113 120 125 4045	113 120 125 4115	113 120 125 4190
	2	114 121 125 3890	114 121 125 3965	114 121 125 4040	114 121 125 4110	114 121 125 4185	113 121 125 4260
38000 V_{FTO} = 157	-2	113 122 129 3965	113 122 129 4040	113 122 129 4120	113 122 129 4195	113 122 129 4275	113 122 129 4350
	-1	113 122 129 3945	113 122 129 4020	113 122 129 4095	113 123 129 4170	113 123 129 4250	113 123 129 4325
	0	114 123 129 3985	114 123 129 4065	114 123 129 4140	113 123 129 4215	113 123 129 4295	113 124 129 4375
	1	116 124 129 4160	116 124 129 4240	116 124 129 4320	116 124 129 4400	116 124 129 4485	116 124 129 4565
	2	119 125 129 4350	119 125 129 4440	118 125 129 4525	118 125 129 4605	118 125 129 4695	118 125 129 4780

TODATA_350SFO_IMP_F20_WET_ALL_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–33 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	115 115 126 3590	114 115 126 3650	114 115 126 3715	114 115 126 3785	114 115 126 3855	114 115 126 3920
	-1	114 115 126 3560	114 115 125 3625	114 115 125 3685	114 115 125 3750	114 115 125 3815	114 115 125 3880
	0	114 115 125 3535	114 115 125 3600	114 115 125 3660	114 115 124 3725	114 115 124 3790	114 115 124 3850
	1	114 115 124 3510	114 115 124 3575	114 115 124 3640	114 115 124 3700	114 115 124 3765	114 115 124 3825
	2	114 115 123 3495	114 115 123 3555	114 115 123 3620	114 115 123 3680	114 115 123 3745	114 115 123 3805
30000 V_{FTO} = 140	-2	114 115 125 3675	114 115 125 3745	114 115 125 3815	114 115 125 3885	114 115 125 3955	114 115 125 4025
	-1	114 115 125 3650	114 115 124 3720	114 115 124 3780	114 115 124 3850	114 115 124 3920	114 115 124 3990
	0	114 115 124 3630	114 115 124 3695	114 115 124 3760	114 115 123 3825	114 115 123 3890	114 115 123 3955
	1	114 115 123 3610	114 115 123 3675	113 115 123 3740	113 115 123 3805	113 115 122 3870	113 115 122 3935
	2	113 115 122 3595	113 115 122 3655	113 115 122 3720	113 115 122 3785	113 115 122 3855	113 115 122 3915
32000 V_{FTO} = 145	-2	114 115 124 3765	114 115 124 3840	114 115 124 3910	114 115 124 3985	114 115 124 4055	114 115 124 4130
	-1	114 115 124 3740	114 115 123 3810	114 115 123 3880	114 115 123 3950	113 115 123 4020	113 115 123 4095
	0	113 115 123 3720	113 115 123 3790	113 115 122 3855	113 115 122 3925	113 115 122 3995	113 115 122 4065
	1	113 115 122 3705	113 115 122 3775	113 115 122 3840	113 115 121 3905	113 115 121 3975	113 115 121 4045
	2	113 115 121 3695	113 115 121 3760	113 115 121 3825	113 115 121 3895	113 115 121 3960	113 115 120 4030
33000 V_{FTO} = 147	-2	114 115 124 3815	114 115 124 3885	114 115 124 3960	114 115 124 4030	114 115 124 4105	113 115 123 4180
	-1	114 115 123 3790	113 115 123 3855	113 115 123 3930	113 115 123 4000	113 115 123 4075	113 115 123 4145
	0	113 115 122 3765	113 115 122 3835	113 115 122 3905	113 115 122 3975	113 115 122 4045	113 115 122 4115
	1	113 115 121 3755	113 115 121 3825	113 115 121 3890	113 115 121 3960	113 115 121 4030	113 115 121 4095
	2	113 115 120 3740	113 115 120 3810	113 115 120 3880	113 115 120 3950	113 115 120 4015	113 115 120 4085

TODATA_350SFO_IMP_F20_WET_ALL_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–34 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3860	114 115 124 3930	113 115 124 4005	113 115 124 4080	113 115 124 4155	113 115 124 4230
	-1	113 115 123 3835	113 115 123 3905	113 115 123 3975	113 115 123 4050	113 115 123 4125	113 115 123 4195
	0	113 115 123 3815	113 115 122 3885	113 115 122 3955	113 116 122 4025	113 116 122 4100	113 116 122 4170
	1	113 116 122 3800	113 116 122 3870	113 116 122 3940	113 116 122 4010	113 116 122 4080	113 116 122 4150
	2	113 116 122 3790	113 117 122 3860	113 117 122 3935	113 117 122 4005	113 117 122 4070	113 117 122 4140
35000 V_{FTO} = 151	-2	113 117 125 3905	113 117 125 3980	113 117 125 4055	113 117 125 4130	113 117 125 4205	113 117 125 4280
	-1	113 117 124 3875	113 117 124 3950	113 117 124 4025	113 117 124 4100	113 117 124 4175	113 117 124 4250
	0	113 117 124 3860	113 117 124 3935	113 117 124 4005	113 117 124 4075	113 117 124 4150	113 117 124 4225
	1	113 118 124 3850	113 118 124 3920	113 118 124 3990	113 118 124 4065	113 118 124 4135	113 118 124 4210
	2	113 119 124 3840	113 119 124 3915	113 119 124 3985	113 119 124 4055	113 119 124 4130	112 119 124 4200
36000 V_{FTO} = 153	-2	113 118 126 3945	113 118 126 4025	113 118 126 4100	113 118 126 4175	113 119 126 4255	113 119 126 4330
	-1	113 119 126 3920	113 119 126 3995	113 119 126 4075	113 119 126 4150	113 119 126 4225	113 119 126 4300
	0	113 119 125 3905	113 119 125 3980	113 119 125 4055	113 119 125 4130	113 119 125 4205	113 119 125 4280
	1	113 120 125 3900	113 120 125 3970	113 120 125 4045	113 120 125 4115	113 120 125 4190	113 120 125 4265
	2	113 121 125 3955	113 121 125 4030	113 121 125 4105	113 121 125 4180	113 121 125 4255	113 121 125 4330
38000 V_{FTO} = 157	-2	113 122 129 4035	113 122 129 4115	113 122 129 4195	113 122 129 4270	113 122 129 4350	113 122 129 4430
	-1	113 122 129 4015	113 122 129 4090	113 123 129 4170	113 123 129 4250	113 123 129 4325	113 123 129 4405
	0	113 123 129 4050	113 123 129 4130	113 123 129 4210	113 123 129 4285	113 123 129 4365	113 124 129 4445
	1	116 124 129 4230	116 124 129 4310	116 124 129 4395	116 124 129 4475	116 124 129 4555	116 124 129 4635
	2	118 125 129 4425	118 125 129 4510	118 125 129 4595	118 125 129 4685	118 125 129 4765	118 125 129 4850

TODATA_350SFO_IMP_F20_WET_ALL_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–34 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3650	114 115 126 3715	114 115 126 3785	114 115 126 3850	114 115 126 3920	114 115 126 3990
	-1	114 115 126 3620	114 115 125 3685	114 115 125 3750	114 115 125 3815	114 115 125 3880	114 115 125 3950
	0	114 115 125 3595	114 115 125 3660	114 115 125 3725	114 115 124 3790	114 115 124 3850	114 115 124 3915
	1	114 115 124 3570	114 115 124 3635	114 115 124 3700	114 115 124 3760	114 115 124 3825	114 115 124 3890
	2	114 115 123 3555	114 115 123 3615	114 115 123 3680	114 115 123 3745	114 115 123 3805	113 115 123 3870
30000 V_{FTO} = 140	-2	114 115 125 3740	114 115 125 3810	114 115 125 3885	114 115 125 3955	114 115 125 4025	114 115 125 4095
	-1	114 115 124 3715	114 115 124 3780	114 115 124 3850	114 115 124 3915	114 115 124 3990	114 115 124 4060
	0	114 115 124 3690	114 115 124 3755	114 115 123 3825	114 115 123 3890	114 115 123 3955	114 115 123 4025
	1	114 115 123 3670	114 115 123 3735	113 115 123 3800	113 115 123 3870	113 115 122 3935	113 115 122 4000
	2	113 115 122 3650	113 115 122 3720	113 115 122 3785	113 115 122 3850	113 115 122 3915	113 115 122 3985
32000 V_{FTO} = 145	-2	114 115 124 3835	114 115 124 3910	114 115 124 3980	114 115 124 4055	114 115 124 4130	114 115 124 4200
	-1	114 115 123 3805	114 115 123 3875	114 115 123 3945	113 115 123 4020	113 115 123 4095	113 115 123 4165
	0	113 115 123 3785	113 115 122 3855	113 115 122 3920	113 115 122 3990	113 115 122 4065	113 115 122 4135
	1	113 115 122 3770	113 115 122 3835	113 115 122 3905	113 115 121 3975	113 115 121 4040	113 115 121 4110
	2	113 115 121 3755	113 115 121 3825	113 115 121 3890	113 115 121 3960	113 115 120 4030	113 115 120 4095
33000 V_{FTO} = 147	-2	114 115 124 3880	114 115 124 3955	114 115 124 4030	114 115 124 4105	114 115 123 4180	113 115 123 4255
	-1	113 115 123 3850	113 115 123 3925	113 115 123 3995	113 115 123 4070	113 115 123 4145	113 115 123 4215
	0	113 115 122 3835	113 115 122 3905	113 115 122 3970	113 115 122 4045	113 115 122 4115	113 115 122 4190
	1	113 115 121 3820	113 115 121 3885	113 115 121 3955	113 115 121 4025	113 115 121 4095	113 115 121 4165
	2	113 115 120 3805	113 115 120 3875	113 115 120 3945	113 115 120 4015	113 115 120 4085	113 115 120 4155

TODATA_350SFO_IMP_F20_WET_ALL_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–35 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3925	114 115 124 4005	113 115 124 4075	113 115 124 4155	113 115 124 4230	113 115 124 4305
	-1	113 115 123 3900	113 115 123 3970	113 115 123 4045	113 115 123 4120	113 115 123 4195	113 115 123 4270
	0	113 115 123 3880	113 115 123 3950	113 116 122 4025	113 116 122 4095	113 116 122 4170	113 116 122 4245
	1	113 116 122 3865	113 116 122 3935	113 116 122 4010	113 116 122 4080	113 116 122 4150	113 116 122 4220
	2	113 116 122 3855	113 117 122 3930	113 117 122 4000	113 117 122 4070	113 117 122 4140	113 117 122 4210
35000 V_{FTO} = 151	-2	113 117 125 3975	113 117 125 4050	113 117 125 4125	113 117 125 4205	113 117 125 4280	113 117 125 4355
	-1	113 117 125 3945	113 117 124 4020	113 117 124 4095	113 117 124 4170	113 117 124 4250	113 117 124 4325
	0	113 117 124 3930	113 117 124 4000	113 117 124 4075	113 117 124 4150	113 117 124 4225	113 117 124 4300
	1	113 118 124 3915	113 118 124 3990	113 118 124 4060	113 118 124 4135	113 118 124 4205	113 118 124 4280
	2	113 119 124 3910	113 119 124 3980	113 119 124 4050	113 119 124 4125	112 119 124 4200	112 119 124 4270
36000 V_{FTO} = 153	-2	113 118 126 4020	113 118 126 4095	113 118 126 4175	113 119 126 4250	113 119 126 4330	113 119 126 4405
	-1	113 119 126 3990	113 119 126 4070	113 119 126 4145	113 119 126 4225	113 119 126 4300	113 119 126 4375
	0	113 119 125 3975	113 119 125 4050	113 119 125 4125	113 119 125 4200	113 119 125 4275	113 119 125 4355
	1	113 120 125 3965	113 120 125 4040	113 120 125 4115	113 120 125 4185	113 120 125 4260	113 120 125 4335
	2	113 121 125 4015	113 121 125 4090	113 121 125 4165	113 121 125 4240	113 121 125 4320	113 121 125 4395
38000 V_{FTO} = 157	-2	113 122 129 4110	113 122 129 4190	113 122 129 4270	113 122 129 4350	113 122 129 4430	113 122 129 4510
	-1	113 122 129 4085	113 122 129 4165	113 123 129 4245	113 123 129 4320	113 123 129 4400	113 123 129 4480
	0	113 123 129 4115	113 123 129 4195	113 123 129 4275	113 123 129 4355	113 124 129 4435	113 124 129 4510
	1	116 124 129 4295	116 124 129 4380	116 124 129 4460	116 124 129 4545	116 124 129 4625	116 124 129 4705
	2	118 125 129 4495	118 125 129 4580	118 125 129 4665	118 125 129 4755	118 125 129 4840	118 125 129 4925

TODATA_350SFO_IMP_F20_WET_ALL_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–35 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3780	114 115 126 3850	114 115 126 3920	114 115 126 3990	114 115 126 4060	114 115 125 4145
	-1	114 115 125 3745	114 115 125 3815	114 115 125 3880	114 115 125 3950	114 115 125 4020	114 115 125 4100
	0	114 115 125 3720	114 115 125 3785	114 115 124 3850	114 115 124 3920	114 115 124 3985	114 115 124 4065
	1	114 115 124 3695	114 115 124 3760	114 115 124 3825	114 115 124 3895	114 115 124 3960	114 115 123 4035
	2	114 115 123 3675	114 115 123 3740	114 115 123 3805	114 115 123 3870	113 115 123 3935	113 115 122 4015
30000 V_{FTO} = 140	-2	114 115 125 3875	114 115 125 3950	114 115 125 4025	114 115 125 4095	114 115 125 4170	114 115 124 4255
	-1	114 115 124 3845	114 115 124 3915	114 115 124 3985	114 115 124 4055	114 115 124 4130	114 115 124 4215
	0	114 115 124 3820	114 115 123 3885	114 115 123 3955	114 115 123 4025	114 115 123 4095	113 115 123 4180
	1	114 115 123 3795	113 115 123 3865	113 115 123 3935	113 115 122 4000	113 115 122 4070	113 115 122 4150
	2	113 115 122 3780	113 115 122 3850	113 115 122 3915	113 115 122 3985	113 115 122 4055	113 115 121 4130
32000 V_{FTO} = 145	-2	114 115 124 3975	114 115 124 4050	114 115 124 4125	114 115 124 4200	114 115 124 4280	113 115 124 4365
	-1	114 115 123 3940	114 115 123 4015	113 115 123 4090	113 115 123 4165	113 115 123 4240	113 115 123 4330
	0	113 115 123 3920	113 115 122 3990	113 115 122 4060	113 115 122 4135	113 115 122 4210	113 115 122 4295
	1	113 115 122 3900	113 115 122 3970	113 115 121 4040	113 115 121 4110	113 115 121 4185	113 115 121 4270
	2	113 115 121 3885	113 115 121 3955	113 115 121 4025	113 115 121 4100	113 115 120 4165	113 115 120 4255
33000 V_{FTO} = 147	-2	114 115 124 4020	114 115 124 4100	114 115 124 4175	113 115 123 4255	113 115 123 4330	113 115 123 4420
	-1	113 115 123 3990	113 115 123 4065	113 115 123 4140	113 115 123 4220	113 115 123 4295	113 115 122 4385
	0	113 115 122 3965	113 115 122 4040	113 115 122 4115	113 115 122 4190	113 115 122 4265	113 115 121 4355
	1	113 115 121 3950	113 115 121 4025	113 115 121 4095	113 115 121 4165	113 115 121 4240	113 115 121 4330
	2	113 115 120 3940	113 115 120 4010	113 115 120 4080	113 115 120 4155	113 115 120 4225	113 115 120 4315

TODATA_350SFO_IMP_F20_WET_ALL_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–36 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 4070	113 115 124 4150	113 115 124 4225	113 115 124 4305	113 115 124 4385	113 115 124 4475
	-1	113 115 123 4040	113 115 123 4115	113 115 123 4195	113 115 123 4270	113 116 123 4350	113 116 123 4440
	0	113 116 123 4015	113 116 123 4090	113 116 123 4165	113 116 123 4245	113 116 123 4320	113 116 122 4410
	1	113 116 122 4000	113 116 122 4075	113 116 122 4150	113 116 122 4225	113 116 122 4295	113 116 122 4390
	2	113 117 122 3990	113 117 122 4065	113 117 122 4140	113 117 122 4210	113 117 122 4285	113 117 122 4375
35000 V_{FTO} = 151	-2	113 117 125 4120	113 117 125 4195	113 117 125 4275	113 117 125 4355	113 117 125 4435	113 117 125 4530
	-1	113 117 125 4090	113 117 125 4165	113 117 125 4245	113 117 124 4325	113 117 124 4400	113 117 124 4495
	0	113 117 124 4065	113 117 124 4140	113 117 124 4220	113 117 124 4295	113 117 124 4375	113 117 124 4470
	1	113 118 124 4055	113 118 124 4125	113 118 124 4205	113 118 124 4280	113 118 124 4355	113 118 124 4450
	2	113 119 124 4045	113 119 124 4120	113 119 124 4195	112 119 124 4270	112 119 124 4345	112 119 124 4435
36000 V_{FTO} = 153	-2	113 118 127 4165	113 119 127 4245	113 119 126 4325	113 119 126 4405	113 119 126 4490	113 119 126 4585
	-1	113 119 126 4135	113 119 126 4215	113 119 126 4295	113 119 126 4375	113 119 126 4455	113 119 126 4550
	0	113 119 125 4115	113 119 125 4195	113 119 125 4270	113 119 125 4350	113 119 125 4430	113 120 125 4525
	1	113 120 125 4105	113 120 125 4180	113 120 125 4255	113 120 125 4335	113 120 125 4410	112 120 125 4510
	2	113 121 125 4140	113 121 125 4220	113 121 125 4295	113 121 125 4370	113 121 125 4450	113 121 125 4580
38000 V_{FTO} = 157	-2	113 122 129 4260	113 122 129 4340	113 122 129 4425	113 122 129 4510	113 122 129 4590	113 122 129 4690
	-1	113 122 129 4235	113 123 129 4315	113 123 129 4395	113 123 129 4480	113 123 129 4560	113 123 129 4660
	0	113 123 129 4250	113 123 129 4330	113 123 129 4410	113 124 129 4490	113 124 129 4570	113 124 129 4700
	1	116 124 129 4435	116 124 129 4520	115 124 129 4600	115 124 129 4685	115 124 129 4770	116 125 129 4905
	2	118 125 129 4635	118 125 129 4725	118 125 129 4810	118 125 129 4900	118 125 129 4990	118 125 129 5135

TODATA_350SFO_IMP_F20_WET_ALL_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–36 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3915	114 115 126 3990	114 115 126 4065	114 115 126 4140	114 115 125 4220	114 115 125 4340
	-1	114 115 125 3885	114 115 125 3950	114 115 125 4025	114 115 125 4095	114 115 125 4175	114 115 124 4300
	0	114 115 124 3855	114 115 124 3920	114 115 124 3990	114 115 124 4060	114 115 124 4135	113 115 123 4260
	1	114 115 124 3830	114 115 124 3895	114 115 124 3965	114 115 123 4035	114 115 123 4110	113 115 122 4235
	2	114 115 123 3805	114 115 123 3875	113 115 123 3940	113 115 123 4010	113 115 122 4085	113 115 122 4210
30000 V_{FTO} = 140	-2	114 115 125 4020	114 115 125 4100	114 115 125 4175	114 115 125 4250	114 115 124 4335	113 115 124 4465
	-1	114 115 124 3985	114 115 124 4060	114 115 124 4135	114 115 124 4210	114 115 124 4290	113 115 123 4425
	0	114 115 123 3960	114 115 123 4030	114 115 123 4100	113 115 123 4175	113 115 123 4255	113 115 122 4390
	1	113 115 123 3935	113 115 122 4005	113 115 122 4075	113 115 122 4150	113 115 122 4225	113 115 121 4365
	2	113 115 122 3915	113 115 122 3985	113 115 122 4060	113 115 121 4130	113 115 121 4205	113 115 121 4345
32000 V_{FTO} = 145	-2	114 115 124 4125	114 115 124 4205	114 115 124 4280	114 115 124 4360	113 115 124 4445	113 115 123 4585
	-1	113 115 123 4090	113 115 123 4165	113 115 123 4245	113 115 123 4320	113 115 123 4405	113 115 122 4545
	0	113 115 122 4060	113 115 122 4135	113 115 122 4210	113 115 122 4290	113 115 122 4375	113 115 121 4520
	1	113 115 121 4040	113 115 121 4115	113 115 121 4190	113 115 121 4260	113 115 121 4345	113 115 120 4495
	2	113 115 121 4025	113 115 121 4100	113 115 120 4175	113 115 120 4245	113 115 120 4330	112 115 120 4480
33000 V_{FTO} = 147	-2	114 115 124 4175	113 115 123 4255	113 115 123 4335	113 115 123 4415	113 115 123 4505	113 115 122 4645
	-1	113 115 123 4140	113 115 123 4220	113 115 123 4300	113 115 122 4375	113 115 122 4465	113 115 122 4610
	0	113 115 122 4115	113 115 122 4190	113 115 122 4265	113 115 122 4345	113 115 121 4430	113 115 121 4580
	1	113 115 121 4095	113 115 121 4170	113 115 121 4245	113 115 121 4320	113 115 121 4405	113 115 120 4560
	2	113 115 120 4080	113 115 120 4155	113 115 120 4230	113 115 120 4305	113 115 120 4390	112 115 120 4550

TODATA_350SFO_IMP_F20_WET_ALL_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–37 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 4225	113 115 124 4305	113 115 124 4390	113 115 124 4470	113 115 124 4560	113 115 123 4700
	-1	113 115 123 4190	113 115 123 4270	113 116 123 4350	113 116 123 4430	113 116 123 4520	113 116 122 4670
	0	113 116 123 4165	113 116 123 4245	113 116 123 4320	113 116 123 4400	113 116 122 4490	113 116 122 4645
	1	113 116 122 4150	113 116 122 4225	113 116 122 4300	113 116 122 4380	113 116 122 4465	112 117 122 4625
	2	113 117 122 4140	113 117 122 4215	113 117 122 4290	113 117 122 4365	112 117 122 4450	112 118 122 4615
35000 V_{FTO} = 151	-2	113 117 125 4275	113 117 125 4355	113 117 125 4440	113 117 125 4525	113 117 125 4615	113 117 124 4760
	-1	113 117 125 4240	113 117 125 4325	113 117 124 4405	113 117 124 4485	113 117 124 4575	113 117 124 4730
	0	113 117 124 4220	113 117 124 4300	113 117 124 4380	113 118 124 4460	113 118 124 4550	112 118 124 4705
	1	113 118 124 4200	113 118 124 4280	113 118 124 4360	113 118 124 4440	113 118 124 4525	112 119 124 4690
	2	113 119 124 4195	112 119 124 4270	112 119 124 4350	112 119 124 4425	112 119 124 4515	112 120 124 4685
36000 V_{FTO} = 153	-2	113 119 127 4325	113 119 126 4410	113 119 126 4490	113 119 126 4575	113 119 126 4670	113 119 126 4820
	-1	113 119 126 4295	113 119 126 4375	113 119 126 4460	113 119 126 4540	113 119 126 4635	113 119 125 4790
	0	113 119 125 4270	113 119 125 4350	113 119 125 4435	113 119 125 4515	113 120 125 4605	112 120 125 4770
	1	113 120 125 4255	113 120 125 4335	113 120 125 4415	113 120 125 4495	112 120 125 4590	112 121 125 4755
	2	113 121 125 4290	113 121 125 4370	113 121 125 4450	113 121 125 4530	113 121 125 4635	115 122 125 4975
38000 V_{FTO} = 157	-2	113 122 129 4420	113 122 129 4510	113 122 129 4595	113 122 129 4680	113 122 129 4775	113 123 129 4935
	-1	113 123 129 4395	113 123 129 4480	113 123 129 4565	113 123 129 4650	113 123 129 4745	112 124 129 4910
	0	113 123 129 4405	113 124 129 4490	113 124 129 4570	113 124 129 4655	113 124 129 4760	114 124 129 5090
	1	115 124 129 4595	115 124 129 4685	115 124 129 4770	115 124 129 4855	115 125 129 4970	117 125 129 5325
	2	118 125 129 4805	118 125 129 4900	118 125 129 4990	118 125 129 5080	118 125 129 5200	120 126 129 5615

TODATA_350SFO_IMP_F20_WET_ALL_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–37 (Sheet 2 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 4070	114 115 126 4145	114 115 125 4220	114 115 125 4300	114 115 125 4420	113 115 124 4560
	-1	114 115 125 4025	114 115 125 4100	114 115 125 4180	114 115 125 4255	114 115 124 4380	113 115 123 4520
	0	114 115 124 3995	114 115 124 4065	114 115 124 4140	114 115 124 4215	113 115 123 4340	113 115 122 4485
	1	114 115 123 3970	114 115 123 4040	114 115 123 4110	114 115 123 4185	113 115 122 4310	113 115 122 4460
	2	113 115 123 3945	113 115 123 4015	113 115 122 4085	113 115 122 4160	113 115 122 4285	113 115 121 4440
30000 V_{FTO} = 140	-2	114 115 125 4175	114 115 125 4255	114 115 124 4335	114 115 124 4420	113 115 124 4545	113 115 123 4695
	-1	114 115 124 4135	114 115 124 4215	114 115 124 4295	114 115 124 4375	113 115 123 4505	113 115 122 4655
	0	114 115 123 4105	113 115 123 4180	113 115 123 4255	113 115 123 4335	113 115 122 4475	113 115 121 4630
	1	113 115 122 4080	113 115 122 4155	113 115 122 4230	113 115 122 4305	113 115 121 4445	113 115 121 4605
	2	113 115 122 4060	113 115 121 4135	113 115 121 4210	113 115 121 4285	113 115 121 4425	112 115 120 4590
32000 V_{FTO} = 145	-2	114 115 124 4285	114 115 124 4365	113 115 124 4450	113 115 124 4535	113 115 123 4670	113 115 122 4825
	-1	113 115 123 4245	113 115 123 4330	113 115 123 4410	113 115 123 4490	113 115 122 4635	113 115 121 4795
	0	113 115 122 4215	113 115 122 4295	113 115 122 4375	113 115 122 4455	113 115 121 4600	113 115 120 4770
	1	113 115 121 4195	113 115 121 4270	113 115 121 4345	113 115 121 4430	113 115 120 4580	112 115 120 4750
	2	113 115 120 4175	113 115 120 4255	113 115 120 4330	113 115 120 4410	112 115 120 4560	112 115 119 4740
33000 V_{FTO} = 147	-2	113 115 123 4335	113 115 123 4420	113 115 123 4505	113 115 123 4590	113 115 122 4730	113 115 122 4895
	-1	113 115 123 4300	113 115 122 4380	113 115 122 4465	113 115 122 4550	113 115 122 4695	113 115 121 4860
	0	113 115 122 4270	113 115 122 4350	113 115 121 4435	113 115 121 4515	113 115 121 4665	112 115 120 4840
	1	113 115 121 4250	113 115 121 4330	113 115 121 4405	113 115 121 4490	113 115 120 4645	112 115 120 4825
	2	113 115 120 4235	113 115 120 4315	113 115 120 4390	113 115 120 4470	112 115 120 4630	112 116 120 4815

TODATA_350SFO_IMP_F20_WET_ALL_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–38 (Sheet 1 of 2)

WET RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 4390	113 115 124 4475	113 115 124 4560	113 116 124 4650	113 115 123 4795	113 115 122 4960
	-1	113 116 123 4355	113 116 123 4440	113 116 123 4520	113 116 123 4610	113 116 122 4760	112 116 122 4930
	0	113 116 123 4325	113 116 122 4410	113 116 122 4490	113 116 122 4575	113 116 122 4730	112 117 122 4905
	1	113 116 122 4305	113 116 122 4385	113 116 122 4465	113 116 122 4550	112 117 122 4710	112 117 122 4895
	2	113 117 122 4295	113 117 122 4375	113 117 122 4455	112 117 122 4535	112 118 122 4700	112 118 122 4890
35000 V_{FTO} = 151	-2	113 117 125 4440	113 117 125 4530	113 117 125 4615	113 117 125 4705	113 117 124 4855	113 117 124 5025
	-1	113 117 124 4410	113 117 124 4495	113 117 124 4580	113 117 124 4665	113 117 124 4820	112 118 124 4995
	0	113 117 124 4380	113 118 124 4465	113 118 124 4550	113 118 124 4635	112 118 124 4795	112 119 124 4975
	1	113 118 124 4360	113 118 124 4445	113 118 124 4525	113 118 124 4615	112 119 124 4780	112 120 124 4970
	2	112 119 124 4355	112 119 124 4435	112 119 124 4515	112 119 124 4600	112 120 124 4770	114 120 124 5130
36000 V_{FTO} = 153	-2	113 119 126 4495	113 119 126 4585	113 119 126 4670	113 119 126 4760	113 119 126 4915	112 119 126 5085
	-1	113 119 126 4460	113 119 126 4550	113 119 126 4635	113 119 126 4725	113 119 126 4880	112 120 126 5060
	0	113 119 126 4435	113 120 126 4520	113 120 126 4610	113 120 126 4695	112 120 126 4860	112 121 126 5045
	1	113 120 126 4420	112 120 126 4505	112 120 126 4590	112 120 126 4675	112 121 126 4845	114 122 126 5195
	2	113 121 126 4460	113 121 126 4545	113 121 126 4630	113 121 126 4715	114 122 126 5045	116 122 126 5465
38000 V_{FTO} = 157	-2	113 122 129 4600	113 122 129 4685	113 122 129 4780	113 122 129 4870	113 123 129 5030	112 123 129 5215
	-1	113 123 129 4570	113 123 129 4655	113 123 129 4745	113 123 129 4840	112 124 129 5005	113 124 129 5300
	0	113 124 129 4580	113 124 129 4670	113 124 129 4755	113 124 129 4845	114 124 129 5165	116 125 129 5550
	1	115 124 129 4780	115 124 129 4875	115 125 129 4965	115 125 129 5055	117 125 129 5400	119 126 129 5835
	2	118 125 129 5000	118 125 129 5095	118 125 129 5190	118 125 129 5285	120 126 129 5690	122 127 129 6170

TODATA_350SFO_IMP_F20_WET_ALL_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–38 (Sheet 2 of 2)

WET RUNWAY WIND CORRECTIONS

	WIND (KNOTS)	UNCORRECTED V_1 (KIAS)				
		110	115	116	120	125
CORRECTED V_1 (KIAS)	-10	110	115	118	122	127
	0	110	115	116	120	125
	10	110	115	115	119	124
	20	110	115	114	118	123
	30	110	115	113	117	122

	WIND (KNOTS)	UNCORRECTED V_1 (KIAS)				
		110	115	116	120	125
TOFL FACTOR	-10	1.33	1.33	1.33	1.33	1.33
	0	1.00	1.00	1.00	1.00	1.00
	10	0.95	0.95	0.95	0.95	0.95
	20	0.89	0.89	0.89	0.89	0.89
	30	0.83	0.83	0.83	0.83	0.83

TODATA_350SFO_F20_WET_WIND_CORR_22FEB19

NOTES:

1. In the tables, tailwinds are shown as negative values and headwinds as positive values.
2. If the corrected V_1 exceeds V_R for the appropriate conditions, use $V_1 = V_R$.

WET RUNWAY CORRECTIONS DISPATCH WITH ONE THRUST REVERSER INOPERATIVE

	UNCORRECTED V_1 (KIAS)				
	110	115	116	120	125
CORRECTED V_1 (KIAS)	110	115	115	119	124
TOFL FACTOR	1.08	1.08	1.08	1.08	1.08

TODATA_350SFO_F20_WET_TREV_CORR_22FEB19

NOTE: If the corrected V_1 exceeds V_R for the appropriate conditions, use $V_1 = V_R$.

Figure 07–11A–01–39

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
28000 V_{FTO} = 136	-2	114 115 126 3460	114 115 126 3515	114 115 126 3565	114 115 126 3620	114 115 126 3675	114 115 126 3730	114 115 125 3825
	-1	114 115 125 3445	114 115 125 3500	114 115 125 3550	114 115 125 3600	114 115 125 3655	114 115 125 3710	114 115 125 3810
	0	114 115 125 3430	114 115 124 3480	114 115 124 3535	114 115 124 3590	114 115 124 3640	114 115 124 3695	113 115 124 3795
	1	114 115 124 3415	114 115 124 3470	114 115 124 3525	114 115 124 3575	114 115 123 3630	114 115 123 3680	113 115 123 3790
	2	114 115 123 3410	114 115 123 3460	114 115 123 3515	114 115 123 3565	113 115 123 3620	113 115 123 3675	113 115 122 3785
30000 V_{FTO} = 140	-2	114 115 125 3545	114 115 125 3600	114 115 125 3655	114 115 125 3710	114 115 125 3765	114 115 125 3820	113 115 124 3925
	-1	114 115 124 3530	114 115 124 3590	114 115 124 3640	114 115 124 3695	114 115 124 3750	114 115 124 3805	113 115 124 3915
	0	114 115 123 3520	114 115 123 3575	114 115 123 3630	114 115 123 3685	113 115 123 3740	113 115 123 3795	113 115 123 3905
	1	113 115 123 3510	113 115 123 3570	113 115 122 3620	113 115 122 3675	113 115 122 3730	113 115 122 3785	113 115 122 3900
	2	113 115 122 3510	113 115 122 3560	113 115 122 3615	113 115 122 3670	113 115 121 3725	113 115 121 3780	113 115 121 3900
32000 V_{FTO} = 145	-2	114 115 124 3630	114 115 124 3690	114 115 124 3745	114 115 124 3800	114 115 124 3855	114 115 124 3915	113 115 124 4025
	-1	114 115 123 3620	113 115 123 3680	113 115 123 3730	113 115 123 3790	113 115 123 3845	113 115 123 3905	113 115 123 4020
	0	113 115 122 3610	113 115 122 3670	113 115 122 3725	113 115 122 3780	113 115 122 3840	113 115 122 3895	113 115 122 4015
	1	113 115 122 3605	113 115 121 3665	113 115 121 3720	113 115 121 3775	113 115 121 3835	113 115 121 3890	113 115 121 4015
	2	113 115 121 3605	113 115 121 3665	113 115 121 3720	113 115 120 3775	113 115 120 3835	113 115 120 3890	112 115 120 4020
33000 V_{FTO} = 147	-2	114 115 124 3675	114 115 124 3730	114 115 123 3790	113 115 123 3845	113 115 123 3905	113 115 123 3960	113 115 123 4075
	-1	113 115 123 3665	113 115 123 3725	113 115 123 3780	113 115 123 3835	113 115 122 3895	113 115 122 3950	113 115 122 4070
	0	113 115 122 3655	113 115 122 3715	113 115 122 3770	113 115 122 3830	113 115 122 3885	113 115 122 3945	113 115 121 4070
	1	113 115 121 3655	113 115 121 3715	113 115 121 3770	113 115 121 3825	113 115 121 3885	113 115 121 3945	113 115 121 4075
	2	113 115 120 3655	113 115 120 3715	113 115 120 3770	113 115 120 3830	113 115 120 3890	113 115 120 3945	112 115 120 4080

TODATA_350SFO_IMP_F20_WETG_ZERO_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–40 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
34000 V_{FTO} = 149	-2	113 115 124 3715	113 115 124 3775	113 115 124 3835	113 115 124 3890	113 115 124 3950	113 115 124 4010	113 115 124 4125
	-1	113 115 123 3710	113 115 123 3765	113 115 123 3825	113 115 123 3880	113 116 123 3940	113 116 123 4000	113 116 123 4125
	0	113 116 122 3700	113 116 122 3765	113 116 122 3820	113 116 122 3880	113 116 122 3935	113 116 122 3995	113 116 122 4125
	1	113 116 122 3705	113 116 122 3765	113 116 122 3820	113 116 122 3880	113 116 122 3935	113 116 122 3995	112 116 122 4130
	2	113 117 122 3705	113 117 122 3765	113 117 122 3825	113 117 122 3885	113 117 122 3945	113 117 122 4000	112 117 122 4140
35000 V_{FTO} = 151	-2	113 117 125 3755	113 117 125 3820	113 117 125 3875	113 117 125 3935	113 117 125 3995	113 117 125 4055	113 117 125 4175
	-1	113 117 124 3750	113 117 124 3810	113 117 124 3870	113 117 124 3930	113 117 124 3990	113 117 124 4050	113 117 124 4175
	0	113 117 124 3750	113 117 124 3810	113 117 124 3870	113 117 124 3930	113 117 124 3985	113 117 124 4045	112 117 124 4180
	1	113 118 124 3750	113 118 124 3815	113 118 124 3870	113 118 124 3930	113 118 124 3990	113 118 124 4050	112 118 124 4190
	2	113 119 124 3785	113 119 124 3850	113 119 124 3905	113 119 124 3965	113 119 124 4025	113 119 124 4090	113 119 124 4275
36000 V_{FTO} = 153	-2	113 118 126 3800	113 119 126 3860	113 119 126 3920	113 119 126 3980	113 119 126 4040	113 119 126 4100	113 119 126 4225
	-1	113 119 126 3795	113 119 126 3855	113 119 126 3915	113 119 126 3975	113 119 126 4035	113 119 126 4100	113 119 126 4230
	0	113 119 125 3795	113 119 125 3855	113 119 125 3915	113 119 125 3975	113 119 125 4035	113 119 125 4095	112 120 125 4235
	1	113 120 125 3845	113 120 125 3910	113 120 125 3970	113 120 125 4030	113 120 125 4095	113 120 125 4155	114 120 125 4345
	2	115 121 125 4000	116 121 125 4070	115 121 125 4130	115 121 125 4195	115 121 125 4255	115 121 125 4320	116 121 125 4530
38000 V_{FTO} = 157	-2	113 122 129 3885	113 122 129 3945	113 122 129 4005	113 122 129 4070	113 122 129 4130	113 122 129 4195	113 122 129 4330
	-1	114 123 129 3940	114 123 129 4010	114 123 129 4070	114 123 129 4135	114 123 129 4200	114 123 129 4265	114 123 129 4450
	0	116 123 129 4105	116 123 129 4175	116 123 129 4240	116 124 129 4305	116 124 129 4370	116 124 129 4440	116 124 129 4640
	1	118 124 129 4275	118 124 129 4350	118 124 129 4415	118 124 129 4485	118 124 129 4555	118 124 129 4625	118 124 129 4845
	2	120 125 129 4460	120 125 129 4540	120 125 129 4610	120 125 129 4680	120 125 129 4755	120 125 129 4825	120 125 129 5070

TODATA_350SFO_IMP_F20_WETG_ZERO_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–40 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
28000 V_{FTO} = 136	-2	114 115 126 3515	114 115 126 3570	114 115 126 3625	114 115 126 3680	114 115 126 3735	114 115 125 3800	114 115 125 3885
	-1	114 115 125 3500	114 115 125 3555	114 115 125 3605	114 115 125 3660	114 115 125 3715	114 115 125 3785	114 115 125 3870
	0	114 115 124 3480	114 115 124 3535	114 115 124 3590	114 115 124 3645	114 115 124 3700	114 115 124 3770	113 115 124 3860
	1	114 115 124 3470	114 115 124 3525	114 115 124 3580	114 115 123 3630	114 115 123 3685	113 115 123 3755	113 115 123 3850
	2	114 115 123 3460	114 115 123 3515	114 115 123 3570	113 115 123 3625	113 115 123 3675	113 115 123 3750	113 115 122 3850
30000 V_{FTO} = 140	-2	114 115 125 3600	114 115 125 3660	114 115 125 3715	114 115 125 3770	114 115 125 3825	114 115 124 3900	113 115 124 3990
	-1	114 115 124 3590	114 115 124 3645	114 115 124 3700	114 115 124 3755	114 115 124 3810	114 115 124 3885	113 115 124 3980
	0	114 115 123 3575	114 115 123 3630	114 115 123 3685	113 115 123 3745	113 115 123 3800	113 115 123 3870	113 115 123 3970
	1	113 115 123 3565	113 115 122 3625	113 115 122 3675	113 115 122 3735	113 115 122 3790	113 115 122 3865	113 115 122 3970
	2	113 115 122 3560	113 115 122 3620	113 115 122 3675	113 115 121 3730	113 115 121 3785	113 115 121 3860	113 115 121 3970
32000 V_{FTO} = 145	-2	114 115 124 3690	114 115 124 3745	114 115 124 3805	114 115 124 3860	114 115 124 3920	113 115 124 3995	113 115 123 4095
	-1	113 115 123 3680	113 115 123 3735	113 115 123 3790	113 115 123 3850	113 115 123 3910	113 115 123 3985	113 115 123 4085
	0	113 115 122 3670	113 115 122 3725	113 115 122 3785	113 115 122 3840	113 115 122 3900	113 115 122 3975	113 115 122 4085
	1	113 115 121 3665	113 115 121 3720	113 115 121 3780	113 115 121 3835	113 115 121 3895	113 115 121 3975	113 115 121 4085
	2	113 115 121 3665	113 115 121 3720	113 115 120 3780	113 115 120 3835	113 115 120 3895	113 115 120 3975	112 115 120 4090
33000 V_{FTO} = 147	-2	114 115 124 3730	114 115 124 3790	113 115 123 3850	113 115 123 3905	113 115 123 3965	113 115 123 4045	113 115 123 4145
	-1	113 115 123 3720	113 115 123 3780	113 115 123 3840	113 115 122 3895	113 115 122 3955	113 115 122 4035	113 115 122 4140
	0	113 115 122 3715	113 115 122 3775	113 115 122 3830	113 115 122 3890	113 115 122 3950	113 115 122 4030	113 115 121 4140
	1	113 115 121 3715	113 115 121 3770	113 115 121 3830	113 115 121 3890	113 115 121 3950	113 115 121 4030	112 115 120 4145
	2	113 115 120 3715	113 115 120 3775	113 115 120 3830	113 115 120 3890	113 115 120 3950	113 115 120 4035	112 115 120 4155

TODATA_350SFO_IMP_F20_WETG_ZERO_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–41 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
34000 V_{FTO} = 149	-2	113 115 124 3775	113 115 124 3835	113 115 124 3890	113 115 124 3955	113 115 124 4015	113 115 124 4095	113 115 123 4195
	-1	113 115 123 3765	113 115 123 3825	113 115 123 3885	113 116 123 3945	113 116 123 4005	113 116 123 4085	113 116 123 4195
	0	113 116 122 3760	113 116 122 3825	113 116 122 3880	113 116 122 3940	113 116 122 4000	113 116 122 4085	113 116 122 4195
	1	113 116 122 3765	113 116 122 3820	113 116 122 3880	113 116 122 3940	113 116 122 4000	113 116 122 4085	112 116 122 4205
	2	113 117 122 3765	113 117 122 3825	113 117 122 3885	113 117 122 3945	113 117 122 4005	112 117 122 4090	112 117 122 4220
35000 V_{FTO} = 151	-2	113 117 125 3820	113 117 125 3880	113 117 125 3935	113 117 125 4000	113 117 125 4060	113 117 125 4140	113 117 125 4250
	-1	113 117 124 3810	113 117 124 3870	113 117 124 3930	113 117 124 3990	113 117 124 4055	113 117 124 4135	113 117 124 4250
	0	113 117 124 3810	113 117 124 3870	113 117 124 3930	113 117 124 3990	113 117 124 4050	113 117 124 4135	112 118 124 4255
	1	113 118 124 3810	113 118 124 3870	113 118 124 3930	113 118 124 3995	113 118 124 4055	112 118 124 4140	112 118 124 4265
	2	113 119 124 3840	113 119 124 3905	113 119 124 3965	113 119 124 4025	113 119 124 4090	113 119 124 4195	113 119 124 4380
36000 V_{FTO} = 153	-2	113 119 126 3860	113 119 126 3925	113 119 126 3980	113 119 126 4045	113 119 126 4105	113 119 126 4190	113 119 126 4300
	-1	113 119 126 3855	113 119 126 3915	113 119 126 3980	113 119 126 4040	113 119 126 4100	113 119 126 4185	113 119 125 4305
	0	113 119 125 3855	113 119 125 3920	113 119 125 3975	113 119 125 4040	113 119 125 4100	113 120 125 4190	112 120 125 4310
	1	113 120 125 3905	113 120 125 3970	113 120 125 4030	113 120 125 4095	113 120 125 4160	113 120 125 4260	114 120 125 4445
	2	115 121 125 4060	115 121 125 4130	115 121 125 4190	115 121 125 4260	115 121 125 4325	115 121 125 4435	116 121 125 4640
38000 V_{FTO} = 157	-2	113 122 129 3945	113 122 129 4010	113 122 129 4070	113 122 129 4135	113 122 129 4200	113 122 129 4285	112 122 129 4405
	-1	114 123 129 4005	114 123 129 4070	114 123 129 4135	114 123 129 4200	114 123 129 4265	114 123 129 4370	114 123 129 4550
	0	116 123 129 4170	116 123 129 4240	116 124 129 4305	116 124 129 4370	116 124 129 4440	116 124 129 4555	116 124 129 4750
	1	118 124 129 4340	118 124 129 4415	118 124 129 4480	118 124 129 4555	118 124 129 4625	118 124 129 4745	119 125 129 4965
	2	120 125 129 4530	120 125 129 4610	120 125 129 4680	120 125 129 4755	120 125 129 4830	120 125 129 4960	121 125 129 5195

TODATA_350SFO_IMP_F20_WETG_ZERO_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–41 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
28000 V_{FTO} = 136	-2	114 115 126 3570	114 115 126 3625	114 115 126 3680	114 115 126 3735	114 115 125 3790	114 115 125 3880	114 115 125 3950
	-1	114 115 125 3555	114 115 125 3605	114 115 125 3660	114 115 125 3715	114 115 125 3775	114 115 125 3865	113 115 124 3935
	0	114 115 124 3535	114 115 124 3590	114 115 124 3645	114 115 124 3700	114 115 124 3755	113 115 124 3850	113 115 124 3925
	1	114 115 124 3525	114 115 124 3580	114 115 124 3635	114 115 123 3690	114 115 123 3745	113 115 123 3840	113 115 123 3920
	2	114 115 123 3515	114 115 123 3570	113 115 123 3625	113 115 123 3680	113 115 123 3735	113 115 122 3835	113 115 122 3915
30000 V_{FTO} = 140	-2	114 115 125 3660	114 115 125 3715	114 115 125 3770	114 115 125 3830	114 115 124 3885	114 115 124 3985	113 115 124 4055
	-1	114 115 124 3640	114 115 124 3700	114 115 124 3755	114 115 124 3815	114 115 124 3870	113 115 124 3970	113 115 123 4045
	0	114 115 123 3630	114 115 123 3690	114 115 123 3745	113 115 123 3800	113 115 123 3860	113 115 123 3960	113 115 123 4040
	1	113 115 123 3625	113 115 122 3680	113 115 122 3735	113 115 122 3790	113 115 122 3850	113 115 122 3955	113 115 122 4040
	2	113 115 122 3615	113 115 122 3675	113 115 122 3730	113 115 121 3785	113 115 121 3845	113 115 121 3955	113 115 121 4040
32000 V_{FTO} = 145	-2	114 115 124 3745	114 115 124 3805	114 115 124 3865	114 115 124 3925	114 115 124 3985	113 115 124 4085	113 115 123 4165
	-1	113 115 123 3735	113 115 123 3795	113 115 123 3850	113 115 123 3910	113 115 123 3970	113 115 123 4075	113 115 122 4155
	0	113 115 122 3725	113 115 122 3785	113 115 122 3840	113 115 122 3900	113 115 122 3960	113 115 122 4070	113 115 122 4155
	1	113 115 121 3720	113 115 121 3780	113 115 121 3835	113 115 121 3895	113 115 121 3955	113 115 121 4070	113 115 121 4160
	2	113 115 121 3720	113 115 121 3780	113 115 120 3835	113 115 120 3895	113 115 120 3955	113 115 120 4075	112 115 120 4165
33000 V_{FTO} = 147	-2	114 115 124 3790	113 115 123 3850	113 115 123 3910	113 115 123 3970	113 115 123 4030	113 115 123 4135	113 115 123 4215
	-1	113 115 123 3780	113 115 123 3840	113 115 123 3900	113 115 122 3960	113 115 122 4020	113 115 122 4125	113 115 122 4210
	0	113 115 122 3775	113 115 122 3835	113 115 122 3890	113 115 122 3950	113 115 122 4010	113 115 121 4125	113 115 121 4215
	1	113 115 121 3770	113 115 121 3830	113 115 121 3890	113 115 121 3950	113 115 121 4010	113 115 121 4125	112 115 120 4220
	2	113 115 120 3770	113 115 120 3830	113 115 120 3890	113 115 120 3950	113 115 120 4010	112 115 120 4135	112 115 120 4230

TODATA_350SFO_IMP_F20_WETG_ZERO_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–42 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
34000 V_{FTO} = 149	-2	113 115 124 3835	113 115 124 3895	113 115 124 3955	113 115 124 4015	113 115 124 4080	113 115 124 4185	113 115 123 4270
	-1	113 115 123 3825	113 115 123 3885	113 116 123 3945	113 116 123 4010	113 116 123 4065	113 116 123 4180	113 116 123 4270
	0	113 116 123 3820	113 116 123 3880	113 116 123 3940	113 116 122 4000	113 116 122 4065	113 116 122 4180	112 116 122 4270
	1	113 116 122 3820	113 116 122 3880	113 116 122 3940	113 116 122 4000	113 116 122 4060	112 116 122 4185	112 116 122 4280
	2	113 117 122 3825	113 117 122 3885	113 117 122 3945	113 117 122 4005	113 117 122 4070	112 117 122 4195	112 117 122 4295
35000 V_{FTO} = 151	-2	113 117 125 3880	113 117 125 3940	113 117 125 4000	113 117 125 4060	113 117 125 4125	113 117 125 4235	113 117 125 4325
	-1	113 117 124 3870	113 117 124 3930	113 117 124 3995	113 117 124 4055	113 117 124 4115	113 117 124 4235	113 117 124 4325
	0	113 117 124 3870	113 117 124 3930	113 117 124 3990	113 117 124 4050	113 118 124 4115	113 118 124 4235	112 118 124 4330
	1	113 118 124 3870	113 118 124 3930	113 118 124 3995	113 118 124 4055	113 118 124 4115	112 118 124 4245	112 119 124 4345
	2	113 119 124 3895	113 119 124 3960	113 119 124 4020	113 119 124 4085	113 119 124 4150	113 119 124 4315	114 119 124 4480
36000 V_{FTO} = 153	-2	113 119 126 3920	113 119 126 3985	113 119 126 4045	113 119 126 4110	113 119 126 4170	113 119 126 4285	113 119 126 4380
	-1	113 119 126 3915	113 119 126 3980	113 119 126 4040	113 119 126 4100	113 119 126 4165	113 119 126 4285	112 119 125 4380
	0	113 119 125 3915	113 119 125 3980	113 119 125 4040	113 119 125 4105	113 120 125 4165	112 120 125 4290	112 120 125 4390
	1	113 120 125 3960	113 120 125 4025	113 120 125 4090	113 120 125 4155	113 120 125 4220	113 120 125 4380	114 121 125 4550
	2	115 121 125 4120	115 121 125 4185	115 121 125 4250	115 121 125 4320	115 121 125 4390	115 121 125 4570	116 121 125 4755
38000 V_{FTO} = 157	-2	113 122 129 4005	113 122 129 4070	113 122 129 4135	113 122 129 4200	113 122 129 4265	113 122 129 4390	112 122 129 4485
	-1	114 123 129 4065	114 123 129 4130	114 123 129 4195	114 123 129 4265	114 123 129 4330	114 123 129 4490	114 123 129 4655
	0	116 123 129 4230	116 124 129 4300	116 124 129 4365	116 124 129 4440	116 124 129 4510	116 124 129 4685	117 124 129 4860
	1	118 124 129 4405	118 124 129 4480	118 124 129 4550	118 124 129 4620	118 124 129 4695	118 124 129 4890	119 125 129 5085
	2	120 125 129 4595	120 125 129 4675	120 125 129 4745	120 125 129 4825	120 125 129 4900	120 125 129 5110	121 126 129 5330

TODATA_350SFO_IMP_F20_WETG_ZERO_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–42 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
28000 V_{FTO} = 136	-2	114 115 126 3685	114 115 126 3740	114 115 126 3800	114 115 125 3855	114 115 125 3935	114 115 125 4055	113 115 125 4080
	-1	114 115 125 3665	114 115 125 3720	114 115 125 3780	114 115 125 3835	114 115 125 3915	113 115 124 4040	113 115 124 4065
	0	114 115 124 3650	114 115 124 3705	114 115 124 3760	114 115 124 3820	114 115 124 3900	113 115 123 4030	113 115 123 4060
	1	114 115 124 3635	114 115 124 3690	114 115 123 3750	114 115 123 3805	113 115 123 3890	113 115 123 4025	113 115 123 4055
	2	114 115 123 3625	113 115 123 3685	113 115 123 3740	113 115 123 3795	113 115 122 3880	113 115 122 4025	113 115 122 4055
30000 V_{FTO} = 140	-2	114 115 125 3775	114 115 125 3835	114 115 125 3895	114 115 124 3955	114 115 124 4040	113 115 124 4170	113 115 124 4195
	-1	114 115 124 3760	114 115 124 3820	114 115 124 3880	114 115 124 3935	113 115 124 4020	113 115 123 4155	113 115 123 4185
	0	114 115 123 3750	114 115 123 3805	113 115 123 3865	113 115 123 3925	113 115 123 4010	113 115 122 4150	113 115 122 4180
	1	113 115 122 3735	113 115 122 3795	113 115 122 3855	113 115 122 3915	113 115 122 4000	113 115 122 4150	113 115 122 4180
	2	113 115 122 3730	113 115 122 3790	113 115 121 3845	113 115 121 3905	113 115 121 4000	113 115 121 4155	112 115 121 4185
32000 V_{FTO} = 145	-2	114 115 124 3865	114 115 124 3925	114 115 124 3990	113 115 124 4050	113 115 124 4140	113 115 123 4280	113 115 123 4310
	-1	113 115 123 3855	113 115 123 3915	113 115 123 3975	113 115 123 4035	113 115 123 4125	113 115 122 4275	113 115 122 4305
	0	113 115 122 3845	113 115 122 3905	113 115 122 3965	113 115 122 4030	113 115 122 4120	113 115 121 4275	113 115 121 4305
	1	113 115 121 3840	113 115 121 3900	113 115 121 3960	113 115 121 4020	113 115 121 4115	112 115 121 4275	112 115 121 4310
	2	113 115 121 3835	113 115 120 3895	113 115 120 3960	113 115 120 4020	113 115 120 4120	112 115 120 4285	112 115 120 4325
33000 V_{FTO} = 147	-2	113 115 123 3910	113 115 123 3975	113 115 123 4035	113 115 123 4100	113 115 123 4190	113 115 123 4335	113 115 123 4370
	-1	113 115 123 3900	113 115 123 3965	113 115 122 4025	113 115 122 4085	113 115 122 4180	113 115 122 4330	113 115 122 4365
	0	113 115 122 3895	113 115 122 3955	113 115 122 4015	113 115 122 4080	113 115 121 4175	112 115 121 4335	112 115 121 4365
	1	113 115 121 3890	113 115 121 3950	113 115 121 4010	113 115 121 4075	113 115 121 4175	112 115 120 4340	112 115 120 4375
	2	113 115 120 3890	113 115 120 3950	113 115 120 4015	113 115 120 4080	112 115 120 4180	112 115 120 4355	112 115 120 4390

TODATA_350SFO_IMP_F20_WETG_ZERO_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–43 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
34000 V_{FTO} = 149	-2	113 115 124 3955	113 115 124 4020	113 115 124 4085	113 115 124 4145	113 116 124 4240	113 115 123 4395	113 115 123 4425
	-1	113 116 123 3950	113 116 123 4010	113 116 123 4075	113 116 123 4135	113 116 123 4230	113 116 123 4390	112 116 122 4425
	0	113 116 123 3940	113 116 123 4005	113 116 123 4070	113 116 123 4130	113 116 123 4230	112 116 122 4395	112 116 122 4430
	1	113 116 122 3940	113 116 122 4005	113 116 122 4065	113 116 122 4130	113 116 122 4230	112 116 122 4405	112 117 122 4440
	2	113 117 122 3945	113 117 122 4005	113 117 122 4070	113 117 122 4135	112 117 122 4240	112 117 122 4420	112 117 122 4460
35000 V_{FTO} = 151	-2	113 117 125 4005	113 117 125 4065	113 117 125 4130	113 117 125 4195	113 117 125 4290	113 117 125 4450	113 117 124 4480
	-1	113 117 125 3995	113 117 125 4055	113 117 125 4120	113 117 124 4185	113 117 124 4285	112 117 124 4450	112 117 124 4485
	0	113 117 124 3990	113 118 124 4055	113 118 124 4120	113 118 124 4185	113 118 124 4285	112 118 124 4455	112 118 124 4495
	1	113 118 124 3995	113 118 124 4055	113 118 124 4120	113 118 124 4185	112 118 124 4290	112 119 124 4470	112 119 124 4510
	2	113 119 124 4010	113 119 124 4075	113 119 124 4140	113 119 124 4210	113 119 124 4340	114 119 124 4630	114 120 124 4700
36000 V_{FTO} = 153	-2	113 119 127 4050	113 119 126 4110	113 119 126 4180	113 119 126 4240	113 119 126 4340	113 119 126 4505	112 119 126 4540
	-1	113 119 126 4045	113 119 126 4105	113 119 126 4170	113 119 126 4235	113 119 126 4340	112 119 125 4505	112 119 125 4545
	0	113 119 125 4040	113 119 125 4105	113 119 125 4170	113 120 125 4235	112 120 125 4340	112 120 125 4520	112 120 125 4565
	1	113 120 125 4080	113 120 125 4140	113 120 125 4210	113 120 125 4280	113 120 125 4410	114 121 125 4700	114 121 125 4770
	2	115 121 125 4240	115 121 125 4305	115 121 125 4375	115 121 125 4450	115 121 125 4595	116 122 125 4915	117 122 125 4990
38000 V_{FTO} = 157	-2	113 122 129 4140	113 122 129 4205	113 122 129 4270	113 122 129 4335	113 122 129 4440	112 122 129 4615	112 123 129 4665
	-1	113 123 129 4185	113 123 129 4250	113 123 129 4320	113 123 129 4395	114 123 129 4525	115 123 129 4810	115 123 129 4875
	0	116 124 129 4355	116 124 129 4425	116 124 129 4495	116 124 129 4575	116 124 129 4715	117 124 129 5025	117 124 129 5095
	1	118 124 129 4535	118 124 129 4605	118 124 129 4685	118 124 129 4760	118 124 129 4920	119 125 129 5255	119 125 129 5335
	2	120 125 129 4730	120 125 129 4805	120 125 129 4885	120 125 129 4970	120 125 129 5140	121 126 129 5515	121 126 129 5610

TODATA_350SFO_IMP_F20_WETG_ZERO_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–43 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	29	
28000 V_{FTO} = 136	-2	114 115 126 3805	114 115 125 3865	114 115 125 3930	114 115 125 4000	114 115 125 4110	113 115 124 4220	
	-1	114 115 125 3790	114 115 125 3845	114 115 125 3905	114 115 125 3980	113 115 124 4090	113 115 124 4205	
	0	114 115 124 3770	114 115 124 3830	114 115 124 3890	114 115 124 3965	113 115 124 4080	113 115 123 4200	
	1	114 115 123 3755	114 115 123 3815	114 115 123 3875	113 115 123 3950	113 115 123 4070	113 115 122 4195	
	2	113 115 123 3745	113 115 123 3805	113 115 122 3865	113 115 122 3940	113 115 122 4065	113 115 121 4200	
30000 V_{FTO} = 140	-2	114 115 125 3905	114 115 124 3965	114 115 124 4025	114 115 124 4100	113 115 124 4220	113 115 123 4345	
	-1	114 115 124 3885	114 115 124 3945	114 115 124 4010	113 115 124 4085	113 115 123 4210	113 115 123 4335	
	0	113 115 123 3870	113 115 123 3935	113 115 123 3995	113 115 123 4075	113 115 123 4200	113 115 122 4330	
	1	113 115 122 3865	113 115 122 3920	113 115 122 3985	113 115 122 4065	113 115 122 4195	112 115 121 4335	
	2	113 115 121 3855	113 115 121 3915	113 115 121 3980	113 115 121 4060	113 115 121 4200	112 115 120 4340	
32000 V_{FTO} = 145	-2	114 115 124 4000	113 115 124 4060	113 115 124 4125	113 115 123 4205	113 115 123 4330	113 115 123 4465	
	-1	113 115 123 3985	113 115 123 4045	113 115 123 4110	113 115 123 4195	113 115 122 4325	113 115 122 4460	
	0	113 115 122 3975	113 115 122 4035	113 115 122 4100	113 115 122 4185	113 115 122 4320	112 115 121 4465	
	1	113 115 121 3965	113 115 121 4030	113 115 121 4095	113 115 121 4180	112 115 121 4320	112 115 120 4470	
	2	113 115 120 3965	113 115 120 4030	113 115 120 4095	113 115 120 4180	112 115 120 4330	112 115 119 4485	
33000 V_{FTO} = 147	-2	113 115 123 4045	113 115 123 4110	113 115 123 4175	113 115 123 4255	113 115 123 4385	113 115 122 4525	
	-1	113 115 122 4030	113 115 122 4095	113 115 122 4165	113 115 122 4245	113 115 122 4380	112 115 121 4525	
	0	113 115 122 4025	113 115 122 4090	113 115 121 4155	113 115 121 4240	113 115 121 4380	112 115 121 4530	
	1	113 115 121 4020	113 115 121 4085	113 115 121 4150	113 115 121 4240	112 115 120 4385	112 115 120 4540	
	2	113 115 120 4025	113 115 120 4085	113 115 120 4155	112 115 120 4240	112 115 120 4395	112 115 120 4560	

TODATA_350SFO_IMP_F20_WETG_ZERO_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–44 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	29	
34000 V_{FTO} = 149	-2	113 115 124 4095	113 116 124 4155	113 116 124 4225	113 116 124 4310	113 116 123 4440	113 115 123 4585	
	-1	113 116 123 4080	113 116 123 4145	113 116 123 4215	113 116 123 4300	113 116 123 4440	112 116 122 4585	
	0	113 116 123 4075	113 116 123 4140	113 116 123 4205	113 116 123 4295	112 116 122 4440	112 116 122 4595	
	1	113 116 122 4075	113 116 122 4140	113 116 122 4205	113 116 122 4295	112 116 122 4450	112 117 122 4610	
	2	113 117 122 4080	113 117 122 4145	112 117 122 4210	112 117 122 4300	112 117 122 4460	112 118 122 4650	
35000 V_{FTO} = 151	-2	113 117 125 4140	113 117 125 4205	113 117 125 4270	113 117 125 4360	113 117 125 4500	112 117 124 4645	
	-1	113 117 125 4130	113 117 125 4195	113 117 124 4265	113 117 124 4355	113 117 124 4495	112 118 124 4650	
	0	113 118 124 4130	113 118 124 4190	113 118 124 4260	113 118 124 4350	112 118 124 4500	112 118 124 4665	
	1	113 118 124 4130	113 118 124 4195	113 118 124 4265	112 118 124 4355	112 119 124 4515	112 119 124 4725	
	2	113 119 124 4150	113 119 124 4215	113 119 124 4285	113 119 124 4395	113 119 124 4645	115 120 124 4940	
36000 V_{FTO} = 153	-2	113 119 126 4185	113 119 126 4250	113 119 126 4320	113 119 126 4410	113 119 126 4555	112 119 125 4705	
	-1	113 119 126 4180	113 119 126 4245	113 119 126 4315	113 119 126 4405	112 119 125 4555	112 120 125 4715	
	0	113 119 125 4180	113 120 125 4245	113 120 125 4315	113 120 125 4405	112 120 125 4560	113 120 125 4790	
	1	113 120 125 4215	113 120 125 4285	113 120 125 4360	113 120 125 4470	114 121 125 4715	115 121 125 5005	
	2	115 121 125 4385	115 121 125 4455	115 121 125 4530	115 121 125 4650	116 122 125 4925	117 122 125 5235	
38000 V_{FTO} = 157	-2	113 122 129 4280	113 122 129 4350	113 122 129 4420	113 122 129 4510	112 122 129 4665	113 123 129 4890	
	-1	113 123 129 4325	113 123 129 4400	113 123 129 4475	113 123 129 4585	114 123 129 4830	115 124 129 5110	
	0	116 124 129 4505	116 124 129 4580	116 124 129 4655	116 124 129 4775	116 124 129 5040	117 124 129 5345	
	1	118 124 129 4690	118 124 129 4765	118 125 129 4850	118 125 129 4975	119 125 129 5270	120 125 129 5600	
	2	120 125 129 4895	120 125 129 4975	120 125 129 5060	120 125 129 5195	121 126 129 5520	122 126 129 5910	

TODATA_350SFO_IMP_F20_WETG_ZERO_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–44 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	27	
28000 V_{FTO} = 136	-2	114 115 125 3940	114 115 125 4000	114 115 125 4070	114 115 125 4175	113 115 124 4300	113 115 124 4365	
	-1	114 115 125 3915	114 115 124 3980	114 115 124 4050	113 115 124 4160	113 115 124 4290	113 115 123 4355	
	0	114 115 124 3900	114 115 124 3960	114 115 124 4030	113 115 123 4145	113 115 123 4280	113 115 123 4345	
	1	114 115 123 3885	113 115 123 3950	113 115 123 4020	113 115 123 4135	113 115 122 4275	113 115 122 4345	
	2	113 115 122 3875	113 115 122 3940	113 115 122 4010	113 115 122 4125	113 115 121 4275	112 115 121 4345	
30000 V_{FTO} = 140	-2	114 115 124 4035	114 115 124 4105	114 115 124 4175	113 115 124 4285	113 115 123 4425	113 115 123 4495	
	-1	114 115 124 4020	114 115 124 4085	113 115 123 4160	113 115 123 4275	113 115 123 4420	113 115 122 4490	
	0	113 115 123 4010	113 115 123 4070	113 115 123 4145	113 115 122 4265	113 115 122 4415	112 115 122 4485	
	1	113 115 122 3995	113 115 122 4060	113 115 122 4135	113 115 122 4260	112 115 121 4415	112 115 121 4490	
	2	113 115 121 3990	113 115 121 4055	113 115 121 4130	113 115 121 4260	112 115 120 4420	112 115 120 4500	
32000 V_{FTO} = 145	-2	113 115 123 4135	113 115 123 4205	113 115 123 4280	113 115 123 4400	113 115 122 4550	113 115 122 4625	
	-1	113 115 123 4125	113 115 123 4190	113 115 123 4265	113 115 122 4390	113 115 122 4545	112 115 121 4620	
	0	113 115 122 4115	113 115 122 4180	113 115 122 4255	113 115 122 4385	112 115 121 4545	112 115 121 4625	
	1	113 115 121 4110	113 115 121 4175	113 115 121 4255	113 115 121 4385	112 115 120 4555	112 115 120 4640	
	2	113 115 120 4105	113 115 120 4175	113 115 120 4250	112 115 120 4390	112 115 119 4570	112 115 119 4655	
33000 V_{FTO} = 147	-2	113 115 123 4185	113 115 123 4255	113 115 123 4330	113 115 123 4455	113 115 122 4615	112 115 122 4685	
	-1	113 115 122 4175	113 115 122 4245	113 115 122 4320	113 115 122 4445	112 115 121 4610	112 115 121 4690	
	0	113 115 121 4165	113 115 121 4235	113 115 121 4315	113 115 121 4445	112 115 120 4615	112 115 120 4695	
	1	113 115 121 4165	113 115 121 4230	113 115 121 4310	112 115 120 4450	112 115 120 4625	112 115 120 4715	
	2	113 115 120 4165	113 115 120 4235	112 115 120 4315	112 115 120 4455	112 116 120 4645	112 116 120 4735	

TODATA_350SFO_IMP_F20_WETG_ZERO_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–45 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED OFF

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	27	
34000 V_{FTO} = 149	-2	113 116 124 4235	113 116 124 4305	113 116 124 4385	113 116 123 4510	113 116 123 4675	112 115 122 4750	
	-1	113 116 123 4225	113 116 123 4295	113 116 123 4375	113 116 123 4505	112 116 122 4675	112 116 122 4755	
	0	113 116 123 4220	113 116 123 4290	113 116 122 4370	112 116 122 4505	112 116 122 4680	112 116 122 4765	
	1	113 116 122 4220	113 116 122 4290	113 116 122 4370	112 116 122 4510	112 117 122 4700	112 117 122 4785	
	2	112 117 122 4225	112 117 122 4295	112 117 122 4375	112 117 122 4525	112 118 122 4740	113 118 122 4890	
35000 V_{FTO} = 151	-2	113 117 125 4285	113 117 125 4355	113 117 125 4435	113 117 125 4565	112 117 124 4735	112 117 124 4815	
	-1	113 117 124 4280	113 118 124 4345	113 118 124 4425	113 118 124 4565	112 118 124 4740	112 118 124 4825	
	0	113 118 124 4275	113 118 124 4345	113 118 124 4425	112 118 124 4565	112 118 124 4750	112 119 124 4840	
	1	113 118 124 4275	112 118 124 4345	112 118 124 4430	112 119 124 4575	113 119 124 4820	113 119 124 4965	
	2	113 119 124 4305	113 119 124 4380	113 119 124 4475	113 119 124 4690	115 120 124 5035	115 120 124 5190	
36000 V_{FTO} = 153	-2	113 119 126 4335	113 119 126 4405	113 119 126 4485	113 119 126 4620	112 119 126 4795	112 119 126 4880	
	-1	113 119 126 4330	113 119 126 4400	113 119 126 4480	112 119 126 4620	112 120 126 4805	112 120 126 4890	
	0	113 120 126 4330	113 120 126 4400	113 120 126 4480	112 120 126 4630	113 121 126 4885	113 121 126 5035	
	1	113 120 126 4380	113 120 126 4455	113 121 126 4550	114 121 126 4760	115 121 126 5105	115 121 126 5265	
	2	115 121 126 4555	115 121 126 4630	115 121 126 4730	116 122 126 4965	117 122 126 5340	118 122 126 5515	
38000 V_{FTO} = 157	-2	113 122 129 4430	113 122 129 4505	113 122 129 4590	112 123 129 4735	113 123 129 4990	114 123 129 5135	
	-1	113 123 129 4495	113 123 129 4570	114 123 129 4665	114 123 129 4880	115 124 129 5215	116 124 129 5365	
	0	116 124 129 4680	116 124 129 4760	116 124 129 4860	116 124 129 5090	117 125 129 5450	118 125 129 5620	
	1	118 125 129 4875	118 125 129 4955	118 125 129 5065	118 125 129 5315	120 125 129 5705	120 126 129 5890	
	2	120 125 129 5085	120 125 129 5170	120 125 129 5285	120 126 129 5560	122 126 129 6025	123 126 129 6235	

TODATA_350SFO_IMP_F20_WETG_ZERO_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–45 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
28000 V_{FTO} = 136	-2	114 115 126 3465	114 115 126 3515	114 115 126 3570	114 115 126 3620	114 115 126 3675	114 115 125 3735	114 115 125 3835
	-1	114 115 125 3445	114 115 125 3500	114 115 125 3550	114 115 125 3605	114 115 125 3655	114 115 125 3715	114 115 124 3820
	0	114 115 124 3430	114 115 124 3485	114 115 124 3535	114 115 124 3590	114 115 124 3640	114 115 124 3705	113 115 124 3810
	1	114 115 124 3420	114 115 124 3475	114 115 124 3525	114 115 124 3580	114 115 123 3630	114 115 123 3690	113 115 123 3800
	2	114 115 123 3410	114 115 123 3465	114 115 123 3515	113 115 123 3570	113 115 123 3620	113 115 123 3685	113 115 122 3800
30000 V_{FTO} = 140	-2	114 115 125 3545	114 115 125 3605	114 115 125 3655	114 115 125 3715	114 115 125 3770	114 115 125 3830	113 115 124 3935
	-1	114 115 124 3535	114 115 124 3590	114 115 124 3645	114 115 124 3695	114 115 124 3750	114 115 124 3815	113 115 124 3930
	0	114 115 123 3520	114 115 123 3575	114 115 123 3630	114 115 123 3685	113 115 123 3740	113 115 123 3800	113 115 123 3920
	1	113 115 123 3515	113 115 122 3570	113 115 122 3625	113 115 122 3675	113 115 122 3730	113 115 122 3795	113 115 122 3920
	2	113 115 122 3510	113 115 122 3565	113 115 122 3620	113 115 122 3670	113 115 121 3725	113 115 121 3790	113 115 121 3920
32000 V_{FTO} = 145	-2	114 115 124 3630	114 115 124 3690	114 115 124 3745	114 115 124 3805	114 115 124 3860	113 115 124 3925	113 115 123 4040
	-1	114 115 123 3620	113 115 123 3680	113 115 123 3735	113 115 123 3790	113 115 123 3845	113 115 123 3915	113 115 123 4035
	0	113 115 122 3610	113 115 122 3670	113 115 122 3725	113 115 122 3785	113 115 122 3840	113 115 122 3905	113 115 122 4030
	1	113 115 121 3610	113 115 121 3665	113 115 121 3720	113 115 121 3780	113 115 121 3835	113 115 121 3900	113 115 121 4035
	2	113 115 121 3605	113 115 121 3665	113 115 120 3720	113 115 120 3780	113 115 120 3835	113 115 120 3900	112 115 120 4040
33000 V_{FTO} = 147	-2	114 115 124 3675	114 115 124 3735	113 115 123 3790	113 115 123 3850	113 115 123 3905	113 115 123 3970	113 115 123 4090
	-1	113 115 123 3665	113 115 123 3725	113 115 123 3780	113 115 123 3835	113 115 122 3895	113 115 122 3960	113 115 122 4085
	0	113 115 122 3660	113 115 122 3715	113 115 122 3775	113 115 122 3830	113 115 122 3890	113 115 122 3955	113 115 121 4085
	1	113 115 121 3655	113 115 121 3715	113 115 121 3770	113 115 121 3830	113 115 121 3885	113 115 121 3955	112 115 120 4090
	2	113 115 120 3660	113 115 120 3715	113 115 120 3775	113 115 120 3830	113 115 120 3890	113 115 120 3955	112 115 120 4100

TODATA_350SFO_IMP_F20_WETG_ECS_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–46 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	35
34000 V_{FTO} = 149	-2	113 115 124 3715	113 115 124 3775	113 115 124 3835	113 115 124 3890	113 115 124 3950	113 115 124 4020	113 115 123 4145
	-1	113 115 123 3710	113 115 123 3765	113 115 123 3825	113 115 123 3885	113 116 123 3945	113 116 123 4010	113 115 123 4140
	0	113 116 122 3705	113 116 122 3765	113 116 122 3820	113 116 122 3880	113 116 122 3935	113 116 122 4005	113 116 122 4140
	1	113 116 122 3705	113 116 122 3765	113 116 122 3820	113 116 122 3880	113 116 122 3940	113 116 122 4010	112 116 122 4150
	2	113 117 122 3710	113 117 122 3770	113 117 122 3825	113 117 122 3885	113 117 122 3945	113 117 122 4015	112 117 122 4165
35000 V_{FTO} = 151	-2	113 117 125 3760	113 117 125 3820	113 117 125 3880	113 117 125 3935	113 117 125 3995	113 117 125 4065	113 117 125 4195
	-1	113 117 124 3755	113 117 124 3810	113 117 124 3870	113 117 124 3930	113 117 124 3990	113 117 124 4060	113 117 124 4195
	0	113 117 124 3750	113 117 124 3810	113 117 124 3870	113 117 124 3930	113 117 124 3985	113 117 124 4060	112 118 124 4200
	1	113 118 124 3755	113 118 124 3815	113 118 124 3870	113 118 124 3930	113 118 124 3990	113 118 124 4060	112 118 124 4210
	2	113 119 124 3790	113 119 124 3855	113 119 124 3910	113 119 124 3970	113 119 124 4030	113 119 124 4110	114 119 124 4345
36000 V_{FTO} = 153	-2	113 118 126 3800	113 119 126 3865	113 119 126 3920	113 119 126 3980	113 119 126 4040	113 119 126 4110	113 119 126 4245
	-1	113 119 126 3795	113 119 126 3860	113 119 126 3915	113 119 126 3975	113 119 126 4040	113 119 126 4110	113 119 125 4250
	0	113 119 125 3795	113 119 125 3860	113 119 125 3920	113 119 125 3975	113 119 125 4035	113 120 125 4110	112 120 125 4255
	1	113 120 125 3850	113 120 125 3920	113 120 125 3975	113 120 125 4040	113 120 125 4100	113 120 125 4180	114 121 125 4410
	2	116 121 125 4005	116 121 125 4075	116 121 125 4135	116 121 125 4200	115 121 125 4265	115 121 125 4345	116 121 125 4605
38000 V_{FTO} = 157	-2	113 122 129 3885	113 122 129 3950	113 122 129 4010	113 122 129 4070	113 122 129 4130	113 122 129 4205	113 122 129 4350
	-1	114 123 129 3950	114 123 129 4015	114 123 129 4075	114 123 129 4140	114 123 129 4205	114 123 129 4285	115 123 129 4515
	0	116 123 129 4110	116 123 129 4180	116 124 129 4245	116 124 129 4310	116 124 129 4380	116 124 129 4465	117 124 129 4710
	1	118 124 129 4280	118 124 129 4355	118 124 129 4420	118 124 129 4490	118 124 129 4560	118 124 129 4650	119 125 129 4925
	2	120 125 129 4470	120 125 129 4550	120 125 129 4615	120 125 129 4690	120 125 129 4760	120 125 129 4855	121 126 129 5165

TODATA_350SFO_IMP_F20_WETG_ECS_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–46 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
28000 V_{FTO} = 136	-2	114 115 126 3515	114 115 126 3570	114 115 126 3625	114 115 126 3680	114 115 125 3735	114 115 125 3810	114 115 125 3895
	-1	114 115 125 3500	114 115 125 3555	114 115 125 3605	114 115 125 3660	114 115 125 3715	114 115 125 3795	113 115 124 3885
	0	114 115 124 3485	114 115 124 3540	114 115 124 3590	114 115 124 3645	114 115 124 3700	114 115 124 3785	113 115 124 3875
	1	114 115 124 3470	114 115 124 3525	114 115 124 3580	114 115 123 3635	114 115 123 3685	113 115 123 3770	113 115 123 3870
	2	114 115 123 3460	114 115 123 3515	113 115 123 3570	113 115 123 3625	113 115 123 3680	113 115 122 3765	113 115 122 3865
30000 V_{FTO} = 140	-2	114 115 125 3605	114 115 125 3660	114 115 125 3715	114 115 125 3775	114 115 125 3825	114 115 124 3910	113 115 124 4005
	-1	114 115 124 3590	114 115 124 3645	114 115 124 3700	114 115 124 3755	114 115 124 3815	113 115 124 3900	113 115 123 3995
	0	114 115 123 3575	114 115 123 3635	114 115 123 3690	113 115 123 3745	113 115 123 3800	113 115 123 3890	113 115 123 3990
	1	113 115 123 3570	113 115 122 3625	113 115 122 3680	113 115 122 3735	113 115 122 3790	113 115 122 3885	113 115 122 3985
	2	113 115 122 3565	113 115 122 3620	113 115 122 3675	113 115 121 3730	113 115 121 3785	113 115 121 3880	113 115 121 3990
32000 V_{FTO} = 145	-2	114 115 124 3690	114 115 124 3750	114 115 124 3805	114 115 124 3860	114 115 124 3920	113 115 124 4010	113 115 123 4110
	-1	113 115 123 3680	113 115 123 3735	113 115 123 3795	113 115 123 3850	113 115 123 3910	113 115 123 4000	113 115 122 4105
	0	113 115 122 3670	113 115 122 3730	113 115 122 3785	113 115 122 3840	113 115 122 3900	113 115 122 3995	113 115 122 4100
	1	113 115 121 3665	113 115 121 3725	113 115 121 3780	113 115 121 3840	113 115 121 3895	113 115 121 3995	113 115 121 4105
	2	113 115 121 3665	113 115 120 3725	113 115 120 3780	113 115 120 3840	113 115 120 3895	113 115 120 3995	112 115 120 4115
33000 V_{FTO} = 147	-2	114 115 124 3735	113 115 123 3795	113 115 123 3850	113 115 123 3910	113 115 123 3970	113 115 123 4060	113 115 123 4165
	-1	113 115 123 3720	113 115 123 3780	113 115 123 3840	113 115 122 3900	113 115 122 3960	113 115 122 4055	113 115 122 4160
	0	113 115 122 3715	113 115 122 3775	113 115 122 3835	113 115 122 3890	113 115 122 3950	113 115 121 4050	113 115 121 4160
	1	113 115 121 3715	113 115 121 3775	113 115 121 3830	113 115 121 3890	113 115 121 3950	113 115 121 4050	112 115 120 4165
	2	113 115 120 3715	113 115 120 3775	113 115 120 3835	113 115 120 3895	113 115 120 3950	112 115 120 4055	112 115 120 4180

TODATA_350SFO_IMP_F20_WETG_ECS_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–47 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	34
34000 V_{FTO} = 149	-2	113 115 124 3775	113 115 124 3835	113 115 124 3895	113 115 124 3955	113 115 124 4015	113 115 124 4110	113 115 123 4215
	-1	113 115 123 3765	113 115 123 3830	113 115 123 3885	113 116 123 3945	113 116 123 4005	113 116 123 4105	113 116 122 4215
	0	113 116 122 3765	113 116 122 3825	113 116 122 3885	113 116 122 3940	113 116 122 4000	113 116 122 4100	112 116 122 4215
	1	113 116 122 3765	113 116 122 3825	113 116 122 3880	113 116 122 3940	113 116 122 4005	113 116 122 4105	112 116 122 4230
	2	113 117 122 3770	113 117 122 3830	113 117 122 3890	113 117 122 3945	113 117 122 4005	112 117 122 4115	112 117 122 4240
35000 V_{FTO} = 151	-2	113 117 125 3820	113 117 125 3880	113 117 125 3940	113 117 125 4000	113 117 125 4060	113 117 125 4160	113 117 124 4270
	-1	113 117 124 3810	113 117 124 3875	113 117 124 3935	113 117 124 3995	113 117 124 4055	113 117 124 4155	113 117 124 4270
	0	113 117 124 3810	113 117 124 3870	113 117 124 3930	113 117 124 3990	113 117 124 4050	113 117 124 4155	112 118 124 4275
	1	113 118 124 3810	113 118 124 3875	113 118 124 3935	113 118 124 3995	113 118 124 4055	112 118 124 4160	112 119 124 4290
	2	113 119 124 3850	113 119 124 3915	113 119 124 3970	113 119 124 4035	113 119 124 4095	113 119 124 4230	114 119 124 4455
36000 V_{FTO} = 153	-2	113 119 126 3865	113 119 126 3925	113 119 126 3985	113 119 126 4045	113 119 126 4105	113 119 126 4205	113 119 126 4325
	-1	113 119 126 3855	113 119 126 3920	113 119 126 3980	113 119 126 4040	113 119 126 4100	113 119 126 4205	112 119 125 4325
	0	113 119 125 3860	113 119 125 3920	113 119 125 3980	113 119 125 4040	113 120 125 4105	113 120 125 4210	112 120 125 4335
	1	113 120 125 3910	113 120 125 3975	113 120 125 4035	113 120 125 4100	113 120 125 4165	113 120 125 4295	114 121 125 4520
	2	116 121 125 4070	116 121 125 4135	115 121 125 4200	115 121 125 4265	115 121 125 4330	116 121 125 4475	116 122 125 4720
38000 V_{FTO} = 157	-2	113 122 129 3950	113 122 129 4010	113 122 129 4070	113 122 129 4135	113 122 129 4200	113 122 129 4305	112 122 129 4430
	-1	114 123 129 4010	114 123 129 4080	114 123 129 4140	114 123 129 4205	114 123 129 4270	114 123 129 4405	115 123 129 4625
	0	116 123 129 4175	116 124 129 4245	116 124 129 4310	116 124 129 4380	116 124 129 4450	116 124 129 4590	117 124 129 4825
	1	118 124 129 4350	118 124 129 4425	118 124 129 4490	118 124 129 4560	118 124 129 4635	118 124 129 4790	119 125 129 5050
	2	120 125 129 4540	120 125 129 4615	120 125 129 4685	120 125 129 4760	120 125 129 4835	120 125 129 5005	121 126 129 5305

TODATA_350SFO_IMP_F20_WETG_ECS_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–47 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
28000 V_{FTO} = 136	-2	114 115 126 3570	114 115 126 3625	114 115 126 3680	114 115 126 3735	114 115 125 3790	114 115 125 3895	114 115 125 3965
	-1	114 115 125 3555	114 115 125 3605	114 115 125 3660	114 115 125 3720	114 115 125 3775	114 115 124 3880	113 115 124 3950
	0	114 115 124 3540	114 115 124 3595	114 115 124 3650	114 115 124 3705	114 115 124 3755	113 115 124 3865	113 115 123 3940
	1	114 115 124 3525	114 115 124 3580	114 115 123 3635	114 115 123 3690	114 115 123 3745	113 115 123 3860	113 115 123 3935
	2	114 115 123 3515	114 115 123 3570	113 115 123 3625	113 115 123 3680	113 115 123 3735	113 115 122 3850	113 115 122 3935
30000 V_{FTO} = 140	-2	114 115 125 3660	114 115 125 3720	114 115 125 3775	114 115 125 3830	114 115 124 3890	113 115 124 4000	113 115 124 4070
	-1	114 115 124 3645	114 115 124 3700	114 115 124 3760	114 115 124 3815	114 115 124 3875	113 115 124 3985	113 115 123 4065
	0	114 115 123 3630	114 115 123 3690	114 115 123 3745	113 115 123 3800	113 115 123 3860	113 115 123 3980	113 115 122 4060
	1	113 115 122 3625	113 115 122 3680	113 115 122 3735	113 115 122 3795	113 115 122 3850	113 115 122 3975	113 115 122 4060
	2	113 115 122 3620	113 115 122 3675	113 115 121 3730	113 115 121 3785	113 115 121 3845	113 115 121 3975	113 115 121 4060
32000 V_{FTO} = 145	-2	114 115 124 3750	114 115 124 3810	114 115 124 3865	114 115 124 3925	114 115 124 3985	113 115 123 4100	113 115 123 4180
	-1	113 115 123 3735	113 115 123 3795	113 115 123 3855	113 115 123 3910	113 115 123 3970	113 115 123 4090	113 115 122 4175
	0	113 115 122 3725	113 115 122 3785	113 115 122 3845	113 115 122 3900	113 115 122 3960	113 115 122 4090	113 115 121 4175
	1	113 115 121 3720	113 115 121 3780	113 115 121 3840	113 115 121 3900	113 115 121 3960	112 115 121 4090	112 115 121 4180
	2	113 115 121 3720	113 115 120 3780	113 115 120 3840	113 115 120 3895	113 115 120 3955	112 115 120 4095	112 115 120 4190
33000 V_{FTO} = 147	-2	114 115 124 3790	113 115 123 3850	113 115 123 3910	113 115 123 3970	113 115 123 4030	113 115 123 4155	113 115 123 4235
	-1	113 115 123 3780	113 115 123 3840	113 115 122 3900	113 115 122 3960	113 115 122 4020	113 115 122 4145	113 115 122 4235
	0	113 115 122 3775	113 115 122 3835	113 115 122 3890	113 115 122 3955	113 115 122 4015	113 115 121 4145	113 115 121 4235
	1	113 115 121 3770	113 115 121 3830	113 115 121 3890	113 115 121 3950	113 115 121 4010	113 115 120 4150	112 115 120 4245
	2	113 115 120 3775	113 115 120 3835	113 115 120 3895	113 115 120 3950	113 115 120 4015	112 115 120 4160	112 115 120 4255

TODATA_350SFO_IMP_F20_WETG_ECS_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–48 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	33
34000 V_{FTO} = 149	-2	113 115 124 3835	113 115 124 3895	113 115 124 3955	113 115 124 4015	113 115 124 4080	113 115 123 4205	113 115 123 4290
	-1	113 115 123 3825	113 115 123 3890	113 116 123 3950	113 116 123 4010	113 116 123 4070	113 116 123 4200	113 116 122 4290
	0	113 116 122 3825	113 116 122 3885	113 116 122 3940	113 116 122 4005	113 116 122 4065	113 116 122 4200	112 116 122 4295
	1	113 116 122 3820	113 116 122 3885	113 116 122 3945	113 116 122 4005	113 116 122 4065	112 116 122 4205	112 117 122 4305
	2	113 117 122 3825	113 117 122 3890	113 117 122 3945	113 117 122 4010	113 117 122 4070	112 117 122 4220	112 117 122 4325
35000 V_{FTO} = 151	-2	113 117 125 3880	113 117 125 3940	113 117 125 4000	113 117 125 4065	113 117 125 4125	113 117 125 4255	113 117 124 4345
	-1	113 117 124 3870	113 117 124 3935	113 117 124 3995	113 117 124 4055	113 117 124 4120	113 117 124 4255	112 117 124 4350
	0	113 117 124 3870	113 117 124 3930	113 117 124 3990	113 117 124 4055	113 118 124 4115	112 118 124 4260	112 118 124 4355
	1	113 118 124 3870	113 118 124 3935	113 118 124 3995	113 118 124 4060	113 118 124 4120	112 118 124 4265	112 119 124 4375
	2	113 119 124 3905	113 119 124 3970	113 119 124 4030	113 119 124 4095	113 119 124 4160	113 119 124 4375	114 120 124 4565
36000 V_{FTO} = 153	-2	113 119 126 3925	113 119 126 3985	113 119 126 4045	113 119 126 4110	113 119 126 4175	113 119 126 4305	113 119 126 4400
	-1	113 119 126 3920	113 119 126 3980	113 119 126 4045	113 119 126 4105	113 119 126 4165	113 119 125 4305	112 119 125 4405
	0	113 119 125 3920	113 119 125 3980	113 119 125 4040	113 119 125 4105	113 120 125 4170	112 120 125 4315	112 120 125 4435
	1	113 120 125 3970	113 120 125 4035	113 120 125 4095	113 120 125 4160	113 120 125 4225	114 121 125 4445	115 121 125 4630
	2	115 121 125 4130	115 121 125 4195	115 121 125 4260	115 121 125 4330	115 121 125 4395	116 121 125 4635	117 122 125 4840
38000 V_{FTO} = 157	-2	113 122 129 4010	113 122 129 4075	113 122 129 4135	113 122 129 4205	113 122 129 4270	113 122 129 4410	113 123 129 4535
	-1	114 123 129 4070	114 123 129 4140	114 123 129 4200	114 123 129 4270	114 123 129 4340	114 123 129 4550	115 123 129 4735
	0	116 123 129 4235	116 124 129 4305	116 124 129 4375	116 124 129 4445	116 124 129 4515	116 124 129 4745	117 124 129 4945
	1	118 124 129 4415	118 124 129 4485	118 124 129 4555	118 124 129 4630	118 124 129 4705	119 125 129 4960	119 125 129 5175
	2	120 125 129 4605	120 125 129 4680	120 125 129 4755	120 125 129 4830	120 125 129 4910	121 125 129 5190	122 126 129 5445

TODATA_350SFO_IMP_F20_WETG_ECS_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–48 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
28000 V_{FTO} = 136	-2	114 115 126 3685	114 115 126 3740	114 115 125 3800	114 115 125 3860	114 115 125 3950	113 115 125 4075	113 115 124 4100
	-1	114 115 125 3665	114 115 125 3725	114 115 125 3780	114 115 125 3840	114 115 125 3930	113 115 124 4060	113 115 124 4090
	0	114 115 124 3650	114 115 124 3705	114 115 124 3765	114 115 124 3820	113 115 124 3920	113 115 123 4050	113 115 123 4080
	1	114 115 124 3635	114 115 123 3695	114 115 123 3750	114 115 123 3810	113 115 123 3910	113 115 122 4045	113 115 122 4075
	2	114 115 123 3630	113 115 123 3685	113 115 123 3740	113 115 123 3795	113 115 122 3900	113 115 122 4045	113 115 121 4075
30000 V_{FTO} = 140	-2	114 115 125 3775	114 115 125 3835	114 115 125 3895	114 115 124 3955	113 115 124 4055	113 115 124 4185	113 115 124 4215
	-1	114 115 124 3760	114 115 124 3820	114 115 124 3880	114 115 124 3935	113 115 124 4040	113 115 123 4175	113 115 123 4205
	0	114 115 123 3750	113 115 123 3805	113 115 123 3865	113 115 123 3925	113 115 123 4030	113 115 122 4175	113 115 122 4205
	1	113 115 122 3740	113 115 122 3795	113 115 122 3855	113 115 122 3915	113 115 122 4025	113 115 121 4175	113 115 121 4205
	2	113 115 122 3735	113 115 122 3790	113 115 121 3850	113 115 121 3910	113 115 121 4025	112 115 121 4180	112 115 120 4215
32000 V_{FTO} = 145	-2	114 115 124 3870	114 115 124 3930	114 115 124 3990	113 115 124 4055	113 115 123 4160	113 115 123 4300	113 115 123 4335
	-1	113 115 123 3855	113 115 123 3915	113 115 123 3975	113 115 123 4040	113 115 123 4150	113 115 122 4295	113 115 122 4330
	0	113 115 122 3845	113 115 122 3905	113 115 122 3965	113 115 122 4030	113 115 122 4145	113 115 121 4295	112 115 121 4330
	1	113 115 121 3840	113 115 121 3900	113 115 121 3960	113 115 121 4025	113 115 121 4140	112 115 120 4305	112 115 120 4340
	2	113 115 120 3840	113 115 120 3900	113 115 120 3960	113 115 120 4025	112 115 120 4145	112 115 120 4315	112 115 119 4350
33000 V_{FTO} = 147	-2	113 115 123 3915	113 115 123 3975	113 115 123 4040	113 115 123 4100	113 115 123 4210	113 115 122 4360	113 115 122 4390
	-1	113 115 123 3905	113 115 122 3965	113 115 122 4025	113 115 122 4090	113 115 122 4200	113 115 122 4355	113 115 121 4390
	0	113 115 122 3895	113 115 122 3955	113 115 122 4020	113 115 121 4080	113 115 121 4200	112 115 121 4360	112 115 121 4395
	1	113 115 121 3890	113 115 121 3955	113 115 121 4015	113 115 121 4080	113 115 121 4200	112 115 120 4370	112 115 120 4405
	2	113 115 120 3895	113 115 120 3955	113 115 120 4015	113 115 120 4080	112 115 120 4210	112 115 120 4385	112 116 120 4425

TODATA_350SFO_IMP_F20_WETG_ECS_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–49 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	30	31
34000 V_{FTO} = 149	-2	113 115 124 3960	113 115 124 4020	113 115 124 4085	113 115 124 4145	113 115 124 4260	113 115 123 4415	113 115 123 4450
	-1	113 116 123 3950	113 116 123 4010	113 116 123 4075	113 116 123 4140	113 116 123 4255	112 116 122 4415	112 116 122 4450
	0	113 116 123 3945	113 116 123 4005	113 116 123 4070	113 116 123 4135	113 116 122 4255	112 116 122 4420	112 116 122 4460
	1	113 116 122 3945	113 116 122 4005	113 116 122 4070	113 116 122 4130	112 116 122 4260	112 117 122 4435	112 117 122 4475
	2	113 117 122 3945	113 117 122 4010	113 117 122 4075	113 117 122 4140	112 117 122 4270	112 118 122 4455	112 118 122 4520
35000 V_{FTO} = 151	-2	113 117 125 4005	113 117 125 4070	113 117 125 4130	113 117 125 4195	113 117 125 4310	113 117 124 4475	113 117 124 4510
	-1	113 117 125 4000	113 117 125 4060	113 117 124 4125	113 117 124 4190	113 117 124 4310	112 117 124 4475	112 117 124 4510
	0	113 117 124 3995	113 118 124 4055	113 118 124 4120	113 118 124 4185	113 118 124 4310	112 118 124 4485	112 118 124 4525
	1	113 118 124 3995	113 118 124 4060	113 118 124 4120	113 118 124 4185	112 118 124 4320	112 119 124 4530	113 119 124 4595
	2	113 119 124 4015	113 119 124 4080	113 119 124 4150	113 119 124 4215	113 119 124 4400	114 120 124 4730	115 120 124 4800
36000 V_{FTO} = 153	-2	113 119 126 4050	113 119 126 4115	113 119 126 4180	113 119 126 4245	113 119 126 4365	112 119 126 4530	112 119 125 4565
	-1	113 119 126 4045	113 119 126 4105	113 119 126 4175	113 119 126 4240	113 119 126 4365	112 119 125 4535	112 120 125 4575
	0	113 119 125 4045	113 119 125 4105	113 120 125 4175	113 120 125 4240	112 120 125 4365	113 120 125 4595	113 120 125 4660
	1	113 120 125 4085	113 120 125 4150	113 120 125 4215	113 120 125 4290	113 120 125 4470	115 121 125 4795	115 121 125 4865
	2	115 121 125 4245	115 121 125 4315	115 121 125 4385	115 121 125 4460	116 121 125 4660	117 122 125 5015	117 122 125 5090
38000 V_{FTO} = 157	-2	113 122 129 4140	113 122 129 4205	113 122 129 4270	113 122 129 4340	113 122 129 4470	113 123 129 4695	113 123 129 4755
	-1	114 123 129 4190	113 123 129 4260	113 123 129 4330	113 123 129 4400	114 123 129 4580	115 124 129 4900	115 124 129 4970
	0	116 124 129 4360	116 124 129 4430	116 124 129 4505	116 124 129 4580	116 124 129 4775	117 124 129 5125	118 124 129 5195
	1	118 124 129 4540	118 124 129 4615	118 124 129 4690	118 124 129 4770	118 125 129 4985	120 125 129 5365	120 125 129 5440
	2	120 125 129 4740	120 125 129 4815	120 125 129 4895	120 125 129 4980	120 125 129 5210	122 126 129 5655	122 126 129 5745

TODATA_350SFO_IMP_F20_WETG_ECS_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–49 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	29	
28000 V_{FTO} = 136	-2	114 115 125 3810	114 115 125 3870	114 115 125 3930	114 115 125 4015	113 115 125 4130	113 115 124 4240	
	-1	114 115 125 3790	114 115 125 3845	114 115 125 3905	114 115 124 3995	113 115 124 4115	113 115 123 4230	
	0	114 115 124 3770	114 115 124 3830	114 115 124 3890	113 115 124 3985	113 115 123 4105	113 115 123 4225	
	1	114 115 123 3760	114 115 123 3820	114 115 123 3875	113 115 123 3970	113 115 122 4095	113 115 122 4220	
	2	113 115 123 3745	113 115 123 3805	113 115 122 3865	113 115 122 3965	113 115 122 4095	112 115 121 4225	
30000 V_{FTO} = 140	-2	114 115 125 3905	114 115 124 3965	114 115 124 4025	114 115 124 4120	113 115 124 4240	113 115 123 4370	
	-1	114 115 124 3885	114 115 124 3945	114 115 124 4010	113 115 124 4105	113 115 123 4230	113 115 122 4360	
	0	113 115 123 3875	113 115 123 3935	113 115 123 3995	113 115 123 4095	113 115 122 4225	113 115 122 4360	
	1	113 115 122 3865	113 115 122 3925	113 115 122 3985	113 115 122 4090	113 115 121 4225	112 115 121 4360	
	2	113 115 121 3855	113 115 121 3920	113 115 121 3980	113 115 121 4085	112 115 121 4225	112 115 120 4370	
32000 V_{FTO} = 145	-2	114 115 124 4000	113 115 124 4065	113 115 123 4125	113 115 123 4225	113 115 123 4355	113 115 122 4490	
	-1	113 115 123 3985	113 115 123 4050	113 115 123 4115	113 115 123 4215	113 115 122 4350	112 115 121 4490	
	0	113 115 122 3975	113 115 122 4040	113 115 122 4100	113 115 122 4205	113 115 121 4345	112 115 121 4495	
	1	113 115 121 3970	113 115 121 4030	113 115 121 4095	113 115 121 4205	112 115 120 4350	112 115 120 4505	
	2	113 115 120 3970	113 115 120 4030	113 115 120 4095	113 115 120 4205	112 115 120 4360	112 115 119 4520	
33000 V_{FTO} = 147	-2	113 115 123 4045	113 115 123 4110	113 115 123 4175	113 115 123 4280	113 115 122 4415	113 115 122 4555	
	-1	113 115 122 4035	113 115 122 4100	113 115 122 4165	113 115 122 4270	113 115 122 4410	112 115 121 4555	
	0	113 115 122 4025	113 115 122 4090	113 115 121 4155	113 115 121 4265	112 115 121 4410	112 115 120 4560	
	1	113 115 121 4025	113 115 121 4085	113 115 121 4155	113 115 121 4265	112 115 120 4415	112 115 120 4575	
	2	113 115 120 4025	113 115 120 4090	113 115 120 4155	112 115 120 4270	112 115 120 4430	112 116 120 4600	

TODATA_350SFO_IMP_F20_WETG_ECS_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–50 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON

V_1 (KIAS) V_R (KIAS)
V_2 (KIAS) TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)						
		5 & BELOW	10	15	20	25	29	
34000 V_{FTO} = 149	-2	113 115 124 4095	113 116 124 4160	113 116 124 4225	113 116 124 4330	113 116 123 4470	112 115 122 4615	
	-1	113 116 123 4085	113 116 123 4150	113 116 123 4215	113 116 123 4325	113 116 122 4465	112 116 122 4620	
	0	113 116 123 4080	113 116 123 4145	113 116 123 4210	113 116 122 4320	112 116 122 4470	112 116 122 4630	
	1	113 116 122 4075	113 116 122 4140	113 116 122 4210	112 116 122 4325	112 117 122 4480	112 117 122 4650	
	2	113 117 122 4080	113 117 122 4145	112 117 122 4210	112 117 122 4330	112 118 122 4500	113 118 122 4760	
35000 V_{FTO} = 151	-2	113 117 125 4140	113 117 125 4205	113 117 125 4275	113 117 125 4380	113 117 124 4525	112 117 124 4675	
	-1	113 117 125 4130	113 117 124 4200	113 117 124 4265	113 117 124 4380	112 117 124 4525	112 118 124 4685	
	0	113 118 124 4130	113 118 124 4195	113 118 124 4265	113 118 124 4380	112 118 124 4535	112 119 124 4700	
	1	113 118 124 4130	113 118 124 4195	113 118 124 4265	112 118 124 4385	112 119 124 4555	113 119 124 4830	
	2	113 119 124 4155	113 119 124 4225	113 119 124 4295	113 119 124 4450	114 120 124 4750	115 120 124 5050	
36000 V_{FTO} = 153	-2	113 119 126 4190	113 119 126 4255	113 119 126 4325	113 119 126 4435	113 119 126 4585	112 119 125 4735	
	-1	113 119 126 4180	113 119 126 4250	113 119 126 4320	113 119 126 4430	112 119 125 4585	112 120 125 4750	
	0	113 120 125 4180	113 120 125 4245	113 120 125 4315	112 120 125 4435	112 120 125 4625	114 121 125 4895	
	1	113 120 125 4225	113 120 125 4295	113 120 125 4365	113 121 125 4520	115 121 125 4820	116 121 125 5120	
	2	115 121 125 4390	115 121 125 4465	115 121 125 4540	115 121 125 4710	117 122 125 5040	118 122 125 5370	
38000 V_{FTO} = 157	-2	113 122 129 4280	113 122 129 4350	113 122 129 4420	113 122 129 4535	113 123 129 4725	114 123 129 4995	
	-1	113 123 129 4335	113 123 129 4405	113 123 129 4480	114 123 129 4635	115 124 129 4935	116 124 129 5220	
	0	116 124 129 4510	116 124 129 4585	116 124 129 4665	116 124 129 4835	117 124 129 5150	118 125 129 5465	
	1	118 124 129 4700	118 124 129 4775	118 125 129 4860	118 125 129 5040	119 125 129 5390	120 126 129 5730	
	2	120 125 129 4900	120 125 129 4985	120 125 129 5070	120 125 129 5265	122 126 129 5665	123 126 129 6065	

TODATA_350SFO_IMP_F20_WETG_ECS_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07−11A−01−50 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	27	
28000 V_{FTO} = 136	-2	114 115 125 3940	114 115 125 4000	114 115 125 4085	114 115 124 4195	113 115 124 4330	113 115 124 4395	
	-1	114 115 125 3920	114 115 124 3980	114 115 124 4070	113 115 124 4180	113 115 123 4315	113 115 123 4380	
	0	114 115 124 3900	114 115 124 3965	113 115 124 4050	113 115 123 4165	113 115 122 4310	113 115 122 4375	
	1	114 115 123 3885	113 115 123 3950	113 115 123 4040	113 115 122 4160	113 115 122 4305	112 115 121 4375	
	2	113 115 122 3880	113 115 122 3940	113 115 122 4030	113 115 122 4150	112 115 121 4310	112 115 121 4385	
30000 V_{FTO} = 140	-2	114 115 124 4040	114 115 124 4105	114 115 124 4195	113 115 124 4310	113 115 123 4455	113 115 123 4525	
	-1	114 115 124 4020	113 115 124 4085	113 115 123 4180	113 115 123 4300	113 115 122 4450	113 115 122 4520	
	0	113 115 123 4010	113 115 123 4070	113 115 123 4165	113 115 122 4290	113 115 121 4445	112 115 121 4520	
	1	113 115 122 4000	113 115 122 4065	113 115 122 4160	113 115 121 4285	112 115 121 4450	112 115 120 4525	
	2	113 115 121 3995	113 115 121 4055	113 115 121 4155	113 115 121 4285	112 115 120 4455	112 115 120 4540	
32000 V_{FTO} = 145	-2	113 115 123 4140	113 115 123 4205	113 115 123 4300	113 115 123 4425	113 115 122 4585	113 115 122 4655	
	-1	113 115 123 4125	113 115 123 4190	113 115 123 4290	113 115 122 4415	112 115 121 4580	112 115 121 4655	
	0	113 115 122 4115	113 115 122 4180	113 115 122 4280	113 115 121 4415	112 115 121 4585	112 115 120 4665	
	1	113 115 121 4110	113 115 121 4175	113 115 121 4280	112 115 120 4415	112 115 120 4595	112 115 119 4680	
	2	113 115 120 4110	113 115 120 4175	113 115 120 4280	112 115 120 4425	112 115 119 4610	112 115 119 4700	
33000 V_{FTO} = 147	-2	113 115 123 4190	113 115 123 4255	113 115 123 4355	113 115 122 4480	113 115 122 4645	112 115 121 4720	
	-1	113 115 122 4175	113 115 122 4245	113 115 122 4345	113 115 121 4475	112 115 121 4645	112 115 121 4725	
	0	113 115 121 4170	113 115 121 4235	113 115 121 4340	113 115 121 4475	112 115 120 4655	112 115 120 4735	
	1	113 115 121 4165	113 115 121 4235	113 115 120 4340	112 115 120 4480	112 115 120 4665	112 115 120 4755	
	2	113 115 120 4165	113 115 120 4235	112 115 120 4345	112 115 120 4490	112 116 120 4690	112 116 120 4780	

TODATA_350SFO_IMP_F20_WETG_ECS_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–51 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C) 5 & BELOW	10	15	20	25	27
34000 V_{FTO} = 149	-2	113 116 124 4235	113 116 124 4305	113 116 124 4405	113 116 123 4535	112 115 122 4710	112 115 122 4785
	-1	113 116 123 4230	113 116 123 4295	113 116 123 4400	113 116 122 4535	112 116 122 4710	112 116 122 4795
	0	113 116 122 4220	113 116 122 4290	113 116 122 4395	112 116 122 4535	112 117 122 4720	112 117 122 4810
	1	113 116 122 4220	113 116 122 4290	112 116 122 4400	112 117 122 4545	112 117 122 4740	112 118 122 4830
	2	112 117 122 4225	112 117 122 4295	112 117 122 4405	112 118 122 4560	113 118 122 4860	113 118 122 5015
35000 V_{FTO} = 151	-2	113 117 125 4285	113 117 125 4355	113 117 125 4460	113 117 124 4595	112 117 124 4770	112 117 124 4850
	-1	113 117 124 4280	113 118 124 4350	113 118 124 4455	112 117 124 4595	112 118 124 4780	112 118 124 4860
	0	113 118 124 4275	113 118 124 4345	113 118 124 4455	112 118 124 4600	112 119 124 4790	112 119 124 4880
	1	113 118 124 4280	112 118 124 4350	112 118 124 4460	112 119 124 4610	113 119 124 4935	114 120 124 5090
	2	113 119 124 4315	113 119 124 4390	113 119 124 4525	114 120 124 4800	115 120 124 5160	116 120 124 5330
36000 V_{FTO} = 153	-2	113 119 126 4335	113 119 126 4410	113 119 126 4515	113 119 126 4650	112 119 126 4835	112 120 126 4915
	-1	113 119 126 4330	113 119 126 4400	113 119 126 4510	112 120 126 4655	112 120 126 4845	112 120 126 4930
	0	113 120 126 4330	113 120 126 4400	112 120 126 4510	112 120 126 4675	114 121 126 5005	114 121 126 5155
	1	113 120 126 4385	113 121 126 4460	113 121 126 4600	114 121 126 4870	116 122 126 5230	116 122 126 5395
	2	115 121 126 4560	115 121 126 4640	115 121 126 4785	117 122 126 5085	118 122 126 5490	119 123 126 5680
38000 V_{FTO} = 157	-2	113 122 129 4435	113 122 129 4510	113 122 129 4620	113 123 129 4780	114 123 129 5105	114 124 129 5250
	-1	114 123 129 4500	114 123 129 4580	114 123 129 4715	115 124 129 4990	116 124 129 5335	117 124 129 5490
	0	116 124 129 4685	116 124 129 4765	116 124 129 4915	117 124 129 5205	118 125 129 5580	119 125 129 5755
	1	118 125 129 4880	118 125 129 4965	118 125 129 5120	119 125 129 5440	120 126 129 5855	121 126 129 6055
	2	120 125 129 5095	120 125 129 5180	120 125 129 5355	121 126 129 5715	123 126 129 6195	124 127 129 6410

TODATA_350SFO_IMP_F20_WETG_ECS_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–51 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	115 115 126 3245	115 115 126 3300	114 115 126 3355	114 115 126 3410	114 115 126 3465	114 115 126 3515
	-1	114 115 126 3230	114 115 126 3285	114 115 125 3340	114 115 125 3390	114 115 125 3445	114 115 125 3500
	0	114 115 125 3215	114 115 125 3270	114 115 125 3325	114 115 125 3380	114 115 124 3430	114 115 124 3485
	1	114 115 124 3205	114 115 124 3260	114 115 124 3315	114 115 124 3365	114 115 124 3420	114 115 124 3475
	2	114 115 123 3195	114 115 123 3250	114 115 123 3305	114 115 123 3360	114 115 123 3410	114 115 123 3465
30000 V_{FTO} = 140	-2	114 115 125 3325	114 115 125 3380	114 115 125 3435	114 115 125 3495	114 115 125 3545	114 115 125 3605
	-1	114 115 125 3310	114 115 125 3370	114 115 124 3420	114 115 124 3480	114 115 124 3535	114 115 124 3590
	0	114 115 124 3300	114 115 124 3355	114 115 124 3410	114 115 123 3470	114 115 123 3520	114 115 123 3580
	1	114 115 123 3290	114 115 123 3350	114 115 123 3405	113 115 123 3460	113 115 123 3515	113 115 122 3570
	2	113 115 122 3285	113 115 122 3345	113 115 122 3400	113 115 122 3455	113 115 122 3510	113 115 122 3565
32000 V_{FTO} = 145	-2	114 115 124 3405	114 115 124 3460	114 115 124 3520	114 115 124 3575	114 115 124 3635	114 115 124 3690
	-1	114 115 124 3395	114 115 124 3450	114 115 123 3505	114 115 123 3565	114 115 123 3625	113 115 123 3680
	0	113 115 123 3385	113 115 123 3440	113 115 122 3500	113 115 122 3560	113 115 122 3615	113 115 122 3670
	1	113 115 122 3380	113 115 122 3435	113 115 122 3495	113 115 122 3550	113 115 121 3610	113 115 121 3670
	2	113 115 121 3380	113 115 121 3435	113 115 121 3495	113 115 121 3555	113 115 121 3610	113 115 120 3670
33000 V_{FTO} = 147	-2	114 115 124 3440	114 115 124 3500	114 115 124 3560	114 115 124 3615	114 115 124 3675	114 115 123 3735
	-1	114 115 123 3435	113 115 123 3490	113 115 123 3550	113 115 123 3610	113 115 123 3665	113 115 123 3725
	0	113 115 122 3425	113 115 122 3485	113 115 122 3545	113 115 122 3600	113 115 122 3660	113 115 122 3720
	1	113 115 121 3425	113 115 121 3480	113 115 121 3540	113 115 121 3600	113 115 121 3660	113 115 121 3720
	2	113 115 120 3425	113 115 120 3485	113 115 120 3545	113 115 120 3600	113 115 120 3660	113 115 120 3720

TODATA_350SFO_IMP_F20_WETG_ALL_SL_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–52 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE SEA LEVEL** V_1 (KIAS) V_R (KIAS)

ENGINE BLEED ON, ENGINE & WING A/I ON V_2 (KIAS) TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3480	114 115 124 3540	114 115 124 3600	113 115 124 3660	113 115 124 3720	113 115 124 3780
	-1	113 115 123 3470	113 115 123 3530	113 115 123 3590	113 115 123 3650	113 115 123 3710	113 115 123 3770
	0	113 115 123 3470	113 115 122 3530	113 115 122 3590	113 115 122 3645	113 116 122 3705	113 116 122 3765
	1	113 116 122 3470	113 116 122 3525	113 116 122 3585	113 116 122 3645	113 116 122 3705	113 116 122 3770
	2	113 116 122 3470	113 116 122 3530	113 117 122 3590	113 117 122 3650	113 117 122 3710	113 117 122 3770
35000 V_{FTO} = 151	-2	113 117 125 3520	113 117 125 3580	113 117 125 3640	113 117 125 3700	113 117 125 3760	113 117 125 3820
	-1	113 117 124 3510	113 117 124 3575	113 117 124 3635	113 117 124 3695	113 117 124 3755	113 117 124 3815
	0	113 117 124 3510	113 117 124 3570	113 117 124 3635	113 117 124 3690	113 117 124 3755	113 117 124 3815
	1	113 118 124 3515	113 118 124 3575	113 118 124 3635	113 118 124 3695	113 118 124 3755	113 118 124 3820
	2	113 119 124 3535	113 119 124 3605	113 119 124 3670	113 119 124 3730	113 119 124 3795	113 119 124 3865
36000 V_{FTO} = 153	-2	113 118 126 3560	113 118 126 3620	113 118 126 3680	113 118 126 3740	113 118 126 3805	113 119 126 3865
	-1	113 118 126 3555	113 119 126 3615	113 119 126 3675	113 119 126 3740	113 119 126 3800	113 119 126 3860
	0	113 119 125 3555	113 119 125 3615	113 119 125 3675	113 119 125 3735	113 119 125 3800	113 119 125 3860
	1	113 120 125 3595	113 120 125 3660	113 120 125 3730	113 120 125 3795	114 120 125 3860	114 120 125 3925
	2	116 121 125 3740	116 121 125 3810	116 121 125 3880	116 121 125 3945	116 121 125 4015	116 121 125 4085
38000 V_{FTO} = 157	-2	113 122 129 3635	113 122 129 3695	113 122 129 3760	113 122 129 3825	113 122 129 3885	113 122 129 3950
	-1	114 122 129 3680	114 122 129 3750	114 122 129 3820	114 123 129 3885	114 123 129 3955	114 123 129 4025
	0	116 123 129 3835	116 123 129 3905	116 123 129 3980	116 123 129 4045	116 123 129 4120	116 124 129 4190
	1	118 124 129 3990	118 124 129 4070	118 124 129 4140	118 124 129 4215	118 124 129 4290	118 124 129 4365
	2	120 125 129 4170	121 125 129 4250	121 125 129 4325	121 125 129 4405	121 125 129 4485	121 125 129 4560

TODATA_350SFO_IMP_F20_WETG_ALL_SL_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–52 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	115 115 126 3295	114 115 126 3355	114 115 126 3410	114 115 126 3465	114 115 126 3515	114 115 126 3570
	-1	114 115 126 3280	114 115 125 3335	114 115 125 3390	114 115 125 3445	114 115 125 3500	114 115 125 3555
	0	114 115 125 3265	114 115 125 3320	114 115 125 3375	114 115 124 3430	114 115 124 3485	114 115 124 3540
	1	114 115 124 3255	114 115 124 3310	114 115 124 3365	114 115 124 3420	114 115 124 3475	114 115 124 3530
	2	114 115 123 3245	114 115 123 3300	114 115 123 3355	114 115 123 3410	114 115 123 3465	114 115 123 3520
30000 V_{FTO} = 140	-2	114 115 125 3375	114 115 125 3435	114 115 125 3490	114 115 125 3545	114 115 125 3605	114 115 125 3660
	-1	114 115 125 3365	114 115 124 3420	114 115 124 3475	114 115 124 3535	114 115 124 3590	114 115 124 3650
	0	114 115 124 3350	114 115 124 3410	114 115 124 3465	114 115 123 3520	114 115 123 3580	114 115 123 3635
	1	114 115 123 3345	114 115 123 3400	113 115 123 3455	113 115 123 3515	113 115 122 3570	113 115 122 3630
	2	113 115 122 3340	113 115 122 3395	113 115 122 3455	113 115 122 3510	113 115 122 3565	113 115 122 3620
32000 V_{FTO} = 145	-2	114 115 124 3455	114 115 124 3515	114 115 124 3575	114 115 124 3630	114 115 124 3690	114 115 124 3750
	-1	114 115 124 3445	114 115 123 3505	114 115 123 3565	114 115 123 3620	113 115 123 3680	113 115 123 3740
	0	113 115 123 3440	113 115 123 3495	113 115 122 3555	113 115 122 3615	113 115 122 3670	113 115 122 3730
	1	113 115 122 3430	113 115 122 3490	113 115 122 3550	113 115 121 3610	113 115 121 3670	113 115 121 3725
	2	113 115 121 3430	113 115 121 3490	113 115 121 3550	113 115 121 3610	113 115 121 3665	113 115 120 3725
33000 V_{FTO} = 147	-2	114 115 124 3495	114 115 124 3555	114 115 124 3615	114 115 124 3675	114 115 124 3735	113 115 123 3795
	-1	114 115 123 3485	113 115 123 3545	113 115 123 3605	113 115 123 3665	113 115 123 3725	113 115 123 3785
	0	113 115 122 3480	113 115 122 3540	113 115 122 3600	113 115 122 3660	113 115 122 3720	113 115 122 3780
	1	113 115 121 3475	113 115 121 3535	113 115 121 3595	113 115 121 3655	113 115 121 3720	113 115 121 3775
	2	113 115 120 3480	113 115 120 3540	113 115 120 3600	113 115 120 3660	113 115 120 3720	113 115 120 3780

TODATA_350SFO_IMP_F20_WETG_ALL_500_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–53 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 500 FT** | V_1 (KIAS) | V_R (KIAS) | V_2 (KIAS) | TOFL (FT)

ENGINE BLEED ON, ENGINE & WING A/I ON

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3535	114 115 124 3595	113 115 124 3655	113 115 124 3715	113 115 124 3780	113 115 124 3840
	-1	113 115 123 3525	113 115 123 3590	113 115 123 3650	113 115 123 3710	113 115 123 3770	113 115 123 3830
	0	113 115 123 3525	113 115 122 3585	113 115 122 3645	113 116 122 3705	113 116 122 3765	113 116 122 3825
	1	113 116 122 3520	113 116 122 3585	113 116 122 3645	113 116 122 3705	113 116 122 3765	113 116 122 3825
	2	113 116 122 3525	113 117 122 3590	113 117 122 3650	113 117 122 3710	113 117 122 3770	113 117 122 3830
35000 V_{FTO} = 151	-2	113 117 125 3575	113 117 125 3635	113 117 125 3700	113 117 125 3760	113 117 125 3820	113 117 125 3885
	-1	113 117 124 3570	113 117 124 3630	113 117 124 3690	113 117 124 3755	113 117 124 3815	113 117 124 3875
	0	113 117 124 3565	113 117 124 3630	113 117 124 3690	113 117 124 3750	113 117 124 3815	113 117 124 3875
	1	113 118 124 3570	113 118 124 3630	113 118 124 3690	113 118 124 3755	113 118 124 3815	113 118 124 3875
	2	113 119 124 3595	113 119 124 3660	113 119 124 3725	113 119 124 3790	113 119 124 3855	113 119 124 3920
36000 V_{FTO} = 153	-2	113 118 126 3615	113 118 126 3675	113 118 126 3740	113 118 126 3800	113 119 126 3865	113 119 126 3925
	-1	113 119 126 3610	113 119 126 3675	113 119 126 3735	113 119 126 3800	113 119 126 3860	113 119 126 3920
	0	113 119 125 3610	113 119 125 3675	113 119 125 3735	113 119 125 3795	113 119 125 3860	113 119 125 3925
	1	113 120 125 3650	113 120 125 3720	113 120 125 3785	113 120 125 3855	113 120 125 3920	113 120 125 3985
	2	116 121 125 3800	116 121 125 3870	116 121 125 3940	116 121 125 4010	116 121 125 4075	116 121 125 4145
38000 V_{FTO} = 157	-2	113 122 129 3695	113 122 129 3755	113 122 129 3820	113 122 129 3885	113 122 129 3950	113 122 129 4015
	-1	114 122 129 3740	114 122 129 3815	114 123 129 3880	114 123 129 3950	114 123 129 4020	114 123 129 4085
	0	116 123 129 3895	116 123 129 3970	116 123 129 4040	116 123 129 4110	116 123 129 4185	116 124 129 4255
	1	118 124 129 4055	118 124 129 4135	118 124 129 4210	118 124 129 4285	118 124 129 4360	118 124 129 4430
	2	120 125 129 4235	120 125 129 4315	120 125 129 4395	120 125 129 4475	120 125 129 4550	120 125 129 4630

TODATA_350SFO_IMP_F20_WETG_ALL_500_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–53 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3350	114 115 126 3405	114 115 126 3460	114 115 126 3515	114 115 126 3570	114 115 126 3630
	-1	114 115 126 3330	114 115 125 3385	114 115 125 3445	114 115 125 3500	114 115 125 3555	114 115 125 3610
	0	114 115 125 3320	114 115 125 3375	114 115 125 3430	114 115 124 3485	114 115 124 3540	114 115 124 3595
	1	114 115 124 3305	114 115 124 3360	114 115 124 3415	114 115 124 3470	114 115 124 3530	114 115 124 3580
	2	114 115 123 3295	114 115 123 3355	114 115 123 3410	114 115 123 3460	114 115 123 3520	113 115 123 3575
30000 V_{FTO} = 140	-2	114 115 125 3430	114 115 125 3490	114 115 125 3545	114 115 125 3605	114 115 125 3660	114 115 125 3720
	-1	114 115 124 3415	114 115 124 3475	114 115 124 3530	114 115 124 3590	114 115 124 3645	114 115 124 3705
	0	114 115 124 3405	114 115 124 3465	114 115 123 3520	114 115 123 3575	114 115 123 3635	114 115 123 3690
	1	114 115 123 3395	114 115 123 3455	113 115 123 3510	113 115 123 3570	113 115 122 3625	113 115 122 3680
	2	113 115 122 3390	113 115 122 3450	113 115 122 3505	113 115 122 3560	113 115 122 3620	113 115 122 3675
32000 V_{FTO} = 145	-2	114 115 124 3510	114 115 124 3570	114 115 124 3630	114 115 124 3690	114 115 124 3750	114 115 124 3810
	-1	114 115 123 3500	114 115 123 3560	114 115 123 3620	113 115 123 3680	113 115 123 3735	113 115 123 3795
	0	113 115 123 3490	113 115 122 3550	113 115 122 3610	113 115 122 3670	113 115 122 3730	113 115 122 3790
	1	113 115 122 3485	113 115 122 3545	113 115 122 3605	113 115 121 3665	113 115 121 3725	113 115 121 3785
	2	113 115 121 3485	113 115 121 3545	113 115 121 3605	113 115 121 3665	113 115 120 3725	113 115 120 3785
33000 V_{FTO} = 147	-2	114 115 124 3555	114 115 124 3610	114 115 124 3670	114 115 124 3735	114 115 123 3795	113 115 123 3850
	-1	113 115 123 3540	113 115 123 3600	113 115 123 3665	113 115 123 3720	113 115 123 3785	113 115 123 3845
	0	113 115 122 3535	113 115 122 3595	113 115 122 3655	113 115 122 3715	113 115 122 3775	113 115 122 3835
	1	113 115 121 3530	113 115 121 3595	113 115 121 3655	113 115 121 3715	113 115 121 3775	113 115 121 3835
	2	113 115 120 3535	113 115 120 3595	113 115 120 3655	113 115 120 3715	113 115 120 3775	113 115 120 3835

TODATA_350SFO_IMP_F20_WETG_ALL_1K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–54 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 1000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	114 115 124 3590	114 115 124 3655	113 115 124 3715	113 115 124 3775	113 115 124 3840	113 115 124 3895
	-1	113 115 123 3585	113 115 123 3645	113 115 123 3705	113 115 123 3765	113 115 123 3830	113 115 123 3890
	0	113 115 123 3580	113 115 123 3640	113 116 122 3700	113 116 122 3765	113 116 122 3825	113 116 122 3885
	1	113 116 122 3580	113 116 122 3640	113 116 122 3700	113 116 122 3765	113 116 122 3825	113 116 122 3885
	2	113 116 122 3580	113 117 122 3645	113 117 122 3705	113 117 122 3765	113 117 122 3830	113 117 122 3890
35000 V_{FTO} = 151	-2	113 117 125 3630	113 117 125 3695	113 117 125 3755	113 117 125 3820	113 117 125 3880	113 117 125 3940
	-1	113 117 125 3625	113 117 124 3690	113 117 124 3750	113 117 124 3810	113 117 124 3875	113 117 124 3935
	0	113 117 124 3625	113 117 124 3685	113 117 124 3745	113 117 124 3810	113 117 124 3875	113 117 124 3935
	1	113 118 124 3625	113 118 124 3685	113 118 124 3750	113 118 124 3810	113 118 124 3875	113 118 124 3935
	2	113 119 124 3650	113 119 124 3715	113 119 124 3780	113 119 124 3845	113 119 124 3915	113 119 124 3975
36000 V_{FTO} = 153	-2	113 118 126 3670	113 118 126 3735	113 118 126 3800	113 119 126 3860	113 119 126 3925	113 119 126 3985
	-1	113 119 126 3665	113 119 126 3730	113 119 126 3795	113 119 126 3855	113 119 126 3920	113 119 126 3985
	0	113 119 125 3665	113 119 125 3730	113 119 125 3795	113 119 125 3855	113 119 125 3920	113 119 125 3980
	1	113 120 125 3705	113 120 125 3775	113 120 125 3840	113 120 125 3910	113 120 125 3975	113 120 125 4040
	2	115 121 125 3855	115 121 125 3925	116 121 125 3995	116 121 125 4065	116 121 125 4135	116 121 125 4205
38000 V_{FTO} = 157	-2	113 122 129 3750	113 122 129 3815	113 122 129 3880	113 122 129 3950	113 122 129 4010	113 122 129 4075
	-1	114 122 129 3800	114 122 129 3870	114 123 129 3940	114 123 129 4010	114 123 129 4080	114 123 129 4145
	0	116 123 129 3955	116 123 129 4030	116 123 129 4100	116 123 129 4175	116 124 129 4245	116 124 129 4315
	1	118 124 129 4120	118 124 129 4195	118 124 129 4270	118 124 129 4345	118 124 129 4420	118 124 129 4495
	2	120 125 129 4300	120 125 129 4380	120 125 129 4460	120 125 129 4535	120 125 129 4615	120 125 129 4695

TODATA_350SFO_IMP_F20_WETG_ALL_1K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–54 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3455	114 115 126 3515	114 115 126 3570	114 115 126 3630	114 115 126 3690	114 115 125 3750
	-1	114 115 125 3440	114 115 125 3495	114 115 125 3555	114 115 125 3610	114 115 125 3670	114 115 125 3735
	0	114 115 125 3425	114 115 125 3480	114 115 124 3535	114 115 124 3595	114 115 124 3655	114 115 124 3720
	1	114 115 124 3410	114 115 124 3470	114 115 124 3525	114 115 124 3580	114 115 124 3640	114 115 123 3705
	2	114 115 123 3400	114 115 123 3455	114 115 123 3515	114 115 123 3570	113 115 123 3630	113 115 122 3700
30000 V_{FTO} = 140	-2	114 115 125 3540	114 115 125 3600	114 115 125 3660	114 115 125 3720	114 115 125 3780	114 115 124 3850
	-1	114 115 124 3525	114 115 124 3585	114 115 124 3645	114 115 124 3705	114 115 124 3765	114 115 124 3835
	0	114 115 124 3510	114 115 123 3570	114 115 123 3630	114 115 123 3690	114 115 123 3750	113 115 123 3820
	1	114 115 123 3505	113 115 123 3565	113 115 123 3620	113 115 122 3680	113 115 122 3740	113 115 122 3810
	2	113 115 122 3495	113 115 122 3555	113 115 122 3615	113 115 122 3675	113 115 122 3735	113 115 121 3805
32000 V_{FTO} = 145	-2	114 115 124 3625	114 115 124 3685	114 115 124 3750	114 115 124 3810	114 115 124 3870	113 115 124 3945
	-1	114 115 123 3615	114 115 123 3670	113 115 123 3735	113 115 123 3795	113 115 123 3860	113 115 123 3930
	0	113 115 123 3605	113 115 122 3665	113 115 122 3725	113 115 122 3790	113 115 122 3845	113 115 122 3920
	1	113 115 122 3600	113 115 122 3660	113 115 121 3720	113 115 121 3780	113 115 121 3845	113 115 121 3920
	2	113 115 121 3595	113 115 121 3660	113 115 121 3720	113 115 121 3780	113 115 120 3840	113 115 120 3920
33000 V_{FTO} = 147	-2	114 115 124 3665	114 115 124 3730	114 115 124 3790	113 115 123 3850	113 115 123 3915	113 115 123 3990
	-1	113 115 123 3655	113 115 123 3715	113 115 123 3780	113 115 123 3840	113 115 123 3905	113 115 122 3980
	0	113 115 122 3650	113 115 122 3710	113 115 122 3775	113 115 122 3835	113 115 122 3895	113 115 121 3975
	1	113 115 121 3645	113 115 121 3710	113 115 121 3770	113 115 121 3830	113 115 121 3895	113 115 121 3970
	2	113 115 120 3645	113 115 120 3710	113 115 120 3770	113 115 120 3835	113 115 120 3895	113 115 120 3975

TODATA_350SFO_IMP_F20_WETG_ALL_2K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–55 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 2000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 3710	113 115 124 3770	113 115 124 3835	113 115 124 3895	113 115 124 3960	113 115 124 4035
	-1	113 115 123 3700	113 115 123 3760	113 115 123 3825	113 115 123 3890	113 116 123 3950	113 116 123 4030
	0	113 116 123 3695	113 116 123 3755	113 116 123 3820	113 116 123 3885	113 116 123 3945	113 116 122 4025
	1	113 116 122 3695	113 116 122 3755	113 116 122 3820	113 116 122 3885	113 116 122 3945	113 116 122 4025
	2	113 117 122 3695	113 117 122 3760	113 117 122 3825	113 117 122 3890	113 117 122 3950	113 117 122 4030
35000 V_{FTO} = 151	-2	113 117 125 3750	113 117 125 3815	113 117 125 3880	113 117 125 3940	113 117 125 4005	113 117 125 4085
	-1	113 117 125 3745	113 117 125 3805	113 117 125 3870	113 117 124 3935	113 117 124 4000	113 117 124 4075
	0	113 117 124 3740	113 117 124 3805	113 117 124 3870	113 117 124 3930	113 117 124 3995	113 117 124 4075
	1	113 118 124 3740	113 118 124 3805	113 118 124 3870	113 118 124 3935	113 118 124 4000	113 118 124 4080
	2	113 119 124 3760	113 119 124 3825	113 119 124 3895	113 119 124 3960	113 119 124 4025	113 119 124 4135
36000 V_{FTO} = 153	-2	113 118 127 3790	113 119 127 3855	113 119 126 3920	113 119 126 3985	113 119 126 4050	113 119 126 4130
	-1	113 119 126 3785	113 119 126 3850	113 119 126 3915	113 119 126 3980	113 119 126 4045	113 119 126 4125
	0	113 119 125 3785	113 119 125 3850	113 119 125 3915	113 119 125 3980	113 119 125 4045	113 120 125 4125
	1	113 120 125 3820	113 120 125 3890	113 120 125 3955	113 120 125 4025	113 120 125 4095	114 120 125 4205
	2	115 121 125 3970	115 121 125 4045	115 121 125 4115	115 121 125 4185	115 121 125 4255	116 121 125 4375
38000 V_{FTO} = 157	-2	113 122 129 3875	113 122 129 3940	113 122 129 4005	113 122 129 4075	113 122 129 4140	113 122 129 4225
	-1	114 122 129 3915	114 123 129 3990	114 123 129 4060	114 123 129 4130	114 123 129 4200	114 123 129 4310
	0	116 123 129 4075	116 123 129 4150	116 123 129 4225	116 124 129 4295	116 124 129 4370	116 124 129 4490
	1	118 124 129 4245	118 124 129 4320	118 124 129 4400	118 124 129 4475	118 124 129 4550	118 125 129 4680
	2	120 125 129 4430	120 125 129 4510	120 125 129 4590	120 125 129 4670	120 125 129 4750	120 125 129 4885

TODATA_350SFO_IMP_F20_WETG_ALL_2K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–55 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3570	114 115 126 3630	114 115 126 3690	114 115 126 3750	114 115 125 3815	114 115 125 3920
	-1	114 115 125 3555	114 115 125 3610	114 115 125 3670	114 115 125 3730	114 115 125 3795	114 115 124 3905
	0	114 115 124 3535	114 115 124 3595	114 115 124 3655	114 115 124 3715	114 115 124 3780	113 115 123 3890
	1	114 115 124 3525	114 115 124 3580	114 115 124 3640	114 115 123 3700	114 115 123 3765	113 115 122 3880
	2	114 115 123 3515	114 115 123 3575	113 115 123 3635	113 115 123 3690	113 115 122 3755	113 115 122 3875
30000 V_{FTO} = 140	-2	114 115 125 3660	114 115 125 3720	114 115 125 3780	114 115 125 3845	114 115 124 3910	113 115 124 4025
	-1	114 115 124 3640	114 115 124 3705	114 115 124 3765	114 115 124 3830	114 115 124 3895	113 115 123 4010
	0	114 115 123 3630	114 115 123 3690	114 115 123 3750	113 115 123 3815	113 115 123 3880	113 115 122 4000
	1	113 115 123 3620	113 115 122 3680	113 115 122 3745	113 115 122 3805	113 115 122 3875	113 115 121 4000
	2	113 115 122 3615	113 115 122 3675	113 115 122 3740	113 115 121 3800	113 115 121 3865	113 115 121 3995
32000 V_{FTO} = 145	-2	114 115 124 3745	114 115 124 3810	114 115 124 3875	114 115 124 3935	113 115 124 4010	113 115 123 4130
	-1	113 115 123 3735	113 115 123 3795	113 115 123 3860	113 115 123 3925	113 115 123 3995	113 115 122 4120
	0	113 115 122 3725	113 115 122 3790	113 115 122 3850	113 115 122 3915	113 115 122 3985	113 115 121 4115
	1	113 115 121 3720	113 115 121 3780	113 115 121 3845	113 115 121 3910	113 115 121 3980	113 115 120 4115
	2	113 115 121 3720	113 115 121 3780	113 115 120 3845	113 115 120 3910	113 115 120 3980	112 115 120 4120
33000 V_{FTO} = 147	-2	114 115 124 3790	113 115 123 3855	113 115 123 3920	113 115 123 3985	113 115 123 4055	113 115 122 4180
	-1	113 115 123 3780	113 115 123 3845	113 115 123 3910	113 115 122 3970	113 115 122 4045	113 115 122 4170
	0	113 115 122 3770	113 115 122 3835	113 115 122 3900	113 115 122 3965	113 115 121 4035	113 115 121 4170
	1	113 115 121 3770	113 115 121 3835	113 115 121 3900	113 115 121 3965	113 115 121 4035	113 115 120 4175
	2	113 115 120 3770	113 115 120 3835	113 115 120 3900	113 115 120 3965	113 115 120 4035	112 115 120 4180

TODATA_350SFO_IMP_F20_WETG_ALL_3K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–56 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 3000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 3835	113 115 124 3900	113 115 124 3965	113 115 124 4030	113 115 124 4105	113 115 123 4230
	-1	113 115 123 3825	113 115 123 3890	113 116 123 3955	113 116 123 4020	113 116 123 4095	113 116 122 4225
	0	113 116 123 3820	113 116 123 3885	113 116 123 3950	113 116 123 4015	113 116 122 4090	113 116 122 4225
	1	113 116 122 3820	113 116 122 3885	113 116 122 3950	113 116 122 4015	113 116 122 4090	112 117 122 4230
	2	113 117 122 3820	113 117 122 3890	113 117 122 3955	113 117 122 4020	112 117 122 4095	112 118 122 4245
35000 V_{FTO} = 151	-2	113 117 125 3875	113 117 125 3945	113 117 125 4010	113 117 125 4075	113 117 125 4150	113 117 124 4280
	-1	113 117 125 3870	113 117 125 3935	113 117 124 4005	113 117 124 4070	113 117 124 4145	113 117 124 4280
	0	113 117 124 3865	113 117 124 3930	113 117 124 4000	113 118 124 4065	113 118 124 4140	112 118 124 4285
	1	113 118 124 3870	113 118 124 3935	113 118 124 4000	113 118 124 4070	113 118 124 4145	112 119 124 4295
	2	113 119 124 3890	113 119 124 3960	113 119 124 4030	113 119 124 4095	113 119 124 4190	114 120 124 4470
36000 V_{FTO} = 153	-2	113 119 127 3920	113 119 126 3985	113 119 126 4055	113 119 126 4125	113 119 126 4200	113 119 126 4335
	-1	113 119 126 3915	113 119 126 3985	113 119 126 4050	113 119 126 4115	113 119 126 4190	113 119 125 4335
	0	113 119 125 3915	113 119 125 3980	113 119 125 4050	113 119 125 4115	113 120 125 4195	113 120 125 4360
	1	113 120 125 3955	113 120 125 4025	113 120 125 4095	113 120 125 4165	113 120 125 4260	115 121 125 4540
	2	115 121 125 4110	115 121 125 4185	115 121 125 4260	115 121 125 4330	115 121 125 4430	117 122 125 4735
38000 V_{FTO} = 157	-2	113 122 129 4005	113 122 129 4075	113 122 129 4145	113 122 129 4215	113 122 129 4290	113 123 129 4460
	-1	114 123 129 4055	114 123 129 4130	114 123 129 4200	114 123 129 4275	114 123 129 4365	115 124 129 4650
	0	116 123 129 4220	116 124 129 4295	116 124 129 4370	116 124 129 4445	116 124 129 4545	117 124 129 4850
	1	118 124 129 4395	118 124 129 4475	118 124 129 4555	118 124 129 4630	118 125 129 4735	120 125 129 5065
	2	120 125 129 4585	120 125 129 4670	120 125 129 4750	120 125 129 4835	120 125 129 4945	122 126 129 5325

TODATA_350SFO_IMP_F20_WETG_ALL_3K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–56 (Sheet 2 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
28000 V_{FTO} = 136	-2	114 115 126 3695	114 115 126 3755	114 115 125 3815	114 115 125 3880	114 115 125 3985	113 115 124 4105
	-1	114 115 125 3675	114 115 125 3735	114 115 125 3800	114 115 125 3860	114 115 124 3970	113 115 123 4095
	0	114 115 124 3660	114 115 124 3720	114 115 124 3780	114 115 124 3845	113 115 123 3955	113 115 122 4085
	1	114 115 123 3645	114 115 123 3705	114 115 123 3770	114 115 123 3830	113 115 122 3945	113 115 122 4080
	2	113 115 123 3635	113 115 123 3695	113 115 122 3755	113 115 122 3820	113 115 122 3940	113 115 121 4080
30000 V_{FTO} = 140	-2	114 115 125 3785	114 115 125 3850	114 115 124 3915	114 115 124 3980	113 115 124 4095	113 115 123 4220
	-1	114 115 124 3770	114 115 124 3835	114 115 124 3895	114 115 124 3960	113 115 123 4080	113 115 122 4210
	0	114 115 123 3755	113 115 123 3820	113 115 123 3885	113 115 123 3950	113 115 122 4070	113 115 121 4210
	1	113 115 122 3745	113 115 122 3810	113 115 122 3875	113 115 122 3940	113 115 121 4065	113 115 121 4210
	2	113 115 122 3740	113 115 121 3805	113 115 121 3865	113 115 121 3935	113 115 121 4065	112 115 120 4215
32000 V_{FTO} = 145	-2	114 115 124 3875	114 115 124 3945	113 115 124 4010	113 115 124 4080	113 115 123 4195	113 115 122 4335
	-1	113 115 123 3865	113 115 123 3930	113 115 123 3995	113 115 123 4065	113 115 122 4190	113 115 121 4330
	0	113 115 122 3855	113 115 122 3920	113 115 122 3985	113 115 122 4055	113 115 121 4185	113 115 120 4335
	1	113 115 121 3850	113 115 121 3915	113 115 121 3980	113 115 121 4050	113 115 120 4185	112 115 120 4340
	2	113 115 120 3845	113 115 120 3915	113 115 120 3980	113 115 120 4050	112 115 120 4190	112 115 119 4355
33000 V_{FTO} = 147	-2	113 115 123 3920	113 115 123 3990	113 115 123 4055	113 115 123 4125	113 115 122 4250	113 115 122 4395
	-1	113 115 123 3910	113 115 122 3975	113 115 122 4045	113 115 122 4115	113 115 122 4240	113 115 121 4390
	0	113 115 122 3905	113 115 122 3970	113 115 121 4040	113 115 121 4110	113 115 121 4240	112 115 120 4395
	1	113 115 121 3900	113 115 121 3970	113 115 121 4035	113 115 121 4105	113 115 120 4245	112 115 120 4405
	2	113 115 120 3900	113 115 120 3970	113 115 120 4035	113 115 120 4105	112 115 120 4250	112 116 120 4420

TODATA_350SFO_IMP_F20_WETG_ALL_4K_PART1_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–57 (Sheet 1 of 2)

WET GROOVED RUNWAY TAKEOFF DATA

FLAPS 20° **ALTITUDE 4000 FT**

ENGINE BLEED ON, ENGINE & WING A/I ON

V_1 (KIAS)	V_R (KIAS)
V_2 (KIAS)	TOFL (FT)

UNCORRECTED TAKEOFF SPEEDS (KIAS) AND FIELD LENGTH (FT)

WT (LB) / V_{FTO} (KIAS)	RWY GRD (%)	TEMPERATURE (°C)					
		-15 & BELOW	-10	-5	0	5	10
34000 V_{FTO} = 149	-2	113 115 124 3965	113 115 124 4035	113 115 124 4105	113 116 124 4175	113 115 123 4300	113 115 122 4450
	-1	113 116 123 3960	113 116 123 4025	113 116 123 4095	113 116 123 4165	113 116 122 4295	112 116 122 4450
	0	113 116 123 3950	113 116 122 4020	113 116 122 4090	113 116 122 4160	113 116 122 4295	112 117 122 4460
	1	113 116 122 3950	113 116 122 4020	113 116 122 4090	113 116 122 4160	112 117 122 4305	112 117 122 4470
	2	113 117 122 3955	113 117 122 4025	113 117 122 4095	112 117 122 4165	112 118 122 4315	113 118 122 4595
35000 V_{FTO} = 151	-2	113 117 125 4010	113 117 125 4080	113 117 125 4150	113 117 125 4220	113 117 124 4355	113 117 124 4510
	-1	113 117 124 4005	113 117 124 4075	113 117 124 4145	113 117 124 4215	113 117 124 4350	112 118 124 4510
	0	113 117 124 4000	113 118 124 4070	113 118 124 4140	113 118 124 4210	112 118 124 4355	112 119 124 4520
	1	113 118 124 4005	113 118 124 4075	113 118 124 4145	113 118 124 4215	112 119 124 4365	114 120 124 4670
	2	113 119 124 4035	113 119 124 4110	113 119 124 4180	113 119 124 4255	114 120 124 4535	116 120 124 4880
36000 V_{FTO} = 153	-2	113 119 126 4060	113 119 126 4130	113 119 126 4200	113 119 126 4270	113 119 126 4405	112 119 126 4565
	-1	113 119 126 4055	113 119 126 4120	113 119 126 4195	113 119 126 4265	113 119 126 4405	112 120 126 4570
	0	113 119 126 4050	113 120 126 4125	113 120 126 4195	113 120 126 4265	113 120 126 4420	114 121 126 4735
	1	113 120 126 4105	113 120 126 4180	113 120 126 4250	113 120 126 4325	115 121 126 4605	116 122 126 4945
	2	115 121 126 4270	115 121 126 4345	115 121 126 4420	115 121 126 4500	117 122 126 4800	118 122 126 5190
38000 V_{FTO} = 157	-2	113 122 129 4150	113 122 129 4220	113 122 129 4290	113 122 129 4365	113 123 129 4525	114 123 129 4835
	-1	114 123 129 4210	114 123 129 4285	114 123 129 4360	114 123 129 4440	115 124 129 4715	116 124 129 5045
	0	116 124 129 4380	116 124 129 4460	116 124 129 4540	116 124 129 4620	117 124 129 4915	119 125 129 5275
	1	118 124 129 4560	118 124 129 4645	118 125 129 4730	118 125 129 4815	119 125 129 5135	121 126 129 5535
	2	120 125 129 4760	120 125 129 4850	120 125 129 4935	120 125 129 5025	122 126 129 5395	123 127 129 5840

TODATA_350SFO_IMP_F20_WETG_ALL_4K_PART2_22FEB19

NOTE: CORRECT V_1 AND TOFL USING THE APPLICABLE CORRECTION TABLE.

Figure 07–11A–01–57 (Sheet 2 of 2)

WET GROOVED RUNWAY WIND CORRECTIONS

	WIND (KNOTS)	UNCORRECTED V_1 (KIAS)				
		110	115	116	120	125
CORRECTED V_1 (KIAS)	-10	110	115	119	123	128
	0	110	115	116	120	125
	10	110	115	115	119	124
	20	110	115	114	118	123
	30	110	115	113	117	122

	WIND (KNOTS)	UNCORRECTED V_1 (KIAS)				
		110	115	116	120	125
TOFL FACTOR	-10	1.34	1.34	1.34	1.34	1.34
	0	1.00	1.00	1.00	1.00	1.00
	10	0.95	0.95	0.95	0.95	0.95
	20	0.90	0.90	0.90	0.90	0.90
	30	0.85	0.85	0.85	0.85	0.85

TODATA_350SFO_F20_WETG_WIND_CORR_26FEB19

NOTES:

1. In the tables, tailwinds are shown as negative values and headwinds as positive values.
2. If the corrected V_1 exceeds V_R for the appropriate conditions, use $V_1 = V_R$.

WET GROOVED RUNWAY CORRECTIONS DISPATCH WITH ONE THRUST REVERSER INOPERATIVE

	UNCORRECTED V_1 (KIAS)				
	110	115	116	120	125
CORRECTED V_1 (KIAS)	110	115	115	119	124
TOFL FACTOR	1.04	1.04	1.04	1.04	1.04

TODATA_350SFO_F20_WETG_TREV_CORR_22FEB19

NOTE: If the corrected V_1 exceeds V_R for the appropriate conditions, use $V_1 = V_R$.

Figure 07–11A–01–58

TAKEOFF PATH

The takeoff path must be adjusted for an SFO takeoff. The Challenger 350 CAFM is required to determine the SFO takeoff path. To determine the takeoff path associated to an SFO takeoff, use the following procedure:

1. Run the CAFM Full Takeoff Module for the SFO conditions at Flaps 20 and assuming a balanced V_1 input. Select the applicable runway surface condition, engine bleed, airport pressure altitude, takeoff weight, ambient temperature, runway gradient, rolling takeoff state and reported wind.
2. With the resulting V_1/V_R ratio, run the CAFM Takeoff Path / Fixed Level–Off Height module with the same SFO input conditions, at the desired Gross Level–Off Height and Gross Final Height.
3. Correct the CAFM calculated Net Flight Path data as follows:
   (a) Apply a distance correction to the horizontal Net Distance trajectory points. The Net Distance corrections provided in Fig. 07–11A–01–59 are a function of airplane weight and of selected Gross Level–Off Height.
   (b) Reduce the calculated Net Heights by 10 ft. This correction is not applicable to the Brake Release, Lift–Off and 35 ft points.
   (c) Increase the Level Acceleration Segment Distance by 170 ft. The Final Segment Net Distances are increased by the sum of the correction provided in Fig. 07–11A–01–59 an of the correction on Level Acceleration Segment Distance.
4. Using the same input conditions, reduce the maximum Level–Off Height calculated by the Takeoff Path / Maximum Level–Off Height module by 300 ft. The Net Flight Path corrections on Net Distance, Net Height and Level Acceleration Segment Distance presented in 3(a), 3(b) and 3(c) respectively must be applied to the Net Flight Path calculated by the Maximum Level–Off Height module.

TAKEOFF PATH NET DISTANCE CORRECTION (FT)

WEIGHT (LB)	GROSS LEVEL-OFF HEIGHT (FT)				
	400	1000	3000	5000	ABOVE 5000
29000 AND BELOW	100	100	100	100	100
30000	100	100	150	230	380
31000	100	100	220	370	630
32000	100	110	300	530	950
33000	110	140	410	730	1150
34000	380	380	430	540	800
35000	460	460	460	460	460
36000	410	410	410	410	410
37000	380	380	380	380	380
38000	350	350	350	350	350

350SFO_IMP_F20_TOPATH_CORR _14MAR19

NOTES:

1. Increase the CAFM Net Distances by the correction provided as a function of airplane weight and gross level-off height.
2. The takeoff starting point (distance zero) remains unchanged.
3. Interpolation is allowed between airplane weight and level-off height values, or the largest correction may be used.

Figure 07–11A–01–59

Example:

Determine the takeoff weight limited by obstacle clearance for the following conditions:

Aircraft Weight	=	33,000 lb
Engine Bleed	=	Engine Bleed On
Runway Surface	=	Dry
Rolling Takeoff	=	Yes
Runway gradient	=	+1.0% (Positive Uphill)
Airport pressure altitude	=	2,000 ft
Reported wind	=	–10 knots (Negative for tailwind)
Airport Temperature (OAT)	=	25 °C
CDL Index	=	Zero
MMEL	=	No MMEL item applicable
Obstacle Height	=	846.7 ft above the runway surface (lift–off end)
Obstacle Distance	=	18,924 ft from the takeoff starting point

Step 1: Determine the applicable V_1/V_R ratio

Open the CAFM Full Takeoff Module. Enter the conditions specified above for a Flaps 20 takeoff (SFO limitation) and assume a balanced V_1 (V_1 Type selection box). Run the CAFM and determine the applicable V_1/V_R ratio in the Output Data View.

For the specified conditions, the applicable V_1/V_R ratio is 1.0.

Step 2: Determine the SFO takeoff path

Open the CAFM Takeoff Path – Fixed Level–Off Height module. Enter the same conditions as in Step 1 and the applicable V_1/V_R ratio (1.0 for the specified conditions). Select appropriate values for the Gross Level–Off Height (LOH) and Gross Final Height. In this example, a Gross LOH of 1,000 ft and a Gross Final Height of 2,000 ft will be used. Run the CAFM to get the uncorrected Net Distance and Net Height trajectory points.

The following points of the takeoff path are calculated by the CAFM:

	BRAKE RELEASE	LIFT–OFF POINT	35 FT POINT	GEAR UP POINT	END 2ND SEGMT	END ACCEL. SEGMT	END FINAL SEGMT
Net Distance (ft)	0	3,656	5,017	7,287	18,784	44,075	55,924
Net Height (ft)	0.0	0.0	35.0	149.3	891.7	891.7	1,796.9

The Maximum LOH is obtained from the CAFM Takeoff Path – Maximum Level–Off Height module. For the associated conditions, the uncorrected Maximum LOH is 7,662 ft.

The following corrections are applicable for an SFO takeoff:

(a) Fig. 07–11A–01–59 provides the takeoff path net distance correction. For a weight of 33,000 lb and a Gross LOH of 1,000 ft, the calculated net distances must be increased by 140 ft. The takeoff starting point (brake release point in CAFM) is unchanged.

(b) The calculated net heights must be reduced by 10 ft. This correction is not applicable to the Brake Release, Lift–Off and 35 ft points.

(c) The calculated Level Acceleration Segment distance must be increased by 170 ft. The calculated Final Segment net distances are increased by the sum of 140 ft (correction in (a) above) and of 170 ft, giving 310 ft.

After application of the corrections, the SFO takeoff path is as follows:

	BRAKE RELEASE	LIFT–OFF POINT	35 FT POINT	GEAR UP POINT	END 2ND SEGMT	END ACCEL. SEGMT	END FINAL SEGMT
Net Distance (ft)	0	3,796	5,157	7,427	18,924	44,385	56,234
Net Height (ft)	0.0	0.0	35.0	139.3	881.7	881.7	1,786.9

The calculated Maximum LOH is reduced by 300 ft, giving an SFO Maximum LOH of 7,362 ft. The SFO Maximum LOH is not limiting the selected Gross LOH of 1,000 ft.

Step 3: Verify the obstacle clearance

The SFO takeoff path obtained in Step 2 is used to verify the obstacle clearance. Per regulations, the net trajectory must clear all obstacles by a minimum of 35 ft. For the specified conditions, the net trajectory clears the obstacle by exactly 35 ft at the beginning of the LOH horizontal segment (end of second segment). At the obstacle distance of 18,924 ft, the net height is of 881.7 ft giving an obstacle clearance of 881.7–846.7 = 35 ft. Therefore, the takeoff weight is limited by obstacle clearance considerations.

In some situations, the selected Gross LOH may result in a net LOH which does not clear all the obstacles by 35 ft. The input Gross LOH is then increased such that the net LOH clears all obstacles by 35 ft, while remaining below the SFO Maximum LOH. If the net trajectory cannot clear an obstacle by 35 ft during the first or second segments, then the takeoff weight must be reduced. Repeat Steps 1 to 3 until obstacle clearance is assured.

STABILIZER TRIM SETTING FOR TAKEOFF

For an SFO takeoff, determine the required stabilizer trim setting for takeoff using the Stabilizer Trim Setting chart provided by Fig. 07–11A–01–60, as a function of aircraft weight and CG position.

STABILIZER TRIM FOR TAKEOFF
FLAPS= 20°

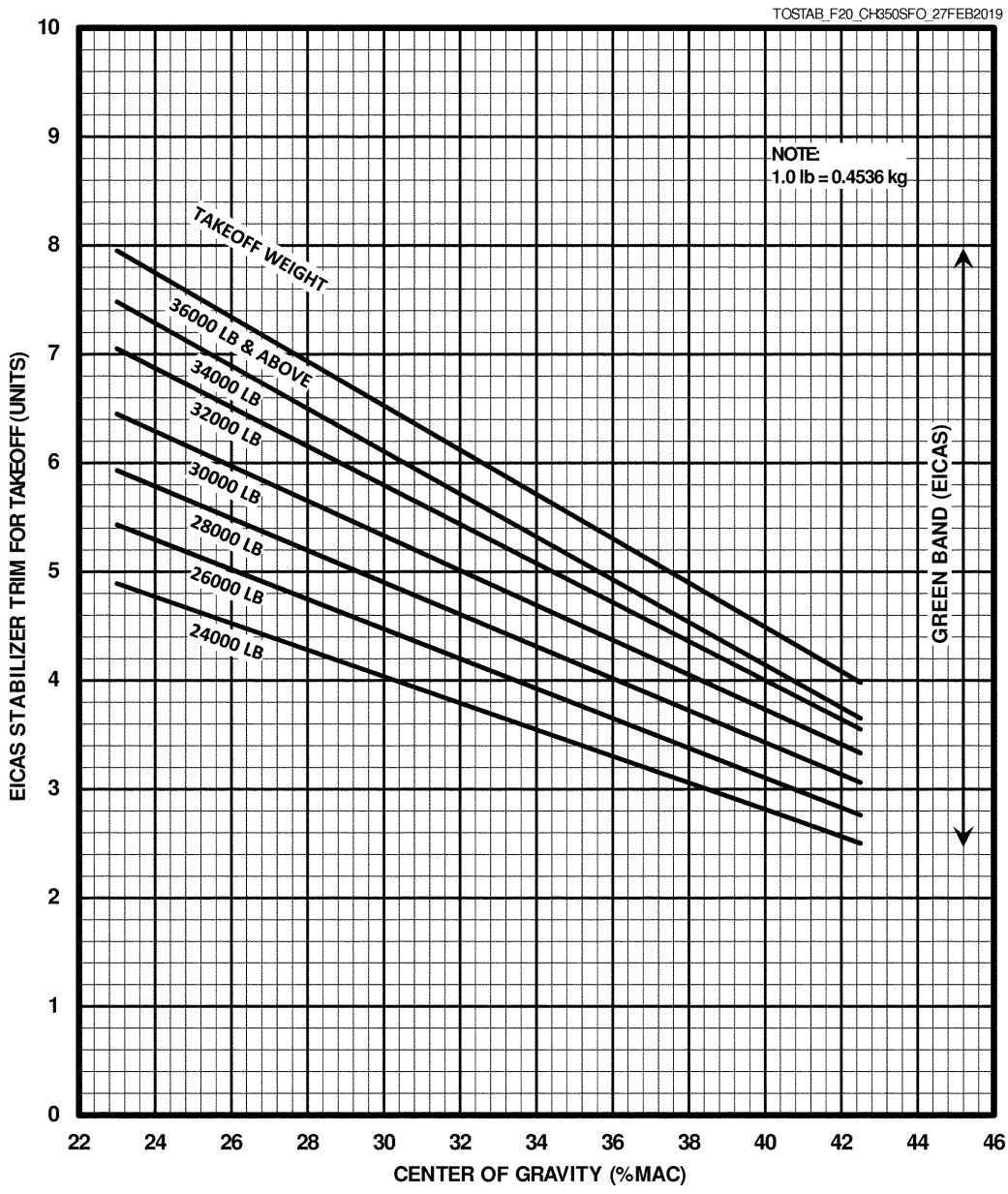


Figure 07–11A–01–60

TURN–AROUND TIME – REJECTED TAKEOFF BRAKE ENERGY – FLAPS 20°

For an SFO takeoff, the Rejected Takeoff Brake Energy calculated in Figure 06–50–2 must be increased by 0.2 x 10^6 ft.lb. The corresponding Cooling Time charts remain applicable for an SFO rejected takeoff.

SUPPLEMENTS

The supplementary data in chapter 7 are applicable except for the following:

- SUPPLEMENT 2 – Supplemental Information for the MMEL
  - **Flight Director Guidance or TOGA Switches Inoperative**

    An SFO takeoff with one or both flight directors inoperative and/or with TOGA switches inoperative is permitted. The target pitch attitudes for a Flaps 20 takeoff presented in Figure 07–02–01–1 are applicable.
  - **Flight with Landing Gear Down**

    An SFO takeoff with fixed landing gear down is prohibited.
  - **Nosewheel Steering Inoperative**

    An SFO takeoff with nosewheel steering inoperative is permitted. The takeoff field length penalty of 1.0% is applicable to SFO takeoffs. When an SFO takeoff is performed with nosewheel steering inoperative, increase the SFO takeoff field length provided in this Supplement by 1.0%.
  - **Radio Altimeter Inoperative**

    An SFO takeoff with the radio altimeter inoperative is permitted. The specified landing distance factor remains applicable to the corresponding landing performance.

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CL-350



CL-350 SUPPLEMENTAL MANUAL

WEIGHT & BALANCE 13

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CHALLENGER 350

BD-100-1A10

WEIGHT AND BALANCE

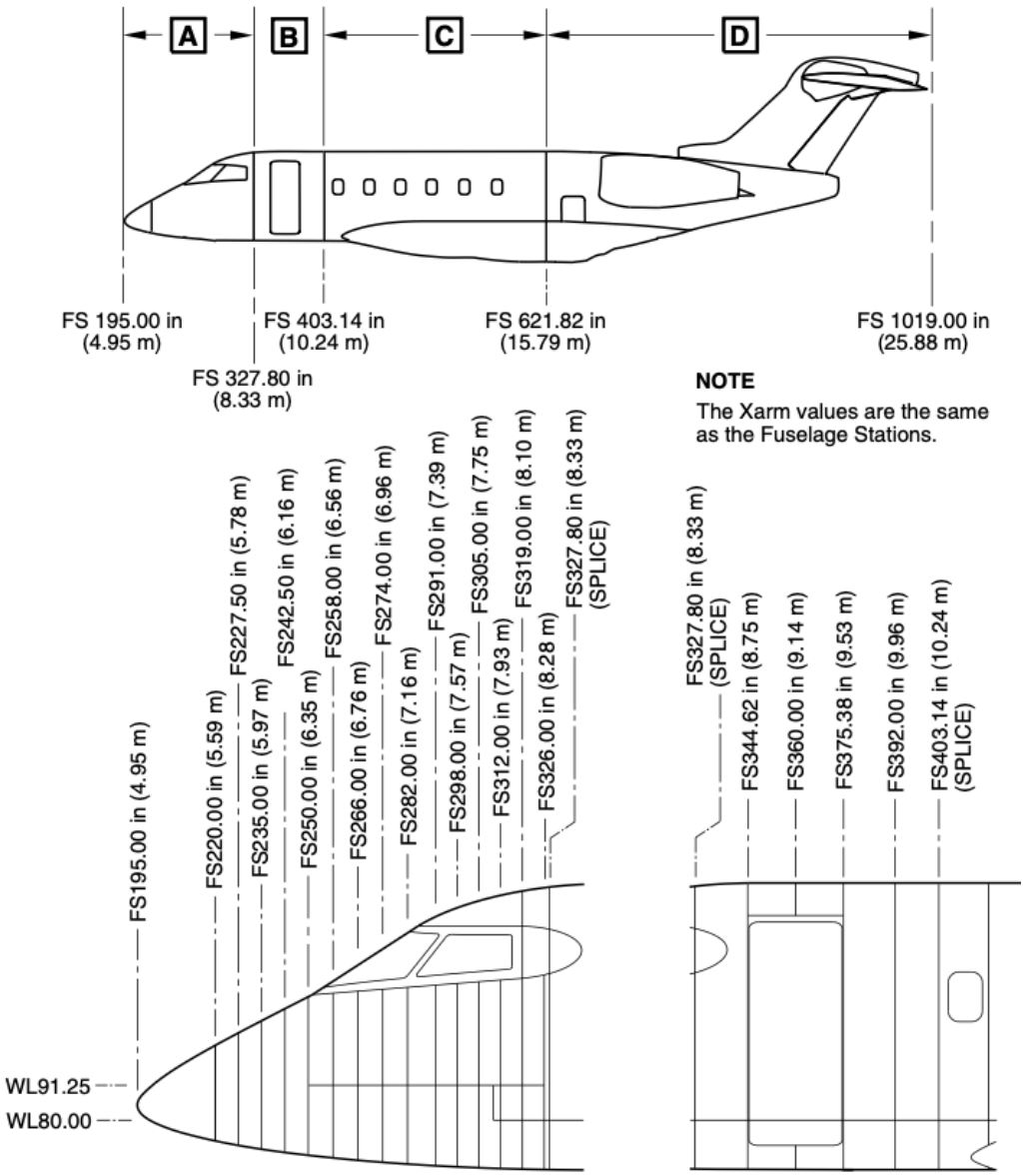


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DEFINITIONS

This section provides definitions of key terms used throughout the Challenger 350 weight and balance calculations. Understanding these terms is essential for accurate weight and balance management.

Term	Definition
BEW	Basic Empty Weight - The weight of the aircraft as delivered from Bombardier, including structure, powerplant, systems, and interior provisions, plus engine oil and unusable fuel.
TEW	True Empty Weight - The actual weighed empty weight of the aircraft including all permanently installed equipment, engine oil, unusable fuel, and hydraulic fluid.
OWE	Operating Weight Empty - TEW plus operating items (crew, crew baggage, flight manuals, and standard cabin equipment). This is the starting point for flight weight calculations.
ZFW	Zero Fuel Weight - OWE plus payload (passengers and baggage). The aircraft weight before fuel is added.
MZFW	Maximum Zero Fuel Weight - 28,200 lb (12,791 kg). The maximum permitted aircraft weight before usable fuel is added.
RW	Ramp Weight - ZFW plus total fuel load. The weight of the aircraft ready for taxi.
MRW	Maximum Ramp Weight - 40,750 lb (18,484 kg). The maximum permitted weight for ground operations and taxi.
TOW	Takeoff Weight - Ramp weight minus taxi fuel burn. The actual weight at brake release.
MTOW	Maximum Takeoff Weight - 40,600 lb (18,416 kg). The maximum permitted weight for takeoff.
LW	Landing Weight - Takeoff weight minus enroute fuel burn. The projected weight at destination.
MLW	Maximum Landing Weight - 34,150 lb (15,490 kg). The maximum permitted weight for landing.
MFW	Minimum Flight Weight - 24,800 lb (11,249 kg). The minimum permitted weight for flight operations.
MAC	Mean Aerodynamic Chord - 112.22 inches. The chord of an imaginary wing with constant chord that has the same aerodynamic characteristics as the actual swept wing.
LEMAC	Leading Edge Mean Aerodynamic Chord - Located at Fuselage Station 556.675 inches.
%MAC	Percent Mean Aerodynamic Chord - The CG position expressed as a percentage of MAC measured from LEMAC. Calculated as: [(CG arm - 556.675) / 112.22] × 100
CG	Center of Gravity - The point at which the aircraft would balance if suspended. Expressed in inches from datum or as %MAC.
ARM	Moment Arm - The horizontal distance in inches from the datum (Zero Reference Datum) to the CG of an item.
MOMENT	The product of weight multiplied by arm. Expressed as moment/1000 (lb-in × 10^{-3}) for ease of calculation.
FCBP	Fuel Curve Boundary Points - Critical points on the fuel curve that define the CG path during fuel burn. Essential for verifying the aircraft remains within CG limits throughout flight.
ZRD	Zero Reference Datum - The reference point (FS 0.00) from which all horizontal measurements are made. Located 195.00 inches forward of the nose radome in the plane of symmetry of the aircraft at BL0.00 and WL0.00.
CDL	Configuration Deviation List - A list of secondary airframe components that may be missing with specific weight or performance penalties applied.

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WEIGHT AND BALANCE OVERVIEW

Aircraft Weighing Process

The Challenger 350 weight and balance process begins with periodic aircraft weighing to establish an accurate Basic Empty Weight (BEW) or True Empty Weight (TEW). While pilots do not perform the actual weighing procedure, understanding the process provides context for the weight data used in flight calculations.

Aircraft weighing is typically performed by qualified maintenance personnel in controlled conditions. The aircraft is placed on calibrated scales in a level attitude with all systems serviced to standard levels. The resulting weight and CG data are recorded on the Aircraft Weighing Report, which becomes the foundation for all subsequent weight and balance calculations.

NOTE: The weight data from the Aircraft Weighing Report should be verified against the actual aircraft documents. Any modifications or equipment changes since the last weighing may affect the aircraft's empty weight and CG.

Challenger 350 Design Weight Limits

The following table summarizes the certificated weight limits for the Challenger 350:

Weight Category	Pounds (lb)	Kilograms (kg)
Maximum Ramp Weight (MRW)	40,750	18,484
Maximum Takeoff Weight (MTOW)	40,600	18,416
Maximum Landing Weight (MLW)	34,150	15,490
Maximum Zero Fuel Weight (MZFW)	28,200	12,791
Minimum Flight Weight (MFW)	24,800	11,249

Maximum Loading

When loading the aircraft, the load must not be more than the maximum load permitted in each area. The following table gives the maximum loading for each aircraft area:

Description	Zone	Loading	Capacity
Avionics Area [1]	FS326.0 to FS344.6	250 lb/Longitudinal ft	400 lb
Galley Area [2]	FS344.6 to FS394.6	150 lb/Longitudinal ft	625 lb
Passenger Compartment Area [2]	FS394.6 to FS630.0	200 lb/Longitudinal ft	3,920 lb
Cargo Hold [3]	FS630.0 to FS668.7	400 lb/Longitudinal ft	750 lb
Flight Compartment Allowance [4]			250 lb
Aft Equipment Bay Allowance	Aft of FS668.7		300 lb

Floor Structure		75 lb/ft²	
Floor Panels		75 lb/ft²	

[1] Allowance in addition to type specification avionics.

[2] Allowance in addition to type specification interior and operating items.

[3] Maximum capacity = 750 lb.

[4] Allowance includes ballast. This ballast weight is in addition to type specification operating items.

Maximum Fuel Capacity

Tank	Volume (US gal)	Weight (lb)	ARM (in)
Main Tanks (Total)	2,096	14,150	573.0

Fuel weight calculated at standard density of 6.75 lb/US gal (0.809 kg/L).

NOTE: Standard fuel density of 6.75 lb/US gal is used for planning purposes. Actual fuel density varies with temperature and fuel type. Crews should use actual fuel density from fuel tickets when available for enhanced precision.

CG CONCEPTS FOR SWEPT WING AIRCRAFT

The Dynamic Nature of CG in Flight

Unlike straight-wing aircraft where fuel CG often coincides closely with the aircraft CG, the Challenger 350's swept wing configuration results in fuel being stored at varying distances from the aircraft's center of gravity. This creates a unique challenge: as fuel burns, the aircraft's CG shifts continuously throughout the flight.

In the Challenger 350, fuel is stored primarily in the wing tanks, with the fuel CG located forward of the aircraft's typical operating CG. As fuel burns from the wings, the overall aircraft CG tends to move aft. This aft shift must be accounted for in pre-flight planning to ensure the aircraft remains within CG limits throughout all phases of flight.

Understanding the Fuel Curve

The fuel curve is a graphical representation of how the aircraft's weight and CG change as fuel is consumed. For the Challenger 350, this curve is not a straight line but follows a specific path determined by the wing geometry and fuel tank configuration.

Key characteristics of the CL350 fuel curve include:

The fuel curve begins at Zero Fuel Weight (ZFW) at the bottom and extends upward as fuel is added. The path the curve takes represents the CG shift that occurs with different fuel loads. At maximum fuel capacity of 14,150 lb, the fuel CG is approximately 573.0 inches, which is forward of most loaded aircraft CG positions.

As fuel burns during flight, the aircraft's position on the fuel curve moves downward toward the ZFW point. The entire fuel curve from takeoff weight to landing weight must remain within the approved CG envelope.

WARNING: The entire applicable portion of the fuel curve must remain within the CG envelope limits throughout the flight. If any portion of the fuel curve exits the envelope, the aircraft loading must be adjusted before flight. If any part of the curve is out of the envelope limits, the aircraft is not safe for take-off, even if the TOW and ZFW points are within limits.

Fuel Curve Boundary Points (FCBP)

Fuel Curve Boundary Points are specific points on the fuel curve that define the extreme CG positions that will be encountered during fuel burn. The Challenger 350 uses two FCBPs to verify that the aircraft remains within limits:

Point	Fuel Weight	Purpose
FCBP1	11,660 lb at 566.1 in ARM	Represents the CG position at approximately 82% fuel capacity. This point typically defines the most forward CG position on the fuel curve for the specific fuel load.
FCBP2	9,310 lb at 562.0 in ARM	Represents the CG position at approximately 66% fuel capacity. This point helps define the fuel curve shape and verifies mid-flight CG positions.

When plotting weight and balance, plot four points on the CG envelope in sequence: TOW, FCBP1, FCBP2, and ZFW. Connect these points with lines to create the fuel curve. The entire curve must remain within the inner area of the CG envelope limits.

IMPORTANT — FCBP EXCLUSION RULE: Do not include a Fuel Curve Boundary Point if it is heavier than the Takeoff Weight (TOW). Specifically:• If FCBP1 is heavier than the TOW, omit FCBP1 and draw lines

connecting only TOW → FCBP2 → ZFW.• If both FCBP1 and FCBP2 are heavier than the TOW, omit both FCBPs and draw a line connecting only TOW → ZFW.This situation occurs when the aircraft departs with a fuel load less than the FCBP fuel quantity. Since those boundary points represent fuel states that will never exist during the flight, including them would plot an inaccurate fuel curve.

If the resulting curve is entirely within the envelope limits, the aircraft is safe for takeoff. If any part of the curve falls outside the envelope limits, the aircraft is not safe for takeoff. You must move, add, or remove payload or ballast until the weight and CG of the aircraft are within the envelope limits.

The CG Slide Method

The CG Slide Method provides a quick graphical means to verify that the aircraft will remain within CG limits throughout fuel burn. This method uses a transparent fuel curve overlay positioned on the CG envelope chart.

To use the CG Slide Method:

1. Calculate the ZFW and %MAC position.
2. Plot the ZFW point on the CG envelope chart.
3. Align the bottom of the transparent fuel curve with your ZFW point.
4. Verify that the entire fuel curve from ZFW to your planned fuel load remains within the envelope.
5. The aircraft is safe for flight only if the entire applicable portion of the fuel curve remains within the envelope.

WARNING: If any part of the curve is out of the envelope limits, the aircraft is not safe for take-off. This applies even if the individual TOW and ZFW points are within limits. The entire fuel curve path must be verified.

CENTER OF GRAVITY ENVELOPE

Longitudinal CG Limits

The Challenger 350's CG envelope defines the acceptable range of CG positions for various aircraft weights. The envelope is bounded by forward and aft limits that vary with aircraft weight.

The following table provides key reference points for the CG envelope:

Weight Condition	Forward Limit	Aft Limit	Weight (lb)
At MRW/MTOW	23% MAC	37% MAC	40,750
At MLW	23% MAC	41% MAC	34,150
At MZFW	25% MAC	43% MAC	28,200
At MFW	27% MAC	43% MAC	24,800

Calculating %MAC

The center of gravity position is expressed as a percentage of the Mean Aerodynamic Chord (%MAC). This standardized expression allows for quick verification against published limits.

%MAC FORMULA

$$\%MAC = [(CG\ ARM - 556.675) / 112.22] \times 100$$

Where: LEMAC = 556.675 inches, MAC = 112.22 inches

Example: If CG ARM = 598.71 inches:

%MAC = [(598.71 - 556.675) / 112.22] × 100 = 37.47%

WEIGHT AND BALANCE CALCULATION PROCEDURE

This section provides a comprehensive step-by-step procedure for calculating the Challenger 350 weight and balance from Operating Weight Empty through Landing Weight.

Step 0: Pre-Calculation CDL/MEL Check

Before beginning weight and balance calculations, review the aircraft's Configuration Deviation List (CDL) and Minimum Equipment List (MEL) for any items that impose weight penalties or performance restrictions.

> **IMPORTANT:** The AFM Appendices note that missing secondary airframe components (e.g., Wing-to-Aileron Side Seals) may require weight reductions (e.g., Takeoff Weight reduced by 30 lb per seal) or drag index adjustments in the Computerized Airplane Flight Manual (CAFM). Always verify CDL/MEL status before completing weight and balance calculations and apply any required weight penalties to the appropriate calculation step.

Step 1: Establish Operating Weight Empty (OWE)

The OWE is the foundation for all flight weight calculations. It includes the aircraft's True Empty Weight plus standard operating items.

Item	Weight (lb)	ARM (in)	Moment/100
True Empty Weight (TEW)	Per Aircraft	Per Rpt	Weight × ARM / 100
Flight Crew (Pilot + Copilot)	Actual	305.20	Weight × 3.052
Crew Baggage	Actual	385.00	Weight × 3.85
Flight Manuals	30	320.00	96.00
Operating Weight Empty (OWE)	**Sum**	—	**Sum**

Step 2: Calculate Zero Fuel Weight (ZFW)

Add all payload items to OWE to determine ZFW. Verify that ZFW does not exceed MZFW of 28,200 lb.

Item	Weight (lb)	ARM (in)	Moment/100
Operating Weight Empty (OWE)	From Step 1	—	From Step 1
Passengers (by seat position)	Actual	Per Seat	Calculate
Baggage (Cabin/Tailcone)	Actual	650.00	Calculate
Galley Supplies	Actual	366.30	Calculate
Zero Fuel Weight (ZFW)	**Sum ≤ 28,200**	Calculate	**Sum**

Calculate ZFW CG: CG = (Total Moment × 100) / Total Weight

Calculate ZFW %MAC: %MAC = [(CG - 556.675) / 112.22] × 100

NOTE: Verify ZFW does not exceed MZFW of 28,200 lb and that %MAC is within envelope limits (typically 25-43% at this weight).

IMPORTANT: Passenger seat arms and galley/baggage compartment arms are TAIL-NUMBER SPECIFIC and vary by interior configuration. The arms listed in this training manual are for sample exercise purposes only. For actual flight operations, always use the arm data from the specific aircraft's Weighing Report (Chapter 2, Aircraft Reports provided by the Completion Center).

Step 3: Calculate Ramp Weight (RW)

Add the planned fuel load to ZFW. Use the Fuel Loading Table to determine fuel moment. Verify RW does not exceed MRW of 40,750 lb.

Item	Weight (lb)	ARM (in)	Moment/100
Zero Fuel Weight (ZFW)	From Step 2	—	From Step 2
Fuel Loading	Per Plan	Variable	From Table
Ramp Weight (RW)	**Sum ≤ 40,750**	Calculate	**Sum**

WARNING — SNOW/ICE ACCUMULATION: When snow or ice has accumulated on the horizontal stabilizer, there is a risk of static stability degradation and potential tip-over during ground operations. Ensure the aircraft is properly de-iced before conducting weight and balance calculations. Snow accumulation on the tail can shift the actual CG aft of calculated values and may exceed the aft limit, creating a tip-over hazard.

Step 4: Calculate Takeoff Weight (TOW)

Subtract taxi fuel from Ramp Weight. A standard taxi fuel burn of 200-300 lb is typical for the CL350.

Item	Weight (lb)	ARM (in)	Moment/100
Ramp Weight (RW)	From Step 3	—	From Step 3
Less: Taxi Fuel	(200-300)	—	Interpolate
Takeoff Weight (TOW)	**Sum ≤ 40,600**	Calculate	**Sum**

WARNING: Calculate TOW CG and %MAC. Verify TOW does not exceed MTOW and that %MAC is within envelope limits (23-37% at maximum weight).

Step 5: Calculate Landing Weight (LW)

Subtract planned enroute fuel burn from Takeoff Weight. Verify LW does not exceed MLW of 34,150 lb.

Item	Weight (lb)	ARM (in)	Moment/100

Takeoff Weight (TOW)	From Step 4	—	From Step 4
Less: Enroute Fuel Burn	Per Plan	—	Interpolate
Landing Weight (LW)	**Sum ≤ 34,150**	Calculate	**Sum**

Step 6: Apply Landing Gear Retraction Moment

The official Weight and Balance Manual requires an adjustment for the balance effect caused by landing gear retraction. When the landing gear is retracted after takeoff, the change in gear position causes a moment change that must be accounted for in flight CG calculations.

BALANCE EFFECTS OF MAJOR OPERATIONS

The operation of certain aircraft systems changes the CG of the aircraft during flight, ground handling, takeoff, and landing operations. The Weight and Balance Manual requires that these moment changes be accounted for when calculating flight CG positions.

Configuration Change	Moment/1000 (lb in)	Moment/1000 (kg m)
Gears Up vs. Gears on Ground	-4.6	-0.053
Flaps Deployed vs. Flaps Stowed	-4.0	-0.046
Thrust Reversers Deployed vs. Stowed	Negligible (-0.06)	Negligible

LANDING GEAR RETRACTION MOMENT

Gear Retraction: Moment Change = -5.3 (Moment/1000)

Approximately -4,600 lb-in

Apply this adjustment to the ZFW (Gear Up) index and to each FCBP calculation. Subtract 5.3 from the Index (Moment/1000) when calculating flight CG positions.

WARNING: Failure to apply the landing gear retraction moment moves the calculated CG aft. On a critical loading scenario, this could lead a pilot to believe they are within the aft CG limit when they are actually outside of it once the gear is retracted. This adjustment is mandatory for all flight CG calculations.

Step 7: Verify Fuel Curve Boundary Points

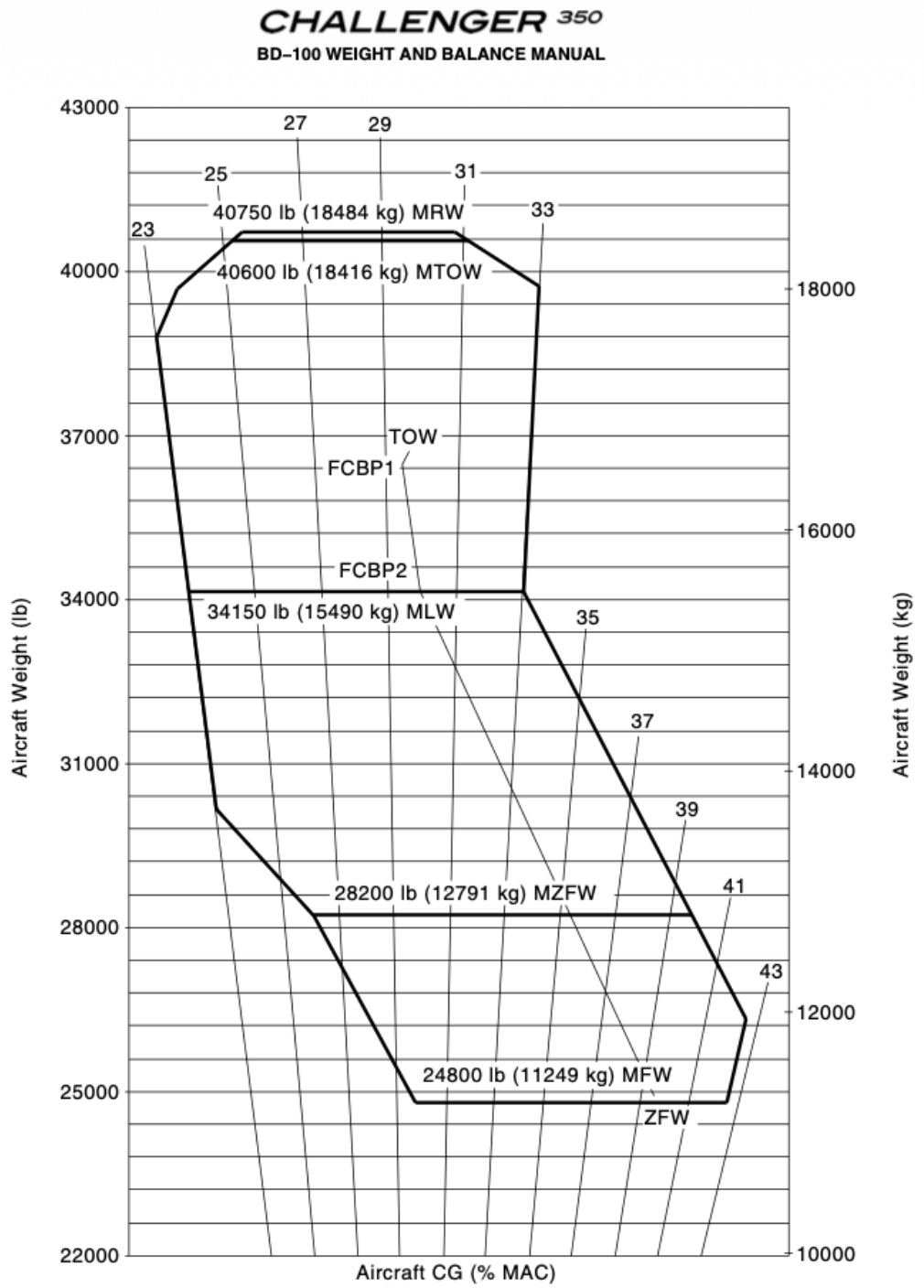
Calculate FCBP1 and FCBP2 to verify the aircraft remains within CG limits throughout fuel burn. Remember to apply the landing gear retraction moment (-5.3 Moment/1000) to each boundary point calculation.

Plot the following four points on the CG envelope and connect them with lines in this sequence: TOW → FCBP1 → FCBP2 → ZFW.

IMPORTANT — FCBP EXCLUSION RULE: Do not include a Fuel Curve Boundary Point if it is heavier than the Takeoff Weight (TOW):• If FCBP1 is heavier than TOW → plot only TOW → FCBP2 → ZFW.• If both FCBP1 and FCBP2 are heavier than TOW → plot only TOW → ZFW.This occurs when departing with less fuel

than the FCBP fuel quantity. Since those fuel states will never exist during the flight, they must be excluded from the fuel curve.

WARNING: If any part of the resulting curve is out of the envelope limits, the aircraft is not safe for takeoff. You must move, add, or remove payload or ballast until the weight and CG of the aircraft are within the envelope limits.



LOADING ARM REFERENCE DATA

IMPORTANT: The arm data listed below is representative of a typical Challenger 350 interior configuration and is provided for training purposes only. Passenger seat arms, galley arms, and baggage compartment arms are TAIL-NUMBER SPECIFIC and vary by aircraft. Always reference the specific aircraft's Weighing Report for actual operational data.

Flight Crew Stations

Station	ARM (in)	Moment/100 per lb
Pilot (LH Seat)	305.20	3.052
Copilot (RH Seat)	305.20	3.052

Passenger Seating Positions

Seat Position	ARM (in)	Seat Position	ARM (in)
Seat 1	422.70	Seat 6	520.70
Seat 2	422.70	Seat 7	565.30
Seat 3	469.30	Seat 8	568.30
Seat 4	471.30	Seat 9 (LAV)	613.00
Seat 5	518.70	—	—

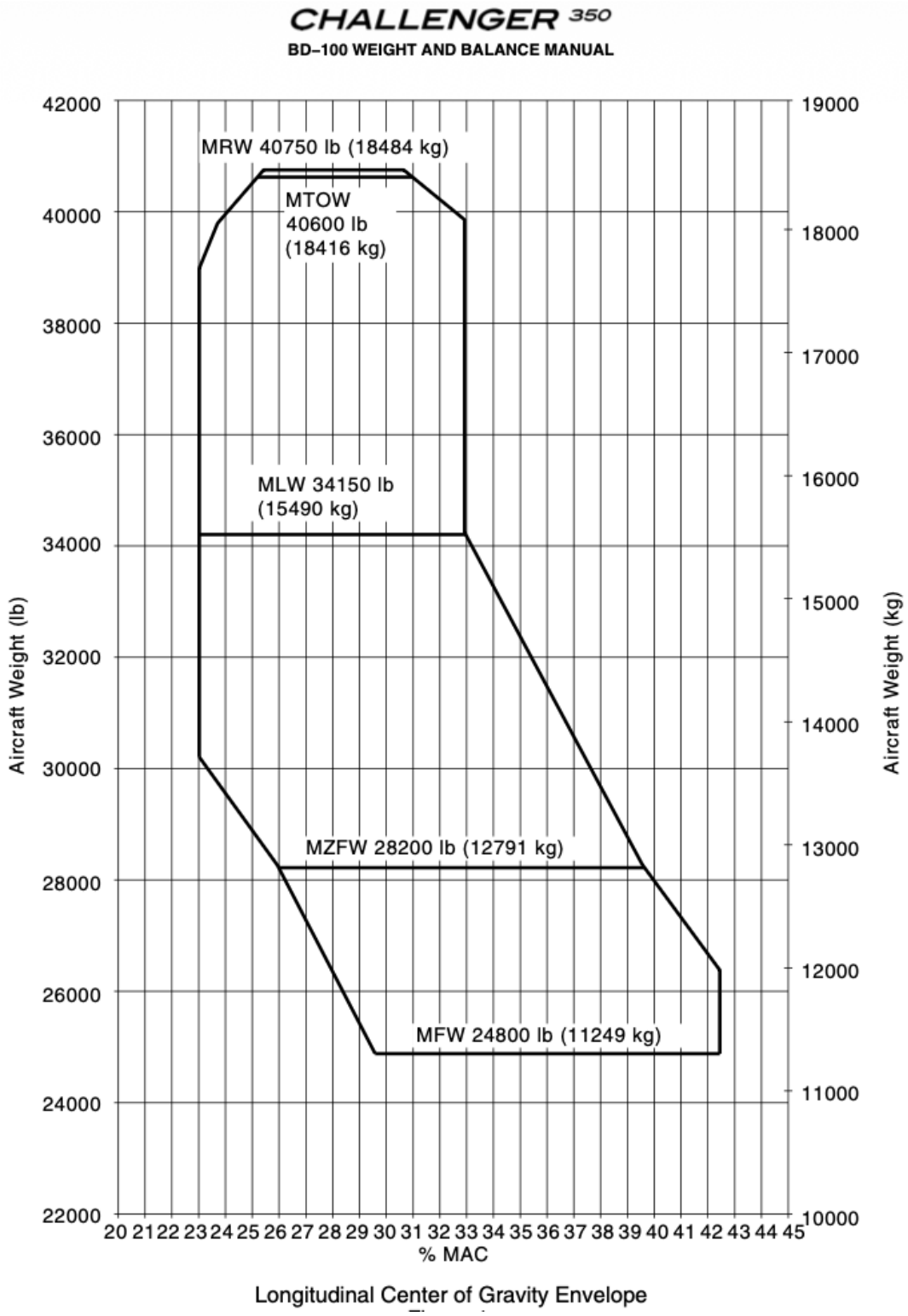
Baggage and Storage Compartments

Compartment	ARM (in)	Max Load (lb)
Crew Carry-On Baggage	385.00	Per Config
Crew Baggage Compartment	650.00	Per Config
Baggage Compartment (Aft)	650.00	Per Config

Standard Equipment Arms

Item	ARM (in)	Typical Weight (lb)
Flight Manuals	320.00	30
Galley Supplies	366.30	Variable
Aft Potable Water	636.00	Variable
Lavatory Chemicals	610.00	20

Lavatory Supplies	610.00	5
Aft Equipment Bay Ladder	737.10	9



Longitudinal Center of Gravity Envelope

FUEL LOADING TABLE

Use this table to determine fuel moment/100 based on fuel weight. For intermediate values, linear interpolation may be used.

NOTE: Fuel weight calculated at standard density of 6.75 lb/US gallon. Actual fuel density varies with temperature and fuel type. When available, use actual fuel density from fuel tickets for more accurate calculations.

Weight (lb)	Moment/100	Weight (lb)	Moment/100	Weight (lb)	Moment/100
0	0.00	5,400	30,484.00	10,800	60,632.00
500	2,717.00	5,900	33,283.00	11,300	63,442.00
1,000	5,456.00	6,400	36,096.00	11,660	66,007.00
1,500	8,210.00	6,900	38,916.00	12,000	67,920.00
2,000	10,976.00	7,400	41,736.00	12,500	70,750.00
2,500	13,755.00	7,900	44,567.00	13,000	73,580.00
3,000	16,546.00	8,400	47,404.00	13,500	76,410.00
3,500	19,348.00	8,900	50,249.00	13,850	78,391.00
4,000	22,160.00	9,310	52,322.00	14,000	79,240.00
4,500	24,984.00	9,800	55,174.00	14,150	81,068.04
4,900	27,216.00	10,300	58,015.00		

NOTE: FCBP1 fuel weight: 11,660 lb at ARM 566.1 in. FCBP2 fuel weight: 9,310 lb at ARM 562.0 in. Maximum fuel capacity: 14,150 lb.

CHALLENGER 350 WEIGHT AND BALANCE COMPUTATION FORM

This form provides a comprehensive worksheet for calculating weight and balance for the Challenger 350. Complete all sections in order.

PRE-CHECK: Before completing this form, verify CDL/MEL status for any weight penalties. Also confirm that seat and baggage arms match the specific aircraft's Weighing Report.

Date:	**Flight #:**
Aircraft:	**Route:**
PIC:	**SIC:**

ITEM	WEIGHT (lb)	ARM (in)	MOMENT/100
AIRCRAFT BASIC DATA			
1. Basic Empty Weight			
OPERATING ITEMS			
2. Pilot		305.20	
3. Copilot		305.20	
4. Crew Carry-On Baggage		385.00	
5. Crew Baggage		650.00	
6. Flight Manuals	30	320.00	96.00
7. Galley Supplies		366.30	
8. Aft Potable Water		636.00	
9. Lav Chemicals		610.00	
10. Lav Supplies		610.00	
11. Aft Equip Bay Ladder		737.10	
PASSENGERS			
12. Seat 1		422.70	
13. Seat 2		422.70	
14. Seat 3		469.30	
15. Seat 4		471.30	
16. Seat 5		518.70	
17. Seat 6		520.70	
18. Seat 7		565.30	
19. Seat 8		568.30	
20. Seat 9 (LAV)		613.00	
BAGGAGE			

21. Baggage Compartment		650.00	
ZERO FUEL WEIGHT (ZFW)	**≤ 28,200**		

ZFW CG:_____ in %MAC:_____

FUEL			
22. Fuel Loading		Varies	
RAMP WEIGHT (RW)	**≤ 40,750**		

RW CG:_____ in %MAC:_____

23. Less: Taxi Fuel	( )	—	( )
TAKEOFF WEIGHT (TOW)	**≤ 40,600**		
LANDING WEIGHT (LW)	**≤ 34,150**		

TOW CG:_____ in %MAC:_____

24. Less: Enroute Fuel Burn	( )	—	( )
LANDING WEIGHT (LW)	**≤ 34,150**		

LW CG:_____ in %MAC:_____

25. Gear Retraction Moment	—	—	**-5.3 (M/1000)**

VERIFICATION: CG within limits for all phases of flight? □ YES □ NO

Prepared by: _____ Date/Time: _____

WEIGHT AND BALANCE EXERCISE

KSAN (San Diego) to KRFD (Rockford)

This exercise demonstrates a complete weight and balance calculation for a flight from San Diego International Airport (KSAN) to Chicago Rockford International Airport (KRFD) using actual aircraft data.

NOTE: The seat arms used in this exercise are for this specific sample aircraft configuration only. Actual seat arms are tail-number specific and must be obtained from the individual aircraft's Weighing Report.

Pilot: John Q. Public	**Copilot:** Jane E. Public
Aircraft: Trainer-1	**Route:** KSAN → KRFD

Step-by-Step Solution

Step 0: Pre-Calculation CDL/MEL Check

Before beginning calculations, verify the Configuration Deviation List (CDL) and Minimum Equipment List (MEL) status for the aircraft. For this exercise, no CDL/MEL items apply — the aircraft is in standard configuration with no weight penalties required.

Step 1: Establish Operating Weight Empty (OWE)

Begin with the Basic Empty Weight (BEW) from the aircraft's Weighing Report, then add all operating items (crew, crew equipment, and standard cabin provisions):

Item	Weight (lb)	ARM (in)	Moment/100
1. Basic Empty Weight	23,981	607.06	145,577.85
2. Pilot	199	305.20	607.35
3. Copilot	199	305.20	607.35
4. Crew Carry-On Baggage	40	385.00	154.00
5. Crew Baggage	60	650.00	390.00
6. Flight Manuals	30	320.00	96.00
7. Galley Supplies	109	366.30	399.27
8. Aft Potable Water	20	636.00	127.20
9. Lav Chemicals	20	610.00	122.00
10. Lav Supplies	5	610.00	30.50
11. Aft Equip Bay Ladder	9	737.10	66.34
Operating Weight Empty (OWE)	**24,672**	600.56 (%MAC: 39.11%)	**148,177.86**

Each moment is calculated as: Weight × ARM ÷ 100. For example, Pilot: 199 × 305.20 ÷ 100 = 607.35.

OWE CG ARM = 148,177.86 × 100 ÷ 24,672 = 600.56 inches. %MAC = [(600.56 − 556.675) ÷ 112.22] × 100 = 39.11%.

Step 2: Calculate Zero Fuel Weight (ZFW)

Add passengers and baggage to the OWE. Passenger weights include carry-on items. Use the seat arms from the specific aircraft's Weighing Report:

Item	Weight (lb)	ARM (in)	Moment/100
Operating Weight Empty (OWE)	24,672	600.56 (%MAC: 39.11%)	148,177.86
12. Seat 1	81	422.70	342.39
13. Seat 2	81	422.70	342.39
14. Seat 3	110	469.30	516.23
15. Seat 4	189	471.30	890.76
16–20. Seats 5–9	0	—	0.00
21. Baggage Compartment	400	650.00	2,600.00
Zero Fuel Weight (ZFW)	**25,533**	598.71 (%MAC: 37.47%)	**152,869.61**

ZFW CG ARM = Total Moment/100 × 100 ÷ Total Weight = 152,869.61 × 100 ÷ 25,533 = 598.71 inches.

%MAC = [(598.71 − 556.675) ÷ 112.22] × 100 = 37.47%

Verify: ZFW of 25,533 lb ≤ MZFW of 28,200 lb ✓. CG at 37.47% MAC is within limits (25–43% at this weight) ✓.

Step 3: Calculate Ramp Weight (RW)

Add the planned fuel load to ZFW. Use the Fuel Loading Table to look up the moment for the fuel weight:

Item	Weight (lb)	ARM (in)	Moment/100
Zero Fuel Weight (ZFW)	25,533	598.71 (%MAC: 37.47%)	152,869.61
22. Fuel Loading	14,150	Varies	81,068.04
Ramp Weight (RW)	**39,683**	589.52 (%MAC: 29.27%)	**233,937.65**

The fuel moment of 81,068.04 is obtained from the Fuel Loading Table for 14,150 lb. The fuel ARM varies with quantity because the fuel CG shifts as tanks fill.

RW CG ARM = 233,937.65 × 100 ÷ 39,683 = 589.52 inches. %MAC = 29.27%.

Verify: RW of 39,683 lb ≤ MRW of 40,750 lb ✓. CG at 29.27% MAC is within limits ✓.

Step 4: Calculate Takeoff Weight (TOW)

Subtract taxi fuel from Ramp Weight. A standard taxi burn of 300 lb is used for this flight. The taxi fuel moment is interpolated from the Fuel Loading Table:

Item	Weight (lb)	ARM (in)	Moment/100
Ramp Weight (RW)	39,683	589.52 (%MAC: 29.27%)	233,937.65
23. Less: Taxi Fuel	(300)	—	(1,857.02)
Takeoff Weight (TOW)	**39,383**	589.29 (%MAC: 29.07%)	**232,080.63**

The taxi fuel moment is determined by interpolating from the Fuel Loading Table for the marginal fuel burned during taxi.

TOW CG ARM = 232,080.63 × 100 ÷ 39,383 = 589.29 inches. %MAC = 29.07%.

Verify: TOW of 39,383 lb ≤ MTOW of 40,600 lb ✓. CG at 29.07% MAC is within limits ✓.

Step 5: Calculate Landing Weight (LW)

Subtract the planned enroute fuel burn from Takeoff Weight:

Item	Weight (lb)	ARM (in)	Moment/100
Takeoff Weight (TOW)	39,383	589.29 (%MAC: 29.07%)	232,080.63
24. Less: Enroute Fuel Burn	(6,151)	—	(36,149.55)
Landing Weight (LW)	**33,232**	589.59 (%MAC: 29.33%)	**195,931.08**

The enroute fuel moment is interpolated from the Fuel Loading Table based on the fuel quantity burned during the flight.

LW CG ARM = 195,931.08 × 100 ÷ 33,232 = 589.59 inches. %MAC = 29.33%.

Verify: LW of 33,232 lb ≤ MLW of 34,150 lb ✓. CG at 29.33% MAC is within limits ✓.

Step 6: Apply Landing Gear Retraction Moment

Apply the gear retraction moment adjustment of −5.3 (Moment/1000) to all gear-up flight CG calculations. This is a moment-only adjustment — it does not change the aircraft weight. Apply this correction to the ZFW, TOW, LW, and each FCBP when verifying CG positions against the gear-up CG envelope.

Step 7: Verify Fuel Curve Boundary Points

Calculate FCBP1 and FCBP2 by adding the boundary point fuel quantities to ZFW. Look up the fuel moment from the Fuel Loading Table for each FCBP fuel weight:

Point	Weight (lb)	ARM (in)	Moment/100
FCBP1 (ZFW + 11,660 lb fuel)	37,193	588.49 (%MAC: 28.35%)	218,876.61
FCBP2 (ZFW + 9,310 lb fuel)	34,843	588.90 (%MAC: 28.71%)	205,191.61

FCBP1: ZFW Moment (152,869.61) + Fuel Moment for 11,660 lb (66,007.00) = 218,876.61. ARM = 218,876.61 × 100 ÷ 37,193 = 588.49 in. %MAC = 28.35%.

FCBP2: ZFW Moment (152,869.61) + Fuel Moment for 9,310 lb (52,322.00) = 205,191.61. ARM = 205,191.61 × 100 ÷ 34,843 = 588.90 in. %MAC = 28.71%.

Both FCBP1 (37,193 lb) and FCBP2 (34,843 lb) are lighter than the TOW (39,383 lb), so both points are included in the fuel curve.

Plot all four points on the CG envelope in sequence: TOW → FCBP1 → FCBP2 → ZFW. The entire fuel curve must remain within the envelope. For this exercise, all points fall within the approved CG limits ✓.

Completed Weight and Balance Computation Form

The following form shows the completed calculation with all values filled in:

ITEM	WEIGHT (lb)	ARM (in)	MOMENT/100
AIRCRAFT BASIC DATA			
1. Basic Empty Weight	23,981	607.06	145,577.85

OPERATING ITEMS			
2. Pilot	199	305.20	607.35
3. Copilot	199	305.20	607.35
4. Crew Carry-On Baggage	40	385.00	154.00
5. Crew Baggage	60	650.00	390.00
6. Flight Manuals	30	320.00	96.00
7. Galley Supplies	109	366.30	399.27
8. Aft Potable Water	20	636.00	127.20
9. Lav Chemicals	20	610.00	122.00
10. Lav Supplies	5	610.00	30.50
11. Aft Equip Bay Ladder	9	737.10	66.34
PASSENGERS			
12. Seat 1	81	422.70	342.39
13. Seat 2	81	422.70	342.39
14. Seat 3	110	469.30	516.23
15. Seat 4	189	471.30	890.76
16-20. Seats 5-9	0	—	0.00
BAGGAGE			
21. Baggage Compartment	400	650.00	2,600.00
ZERO FUEL WEIGHT (ZFW)	**25,533**	598.71	**152,869.61**

ZFW CG: 598.71 in %MAC: 37.47% [MZFW = 28,200 lb ✓]

FUEL			
22. Fuel Loading	14,150	Varies	81,068.04
RAMP WEIGHT (RW)	**39,683**	589.52	**233,937.65**

RW CG: 589.52 in %MAC: 29.27% [MRW = 40,750 lb ✓]

23. Less: Taxi Fuel	(300)	—	(1,857.02)
TAKEOFF WEIGHT (TOW)	**39,383**	589.29	**232,080.63**

TOW CG: 589.29 in %MAC: 29.07% [MTOW = 40,600 lb ✓]

24. Less: Enroute Fuel Burn	(6,151)	—	(36,149.55)
LANDING WEIGHT (LW)	**33,232**	589.59	**195,931.08**

LW CG: 589.59 in %MAC: 29.33% [MLW = 34,150 lb ✓]

EXERCISE RESULTS SUMMARY

Zero Fuel Weight: 25,533 lb at 37.47% MAC — Within limits ✓
Ramp Weight: 39,683 lb at 29.27% MAC — Within limits ✓
Takeoff Weight: 39,383 lb at 29.07% MAC — Within limits ✓
Landing Weight: 33,232 lb at 29.33% MAC — Within limits ✓

ALL WEIGHTS AND CG POSITIONS WITHIN LIMITS — FLIGHT APPROVED

QUICK REFERENCE DATA

Weight Limits

Limit	Weight (lb)	Weight (kg)
Maximum Ramp Weight (MRW)	40,750	18,484
Maximum Takeoff Weight (MTOW)	40,600	18,416
Maximum Landing Weight (MLW)	34,150	15,490
Maximum Zero Fuel Weight (MZFW)	28,200	12,791
Minimum Flight Weight (MFW)	24,800	11,249
Maximum Fuel Capacity	14,150	6,418

CG Reference Data

Parameter	Value
Leading Edge MAC (LEMAC)	**556.675 inches**
Mean Aerodynamic Chord (MAC)	**112.22 inches**
%MAC Formula	**[(CG - 556.675) / 112.22] × 100**
Landing Gear Retraction Moment	**-5.3 (Moment/1000)**

Fuel Curve Boundary Points

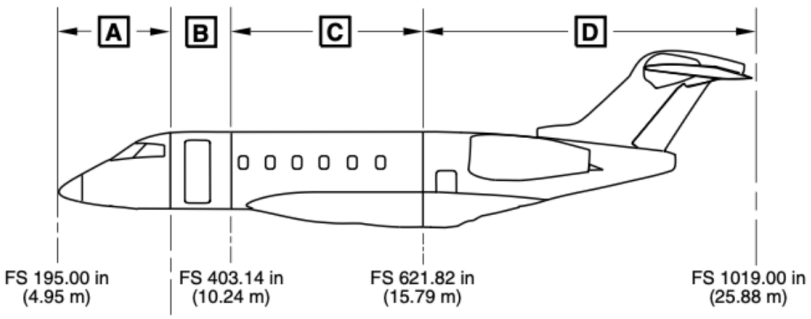
Point	Fuel Weight	Fuel ARM
FCBP1	**11,660 lb**	566.1 in
FCBP2	**9,310 lb**	562.0 in

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CHALLENGER 350

BD-100-1A10

WEIGHT AND BALANCE





17 March 2026 Revision: Original 1

Aircraft Standard Stations – Use the following ARMs for this exercise.

Aircraft & Baggage

	Weight (lb)	Arm (in)	Moment/100
Basic Empty Weight	23981	607.06	145579.06
Taxi Fuel	200	—	0.00
Crew Carry on Baggage	40	385.00	154.00
Crew Baggage	60	650.00	390.00
Baggage		650.00	0.00

Aircraft Items

	Weight (lb)	Arm (in)	Moment/100
Flight Manuals	30	320.00	96.00
Galley Supplies	109	366.30	399.27
Aft Potable Water	20	636.00	127.20
Lav Chemicals	20	610.00	122.00
Lav Supplies	5	610.00	30.50
Aft Equip Bay Ladder	9	737.10	66.34

Occupants

	Weight (lb)	Arm (in)	Moment/100
Pilot		305.20	0.00
Copilot		305.20	0.00
Seat 1		422.70	0.00
Seat 2		422.70	0.00
Seat 3		469.30	0.00
Seat 4		471.30	0.00
Seat 5		518.70	0.00
Seat 6		520.70	0.00
Seat 7		565.30	0.00
Seat 8		568.30	0.00
Seat 9 LAV		613.00	0.00

True Empty Weight (TEW/BEW) - The actual weighed empty weight of the aircraft including all permanently installed equipment, engine oil, unusable fuel, and hydraulic fluid.

For this example, we will use: 23,981 lbs., Arm: 607.06 Arm, Moment: 145577.85, %Mac: 41

Operating Weight Empty – TEW/BEW plus operating items (crew, crew baggage, flight manuals, and standard cabin equipment). This is the starting point for flight weight calculations.

Add the following:

Item	Weight (lb)	Arm (in)
Flight Manuals	30	320
Crew Baggage	40	385
Flight Crew	398	305.2

OWE CALCULATION FORM

ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1 000 lb in (kg m)	%MAC	REFERENCE	NOTE
TRUE EMPTY WEIGHT (TEW)						LAST WEIGHING RESULT	[1] [2]
OPERATING ITEMS							
FLIGHT COMPARTMENT CREW	+					01–40–10	
CREW BAGGAGE	+					01–40–10	
FLIGHT MANUALS / MAGAZINES	+					01–40–10	
OPERATING WEIGHT EMPTY (OWE)	=						[1]

NOTES:
[1] %MAC (imperial) = [(Xarm – 556.675) / 112.22] x 100
%MAC (SI) = [(Xarm – 14.13) / 2.85] x 100
[2] Last weighing result for TEW given in Chapter 2, Aircraft Reports.

Payload Item Form - Use for the passengers and place the total in the "ADJUSTMENT" line in the ZFW buildup on the next page. Add the following standard items as well:

Item	Weight (lb)	Arm (in)
Galley Supplies	109	366.3
Aft Potable Water	20	636
Lav Chemicals	20	610
Lav Supplies	5	610
Aft Equip Bay Ladder	9	737.1
Passenger – Seat 1	81	422.7
Passenger – Seat 2	81	422.7
Passenger – Seat 3	110	469.30
Passenger – Seat 4	189	469.30

PAYLOAD ITEM FORM

ITEM	WEIGHT	Xarm	MOMENT / 1 000
	lb (kg)	in (m)	lb in (kg m)

Zero Fuel Weight - OWE plus payload (passengers and baggage). The aircraft weight before fuel is added. "ADJUSTMENT" is from the Payload Item Form.

Item	Weight (lb)	Arm (in)
Check-In Baggage	460	650

WEIGHT BUILD–UP – ZFW CALCULATION FORM

ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT 1000 lb in (kg m)	%MAC	REFERENCE	NOTE
OPERATING WEIGHT EMPTY (OWE)	=					01–90–10	[1] [2]
PAYLOAD ITEMS							
CHECK–IN BAGGAGE OR CARGO	+					01–60–00	
ADJUSTMENT							
ADJUSTMENT	+					01–40–10	[3]
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[2]
GEAR UP	+			–4.6 (–0.053)		01–00–80	
ZERO FUEL WEIGHT – ZFW (GEAR UP)							
ZERO–FUEL–WEIGHT GEAR UP (ZFW GEAR UP)	=					01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [(Xarm $_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [(Xarm $_{CG}$ – 14.13) / 2.85] x 100
[3] To use when necessary.

Ramp Weight - ZFW plus total fuel load. The weight of the aircraft ready for taxi.

WEIGHT BUILD–UP – RW CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1 000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
FUEL TANK	+					01–20–10	
RAMP WEIGHT – RW (GEAR DOWN)							
RAMP–WEIGHT GEAR DOWN (RW GEAR DOWN)	=					01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = $[(Xarm_{CG} - 556.675) / 112.22] \times 100$
%MAC (SI) = $[(Xarm_{CG} - 14.13) / 2.85] \times 100$

Takeoff Weight - Ramp weight minus taxi fuel burn. The actual weight at brake release.

WEIGHT BUILD–UP – TOW CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1 000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
REMAINING FUEL PRIOR TAKE–OFF	+					01–20–10	
TAKE–OFF WEIGHT – TOW (GEAR DOWN)							
TAKE–OFF–WEIGHT GEAR DOWN (TOW GEAR DOWN)	=					01–00–50	[2]

Notes:

[1] Results from previous sum.

[2] %MAC (imperial) = $[(Xarm_{CG} - 556.675) / 112.22] \times 100$

%MAC (SI) = $[(Xarm_{CG} - 14.13) / 2.85] \times 100$

Fuel Curve Boundary Points - Critical points on the fuel curve that define the CG path during fuel burn. Essential for verifying the aircraft remains within CG limits throughout flight.

WEIGHT BUILD–UP – FCBP1 CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
FUEL QUANTITY FOR FUEL–CURVE BOUNDARY–POINT	+	11660 (5289)	566.1 (14.38)	6600.7 (76.049)		01–20–10	
FUEL–CURVE BOUNDARY–POINT 1 – FCBP1 (GEAR DOWN)							
FUEL–CURVE BOUNDARY–POINT 1 – FCBP1 (GEAR DOWN)	=						[2]
ADD GEAR RETRACTION MOMENT	+			–4.6 (–0.053)		01–00–80	[3]
FUEL–CURVE BOUNDARY–POINT 1 – FCBP1 (GEAR UP)							
FUEL–CURVE BOUNDARY–POINT 1 – FCBP1 (GEAR UP)	=					01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [(Xarm $_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [(Xarm $_{CG}$ – 14.13) / 2.85] x 100
[3] The total aircraft moment decreases by approximately 4600 lb in (53 kg m) when the landing gears are retracted.

WEIGHT BUILD–UP – FCBP2 CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
FUEL QUANTITY FOR FUEL–CURVE BOUNDARY–POINT	+	9310 (4223)	562.0 (14.27)	5232.2 (60.282)		01–20–10	
FUEL–CURVE BOUNDARY–POINT 2 – FCBP2 (GEAR DOWN)							
FUEL–CURVE BOUNDARY–POINT 2 – FCBP2 (GEAR DOWN)	=						[2]
ADD GEAR RETRACTION MOMENT	+			–4.6 (–0.053)		01–00–80	[3]
FUEL–CURVE BOUNDARY–POINT 2 – FCBP2 (GEAR UP)							
FUEL–CURVE BOUNDARY–POINT 2 – FCBP2 (GEAR UP)	=					01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [(Xarm $_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [(Xarm $_{CG}$ – 14.13) / 2.85] x 100
[3] The total aircraft moment decreases by approximately 4600 lb in (53 kg m) when the landing gears are retracted.

Landing Weight - Takeoff weight minus enroute fuel burn. The projected weight at destination.

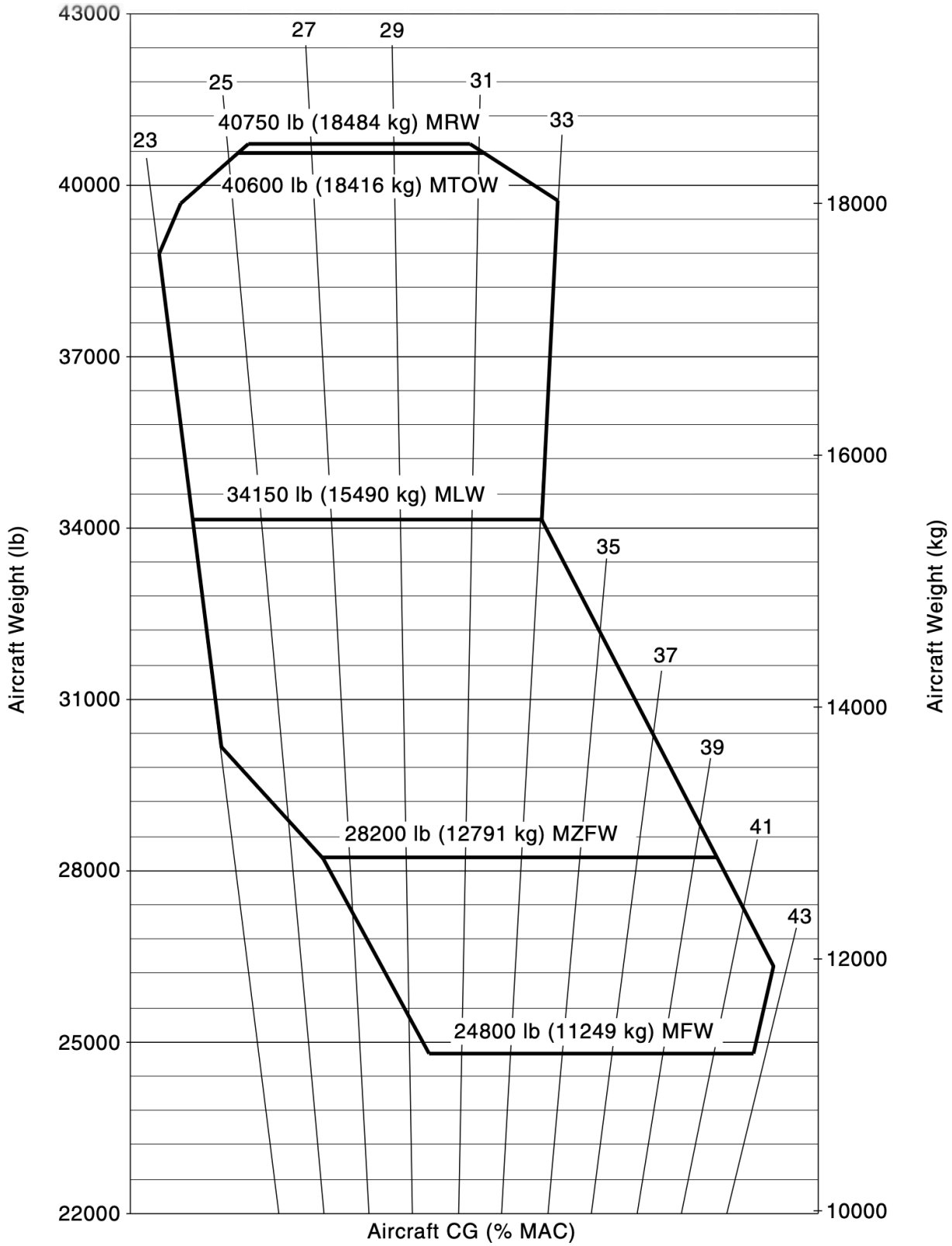
WEIGHT BUILD–UP – LW CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1 000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
REMAINING FUEL AT LANDING	+					01–20–10	
LANDING WEIGHT – LW (GEAR DOWN)							
LANDING–WEIGHT GEAR DOWN (LW GEAR DOWN)	=					01–00–50	[2]

Notes:

[1] Results from previous sum.

[2] %MAC (imperial) = $[(Xarm_{CG} - 556.675) / 112.22] \times 100$

%MAC (SI) = $[(Xarm_{CG} - 14.13) / 2.85] \times 100$


43000
40000
37000
34000
31000
28000
25000
22000
Aircraft Weight (lb)
18000
16000
14000
12000
10000
Aircraft Weight (kg)
23
25
27
29
31
33
35
37
39
41
43
40750 lb (18484 kg) MRW
40600 lb (18416 kg) MTOW
34150 lb (15490 kg) MLW
28200 lb (12791 kg) MZFW
24800 lb (11249 kg) MFW
Aircraft CG (% MAC)

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Weight and Balance Manual

MODEL	A/C EFFECTIVITY
BD-100-1A10 (CH-350)	20501-20999

CHALLENGER 350

Publication No. CH 350 WBM

BOMBARDIER CHALLENGER 350* (MODEL BD-100-1A10)

WEIGHT AND BALANCE MANUAL

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CHALLENGER 350

BD–100 WEIGHT AND BALANCE MANUAL

REVISION 4 – TRANSMITTAL LETTER

This package contains BD–100 WEIGHT AND BALANCE MANUAL, Revision 4, dated Sep 05/2018.

Record the incorporation of Revision 4 on the RECORD OF REVISIONS sheet at the front of your manual.

To bring your manual up to date, remove the old pages indicated below and insert the corresponding new pages, according to the following list.

REMOVE:			**INSERT:**		
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A signature in the "INSERTED BY" column shows that the publication holder has incorporated the revision.

REVISION NO.	ISSUE DATE	DATE INSERTED	INSERTED BY
Basic	Jun 11/2014	Jun 11/2014	Bombardier
1	Sep 15/2014	Sep 15/2014	Bombardier
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INTRODUCTION

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INTRODUCTION

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INTRODUCTION

1. Scope

The Weight and Balance Manual (WBM) prepared by Bombardier Business Aircraft agrees with specification No. 100 of the Air Transport Association of America (ATA–100), Revision 26, dated April 1987. The WBM contains data on the aircraft loads and aircraft operations for the Challenger 350 aircraft.

The weight and balance procedure is a necessary pre–flight check to make sure of the safe and satisfactory operation of the aircraft. Personnel must obey the procedures given in the WBM for the calculations of weight and balance. Only fully qualified and licensed personnel can do these procedures.

2. How to Use the Manual

The ATA–100 has a three–element number system to identify the different subjects contained in the WBM. The first element identifies the chapter (Ch), the second element identifies a section (Se) in the chapter and the third element identifies a subject (Su) in the section. The example that follows shows and briefly describes a typical three–element number:

“01–00–30”

The first element identifies Chapter 01 for CONTROL,

The second element identifies Section 00 for GENERAL,

The third element identifies Subject 30 for AIRCRAFT STATIONS.

3. Acronyms

Refer to the Subjects that follow for the technical definition of the acronyms found in the Weight and Balance Manual:

- DEFINITIONS (Subject 01–00–20)
- AIRCRAFT STATIONS (Subject 01–00–30)
- REFERENCE POINTS (Subject 01–00–40).

In the Weight and Balance Manual, terms are spelled out the first time they are used and the acronym is given in parentheses. Then only the acronym is given.

4. Warnings, Cautions and Notes

Warnings, cautions and notes added to the text are there to show important parts of the text when necessary. Their definitions are as follows:

A. Warning

A warning shows personnel how to use the materials. It also gives the limits and procedures that the personnel must obey to prevent injury to persons and damage to equipment.

B. Caution

A caution shows a procedure that personnel must obey to prevent damage to equipment.

C. Note

A note shows procedures that make the job easier.

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CHAPTER 01 – CONTROL

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GENERAL

1. Description

This section gives general data applicable to the aircraft as follows:

- DIMENSIONS AND AREAS (Subject 01–00–10)
- DEFINITIONS (Subject 01–00–20)
- AIRCRAFT STATIONS (Subject 01–00–30)
- REFERENCE POINTS (Subject 01–00–40)
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DIMENSIONS AND AREAS

1. Dimensions

Refer to Figure 1.

This part of the manual shows the general external and primary dimensions of the aircraft. The dimensions are in imperial units. The equivalent values in SI units are also given.

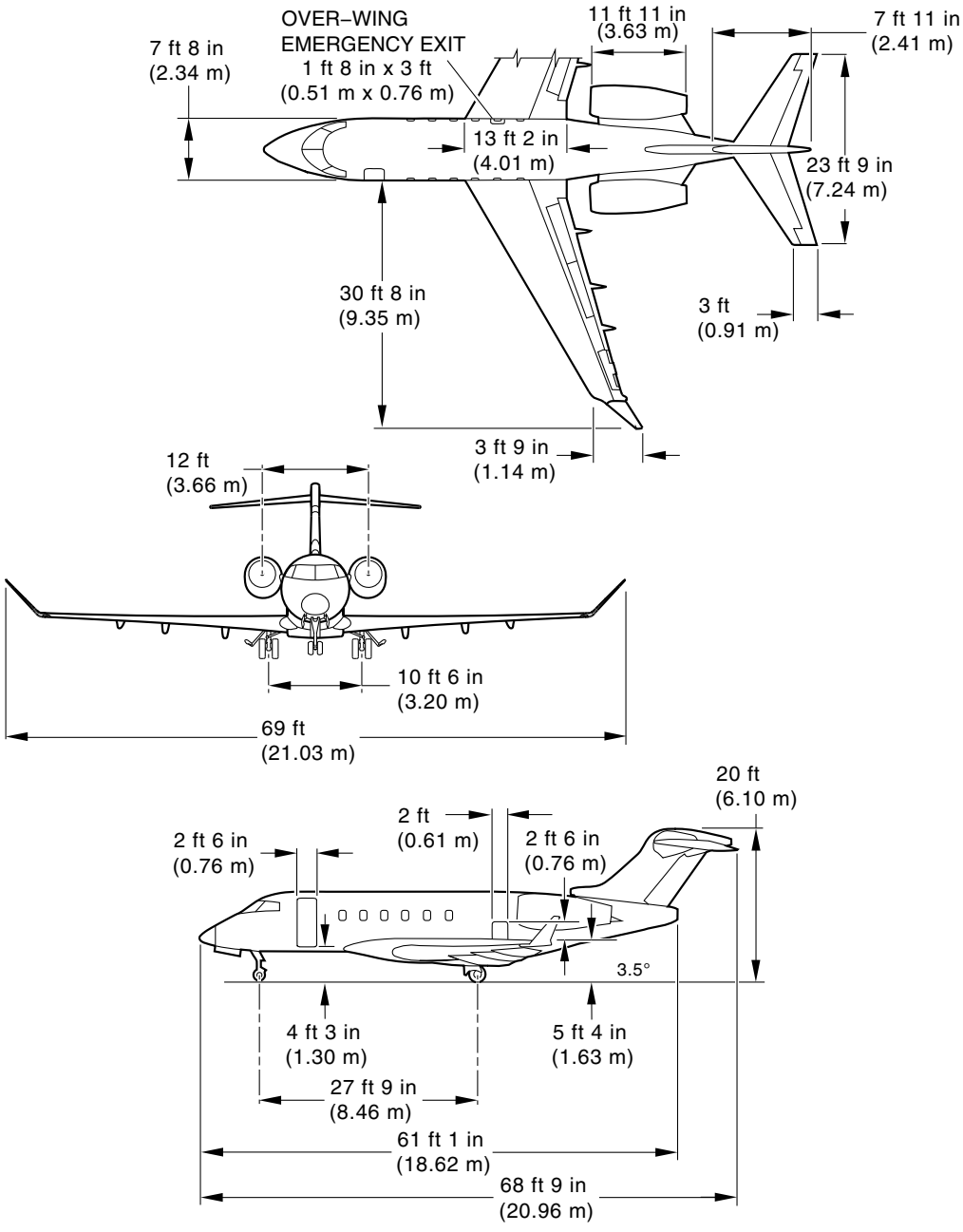
The Table 1 that follows shows the dimensions and areas of the primary aircraft assemblies.

NOTE: The values found in Table 1 are for general information only. Do not use them to do inspections or to reject assemblies.

Table 1 – General Dimensions and Areas of the Aircraft

Dimensions/Areas	Imperial (SI) Units
Aircraft	
Total Length	825.0 in (20.96 m)
Total Height	240.0 in (6.10 m)
Wing	
Span	827.9 in (21.03 m)
Mean Aerodynamic Chord (MAC)	112.22 in (2.85 m)
Leading Edge MAC (LEMAC)	556.675 in (14.14 m)
Horizontal Stabilizer	
Span	284.6 in (7.23 m)
Fuselage	
Diameter (external)	92.0 in (2.34 m)
Length	733.0 in (18.62 m)
Static Ground Angle (nominal)	–0.86 Degrees
Area	
Total Upper–Exposed Wing [1]	75 168.0 in^2 (48.50 m^2)
Total Upper–Exposed Horizontal–Stabilizer	17 640.0 in^2 (11.38 m^2)

Table 1 – General Dimensions and Areas of the Aircraft	
Dimensions/Areas	**Imperial (SI) Units**
Total Upper–Exposed Vertical–Stabilizer	11 980.8 in^2 (7.73 m^2)
Note: [1] Wing Area includes ailerons, flaps, spoilers and fuselage area.	
Landing Gear	
Track	126.0 in (3.20 m)
Wheel Base	333.0 in (8.46 m)
Minimum Turning Circle Diameter	754.0 in (19.15 m)
Main–Landing–Gear Tire Dimension	H26.5 x 8–14
Main–Landing–Gear Wheel Dimension	14.0 in (0.36 m)
Nose–Landing–Gear Tire Dimension	H18 x 5.5–8
Nose–Landing–Gear Wheel Dimension	8.0 in (0.20 m)



External Aircraft Dimensions
Figure 1

EFFECTIVITY: ALL

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DEFINITIONS

1. General

This section contains a list of acronyms and the definitions of terms found in the Weight and Balance Manual (WBM). The list of acronyms also includes abbreviations.

2. Acronyms

Acronym	Term
ACM	Additional Crew Member
a/c	Aircraft
BL	Buttock Line
BWE	Basic Weight Empty
CG	Center of Gravity
CPLT	Copilot
DWE	Delivered Weight Empty
FCBP	Fuel Curve Boundary–Points
FLT#	Flight Number
FOB	Fuel On Board
FS	Fuselage Station
F/A	Flight Attendant
HSS	Horizontal Stabilizer Station
I/B	Inboard
LEMAC	Leading–Edge Mean–Aerodynamic–Chord
MAC	Mean Aerodynamic Chord
MFW	Minimum Flight Weight
MLG	Main Landing Gear
MLW	Maximum Landing Weight
MRW	Maximum Ramp Weight
MTOW	Maximum Take–Off Weight
MWE	Manufacturer's Weight Empty

Acronym	Term
MZFW	Maximum Zero–Fuel Weight
NLG	Nose Landing Gear
OWE	Operating Weight Empty
O/B	Outboard
PLT	Pilot
RW	Ramp Weight
SB	Service Bulletin
STGR	Stringer
TEW	True Empty Weight
TOW	Take–Off Weight
VSS	Vertical Stabilizer Station
WD	Weighing Datum
WGLTS	Winglet Station
WL	Water Line
WRP	Wing Reference Plane
WS	Wing Station
ZFW	Zero Fuel Weight
ZRD	Zero Reference Datum
3D	Three Dimensions

3. Definitions

Basic Weight Empty (BWE)

The BWE is defined as follows:

TEW + Temporary fixed equipment necessary for particular flights.

NOTE: Examples of temporary equipment are temporary ballast, flight test equipment or ferry kit.

Delivered Weight Empty (DWE)

The DWE includes the MWE, all fixed interior equipment (standard and optional) and the customer options.

Fuel Curve Boundary–Points (FCBP)

A group of points defined by the fuel curve and the longitudinal CG envelope. These FCBP define the area to use for the check of the aircraft longitudinal CG position, given a particular loading.

Manufacturer's Weight Empty (MWE)

The MWE includes the weight of the structure, power plant, systems and interior provisions. The MWE does not include the engine oil and the unusable fuel.

Maximum Landing Weight (MLW)

The MLW is the maximum aircraft weight permitted during a landing at the nominal descent velocity.

Maximum Ramp Weight (MRW)

The MRW is the maximum possible aircraft weight. An aircraft is permitted to have the MRW only during ground handling and taxiing.

Maximum Take–Off Weight (MTOW)

The MTOW is the maximum weight for the take–off operation.

Maximum Zero–Fuel Weight (MZFW)

The MZFW is the maximum permitted aircraft weight before the load of the usable fuel is added to the aircraft.

Mean Aerodynamic Chord (MAC)

The MAC is the chord of an imaginary wing with a constant chord that has the same aerodynamic characteristics as the aircraft wing.

Minimum Flight Weight (MFW)

The MFW is the minimum permitted aircraft weight for flight operations.

Operating Items

The operating items include the engine oil, unusable fuel, crew, crew equipment and passenger service items. Operating items also include other items necessary for the operation of the aircraft during usual flights.

Operating Weight Empty (OWE)

The OWE includes the TEW and operating items. The operating items do not include the engine oil and unusable fuel already included in the TEW.

Payload

The payload includes the passengers, baggage and cargo.

Ramp Weight (RW)

The RW includes the ZFW and usable fuel.

TakeOff Weight (TOW)

The TOW is the weight at the start of the take–off operation.

True Empty Weight (TEW)

The TEW is the weight of the aircraft in a condition where only the crew and fuel are necessary for the flight. The condition can change as follows:

1. TEW = MWE + Engine Oil + Unusable Fuel.
2. TEW = DWE + Engine Oil + Unusable Fuel.

Useful Load

The useful load is the difference between the RW and the OWE.

Xarm

The Xarm is the distance along the longitudinal axis of the aircraft from the Zero Reference Datum (ZRD) up to the CG of the item.

Zero Fuel Weight (ZFW)

The ZFW includes the OWE and payload.

AIRCRAFT STATIONS

1. General

Refer to Figure 1, Figure 2, Figure 3, Figure 4, Figure 5 and Figure 6.

To calculate the arm of a given component on the aircraft, aircraft coordinates are used. This section shows the six primary components of the aircraft in relation to their reference planes. The six primary components are shown, in the order that follows:

- Fuselage,
- Wing,
- Winglets,
- Vertical Stabilizer,
- Horizontal Stabilizer,
- Engine–Nacelles.

A. Buttock Line (BL)

The BL are vertical lines (planes in 3D) perpendicular to the Yarm axis. They are used to measure the distance in inches along the Yarm axis. The plane of symmetry of the aircraft at BL0.00 gives the ZRD. Refer to Figure 5 to see some BL.

B. Fuselage Station (FS)

The FS are vertical lines (planes in 3D) perpendicular to the Xarm axis. They are used to measure the distance in inches along the Xarm axis. The fuselage stations values start at the zero reference datum (ZRD) and increase thru the rear end of the aircraft, as shown. Refer to Figure 1 and Figure 6.

C. Horizontal Stabilizer Station (HSS)

The HSS are vertical lines (planes in 3D) parallel to the BL. They are measured from the symmetrical center line of the aircraft. Refer to Figure 5.

D. Vertical Stabilizer Station (VSS)

The VSS are lines (planes in 3D) related to the vertical–stabilizer reference axis. Refer to Figure 4.

E. Water Line (WL)

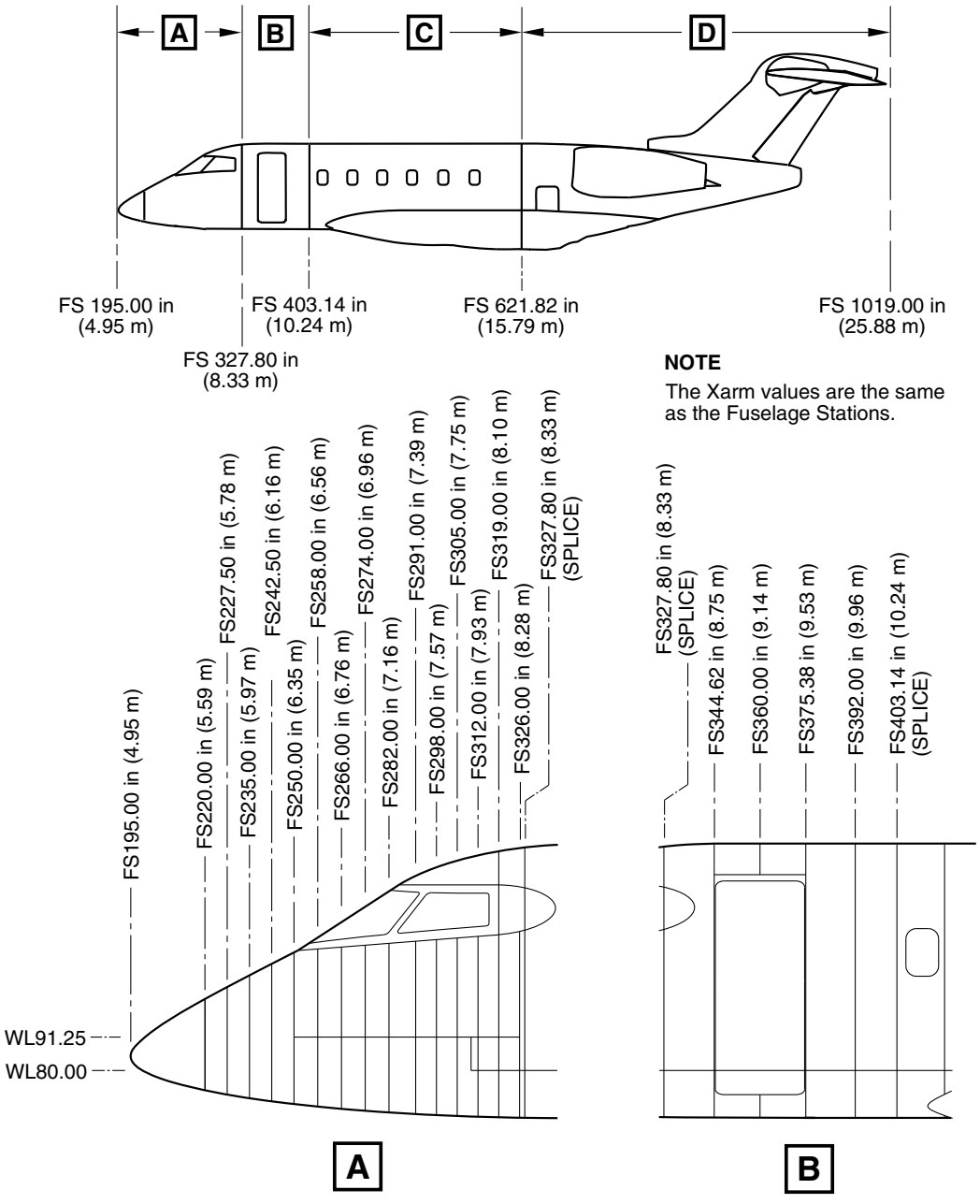
The WL are horizontal lines (planes in 3D) perpendicular to the Zarm axis and they are parallel to the fuselage center line. They are used to measure the distance in inches along the Zarm axis. Refer to Figure 4, Figure 5s to see the WL.

F. Wing Station (WS)

The WS are vertical lines (planes in 3D) perpendicular to the wing reference plane (WRP). Refer to Figure 2.

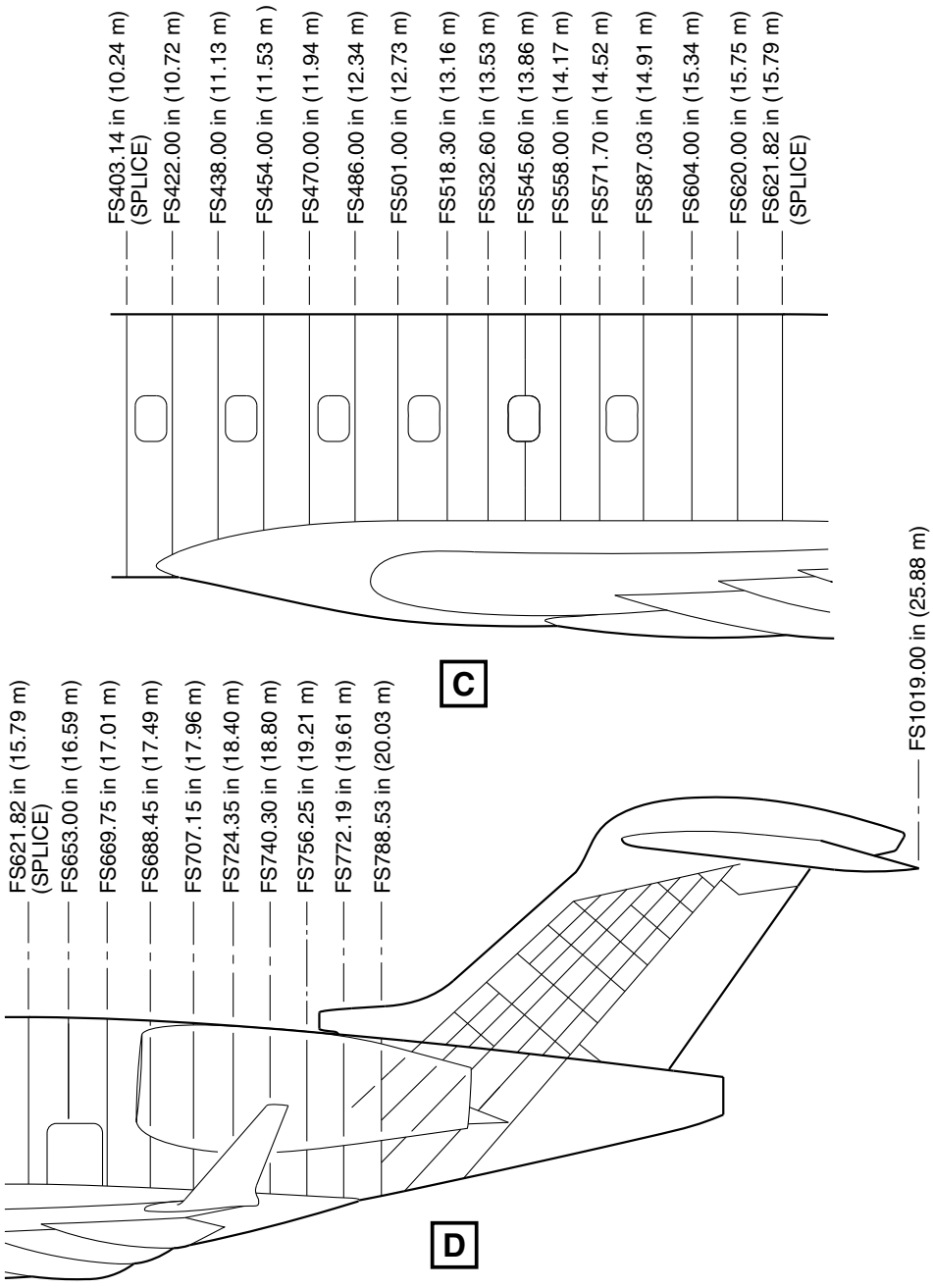
G. Winglet Station (WGLTS)

The WGLTS are horizontal lines parallel to the wing reference plane (WRP). Refer to Figure 3.



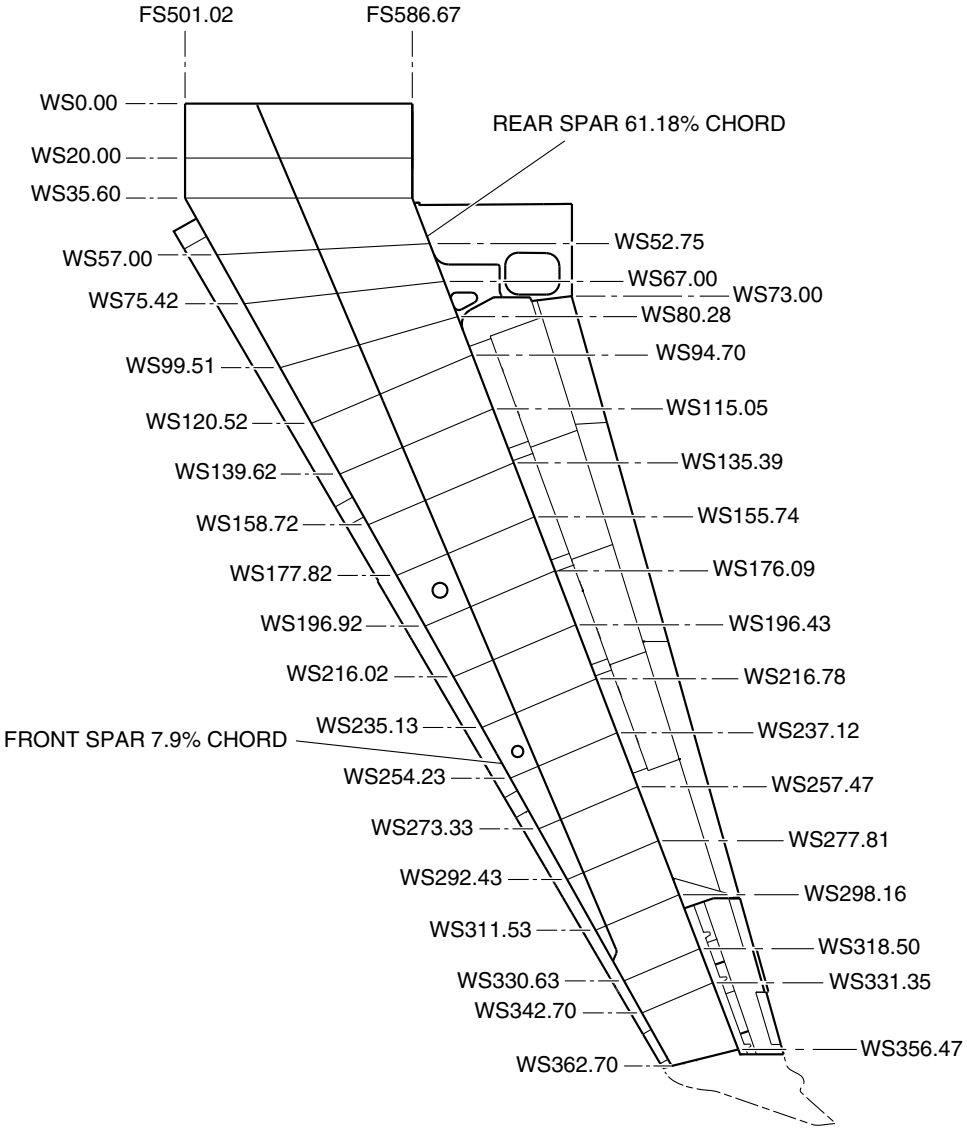
Fuselage Station Locations
Figure 1 (Sheet 1 of 2)

EFFECTIVITY: ALL



Fuselage Station Locations
Figure 1 (Sheet 2 of 2)

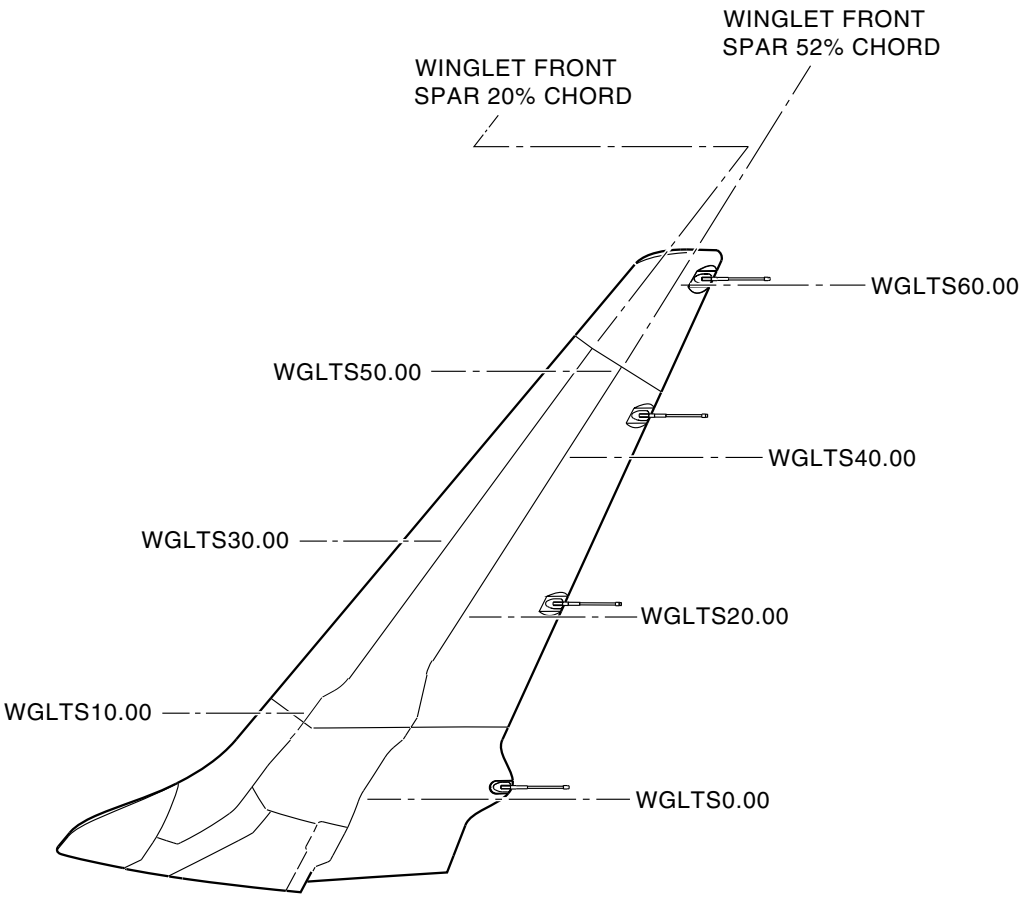
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LH UPPER WING SURFACE SHOWN

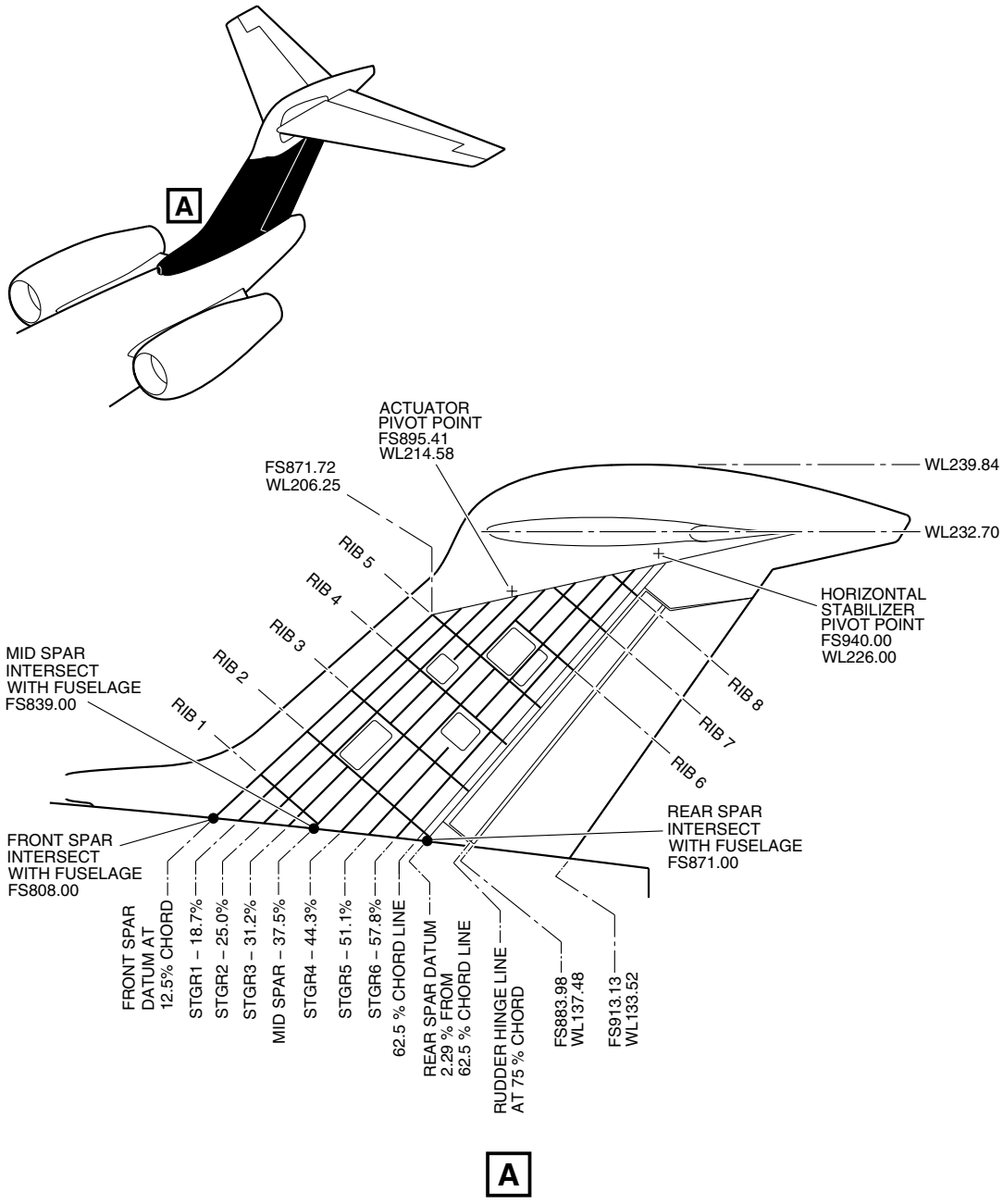
Wing Station Locations
Figure 2

EFFECTIVITY: ALL

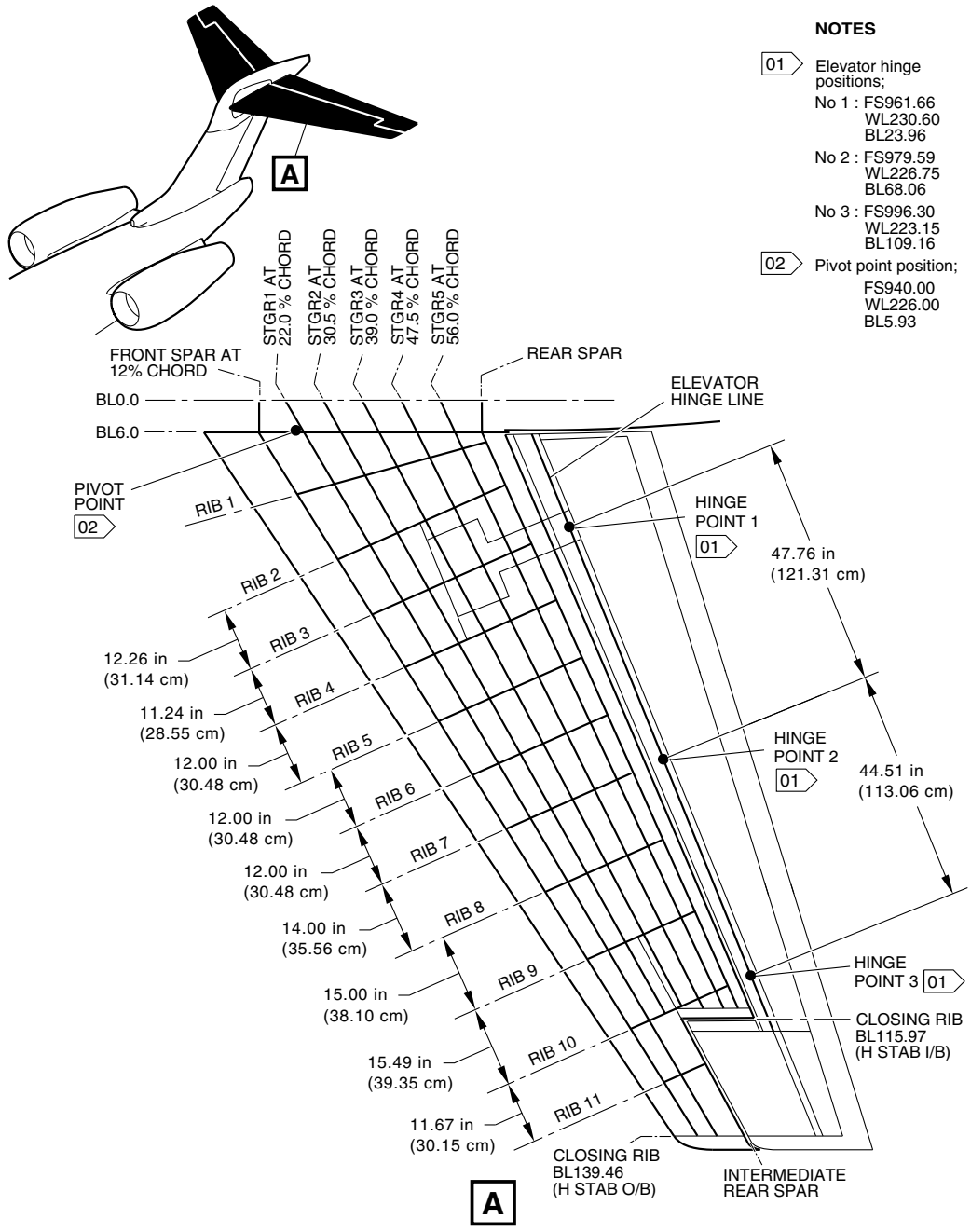


Winglet Station Locations
Figure 3

EFFECTIVITY: ALL

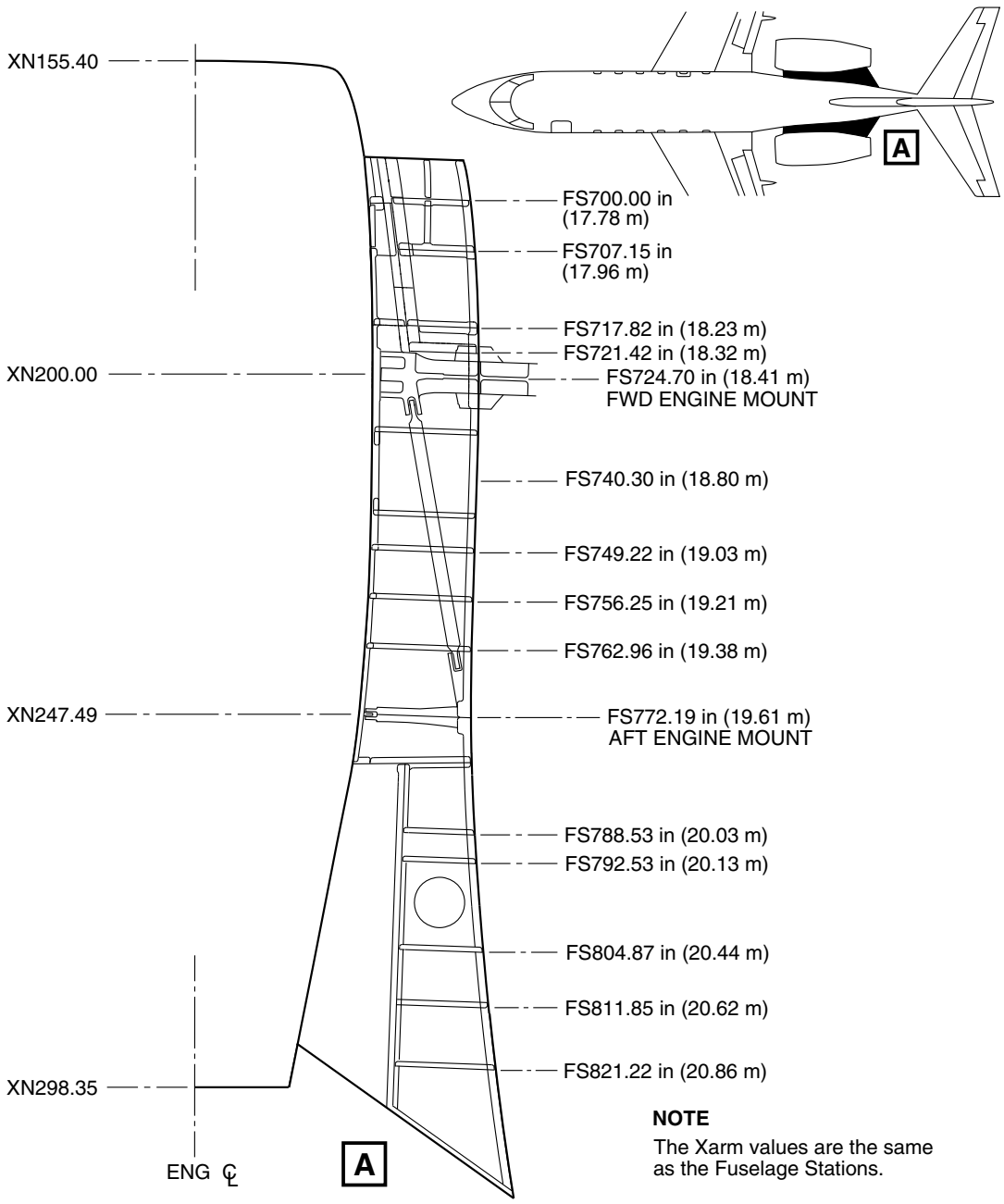


Vertical–Stabilizer Station locations
Figure 4



Horizontal–Stabilizer Station Locations
Figure 5

EFFECTIVITY: ALL



Engine–Nacelle Station Locations
Figure 6

EFFECTIVITY: ALL

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REFERENCE POINTS

1. General

This section gives data related to the reference points.

A. Leading–Edge Mean–Aerodynamic–Chord (LEMAC)

LEMAC is the distance along the Xarm axis from the ZRD to the leading edge, at the location where the wing chord is equal to the MAC.

B. Main–Landing–Gear (MLG) Axle Center–Line

The MLG axle center–line is the center of the MLG wheel. The MLG axle center–line can move forward or aft of its center position as a function of the MLG load and the shock strut pressure.

C. Mean Aerodynamic Chord (MAC)

The MAC is parallel to the fuselage center line. The location of the MAC is between the leading edge and trailing edge of the wing.

D. Nose–Landing–Gear (NLG) Axle Center–Line

The NLG axle center–line is the center of the nosewheel.

E. Weighing Datum (WD)

The WD is a reference point that is on the bottom of the aircraft fuselage.

F. Zero Reference Datum (ZRD)

The ZRD is a point that is in the plane of symmetry of the aircraft. The location of this point is at fuselage station FS0.00, forward of the nose radome at buttock line BL0.00, and at water line WL0.00. Refer to Figure 1 (Subject 01–80–30).

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DESIGN WEIGHT LIMITS

1. General

The Table that follows gives the maximum and minimum design weight limits of the aircraft:

– Refer to Table 1 for Aircraft 20501 and Subs.

EFFECTIVITY: ALL

Table 1 – Design Weight Limits (Aircraft with Maximum Ramp Weight of 40 750 lb (18 484kg))		
Description	**Weight**	
	lb	**kg**
Maximum Ramp Weight (MRW)	40 750	18 484
Maximum Take–Off Weight (MTOW)	40 600	18 416
Maximum Landing Weight (MLW)	34 150	15 490
Maximum Zero–Fuel Weight (MZFW)	28 200	12 791
Minimum Flight Weight (MFW)	24 800	11 249

EFFECTIVITY: ALL

CENTER OF GRAVITY LIMITS

1. General

This section contains the tables and chart related to the longitudinal CG envelope. The longitudinal CG envelope shows the weight and CG limits for the take–off, flight and landing conditions.

The balance limits are different for ground operations (Subject 01–80–60).

2. Longitudinal CG Envelope

Refer to Figure 1.

Use the Table 1A (imperial units) or Table 1B (SI units) that follows to quickly find the relation between the Xarm and the MAC (%MAC). This will make it easier to use the longitudinal CG envelope.

The formula to convert from Xarm to %MAC is:

%MAC = [(Xarm – LEMAC) / MAC] x 100

NOTE: The Weight and Balance Manual gives the definitions of LEMAC and MAC (Subject 01–00–40) . The values of LEMAC and MAC are in Table 1 (Subject 01–00–10) .

Table 1A – Xarm to %MAC (Imperial Units)

Xarm (in.)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
580	20.79	20.87	20.96	21.05	21.14	21.23	21.32	21.41	21.50	21.59
581	21.68	21.77	21.85	21.94	22.03	22.12	22.21	22.30	22.39	22.48
582	22.57	22.66	22.75	22.83	22.92	23.01	23.10	23.19	23.28	23.37
583	23.46	23.55	23.64	23.73	23.81	23.90	23.99	24.08	24.17	24.26
584	24.35	24.44	24.53	24.62	24.71	24.80	24.88	24.97	25.06	25.15
585	25.24	25.33	25.42	25.51	25.60	25.69	25.78	25.86	25.95	26.04
586	26.13	26.22	26.31	26.40	26.49	26.58	26.67	26.76	26.84	26.93
587	27.02	27.11	27.20	27.29	27.38	27.47	27.56	27.65	27.74	27.82
588	27.91	28.00	28.09	28.18	28.27	28.36	28.45	28.54	28.63	28.72

EFFECTIVITY: ALL

Table 1A – Xarm to %MAC (Imperial Units)										
Xarm (in.)	**0.0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
589	28.81	28.89	28.98	29.07	29.16	29.25	29.34	29.43	29.52	29.61
590	29.70	29.79	29.87	29.96	30.05	30.14	30.23	30.32	30.41	30.50
591	30.59	30.68	30.77	30.85	30.94	31.03	31.12	31.21	31.30	31.39
592	31.48	31.57	31.66	31.75	31.83	31.92	32.01	32.10	32.19	32.28
593	32.37	32.46	32.55	32.64	32.73	32.82	32.90	32.99	33.08	33.17
594	33.26	33.35	33.44	33.53	33.62	33.71	33.80	33.88	33.97	34.06
595	34.15	34.24	34.33	34.42	34.51	34.60	34.69	34.78	34.86	34.95
596	35.04	35.13	35.22	35.31	35.40	35.49	35.58	35.67	35.76	35.84
597	35.93	36.02	36.11	36.20	36.29	36.38	36.47	36.56	36.65	36.74
598	36.82	36.91	37.00	37.09	37.18	37.27	37.36	37.45	37.54	37.63
599	37.72	37.81	37.89	37.98	38.07	38.16	38.25	38.34	38.43	38.52
600	38.61	38.70	38.79	38.87	38.96	39.05	39.14	39.23	39.32	39.41
601	39.50	39.59	39.68	39.77	39.85	39.94	40.03	40.12	40.21	40.30
602	40.39	40.48	40.57	40.66	40.75	40.83	40.92	41.01	41.10	41.19
603	41.28	41.37	41.46	41.55	41.64	41.73	41.82	41.90	41.99	42.08
604	42.17	42.26	42.35	42.44	42.53	42.62	42.71	42.80	42.88	42.97
605	43.06	43.15	43.24	43.33	43.42	43.51	43.60	43.69	43.78	43.86

Table 1B – Xarm to %MAC (SI Units)										
Xarm (m)	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
14.7	19.66	20.01	20.36	20.71	21.07	21.42	21.77	22.12	22.47	22.82
14.8	23.17	23.52	23.87	24.22	24.57	24.92	25.28	25.63	25.98	26.33
14.9	26.68	27.03	27.38	27.73	28.08	28.43	28.78	29.13	29.49	29.84

EFFECTIVITY: ALL

Table 1B – Xarm to %MAC (SI Units)										
Xarm (m)	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
15.0	30.19	30.54	30.89	31.24	31.59	31.94	32.29	32.64	32.99	33.34
15.1	33.70	34.05	34.40	34.75	35.10	35.45	35.80	36.15	36.50	36.85
15.2	37.20	37.55	37.91	38.26	38.61	38.96	39.31	39.66	40.01	40.36
15.3	40.71	41.06	41.41	41.76	42.12	42.47	42.82	43.17	43.52	43.87
15.4	44.22	44.57	44.92	45.27	45.62	45.97	46.33	46.68	47.03	47.38

The Tables 2A, 2B that follow give the center of gravity limits:

– Refer to Table 2A for Imperial units and Table 2B for SI units.

Table 2A – Center of Gravity Limits (Imperial Units)						
Weight	**Forward Limit**			**Aft Limit**		
	Xarm	**Moment/ 1 000**	**%MAC**	**Xarm**	**Moment/ 1 000**	**%MAC**
lb	**in.**	**lb in.**		**in.**	**lb in.**	
24 800	590.0	14631.0	29.66	604.4	14988.3	42.50
25 000	589.7	14 742.9	29.44	604.4	15 109.2	42.50
25 500	589.1	15 022.3	28.90	604.4	15 411.4	42.50
26 000	588.5	15 301.0	28.36	604.4	15 713.6	42.50
26 329	588.1	15 484.1	28.01	604.4	15 912.4	42.50
26 500	587.9	15 579.2	27.82	604.1	16 008.0	42.24
27 000	587.3	15 856.8	27.28	603.2	16 287.1	41.48
27 500	586.7	16 133.7	26.74	602.4	16 565.3	40.72
28 000	586.1	16 410.0	26.20	601.5	16 842.6	39.96
28 200	585.8	16 520.4	25.98	601.2	16 953.3	39.66
28 500	585.3	16 681.4	25.52	600.8	17 122.9	39.32

Table 2A – Center of Gravity Limits (Imperial Units)						
Weight	Forward Limit			Aft Limit		
	Xarm	Moment/ 1 000	%MAC	Xarm	Moment/ 1 000	%MAC
lb	in.	lb in.		in.	lb in.	
29 000	584.5	16 949.1	24.75	600.2	17 405.1	38.76
29 500	583.6	17 215.9	23.99	599.5	17 686.7	38.20
30 000	582.7	17 481.9	23.22	598.9	17 967.6	37.65
30 142	582.5	17 557.3	23.00	598.7	18 047.3	37.49
30 500	582.5	17 765.8	23.00	598.3	18 247.9	37.09
31 000	582.5	18 057.1	23.00	597.7	18 527.6	36.53
31 500	582.5	18 348.3	23.00	597.0	18 806.6	35.97
32 000	582.5	18 639.5	23.00	596.4	19 085.1	35.41
32 500	582.5	18 930.8	23.00	595.8	19 362.9	34.85
33 000	582.5	19 222.0	23.00	595.2	19 640.0	34.29
33 500	582.5	19 513.3	23.00	594.5	19 916.6	33.73
34 000	582.5	19 804.5	23.00	593.9	20 192.5	33.17
34 150	582.5	19 891.9	23.00	593.7	20 275.1	33.00
34 500	582.5	20 095.8	23.00	593.7	20 482.9	33.00
35 000	582.5	20 387.0	23.00	593.7	20 779.8	33.00
35 500	582.5	20 678.2	23.00	593.7	21 076.6	33.00
36 000	582.5	20 969.5	23.00	593.7	21 373.5	33.00
36 500	582.5	21 260.7	23.00	593.7	21 670.3	33.00
37 000	582.5	21 552.0	23.00	593.7	21 967.2	33.00
37 500	582.5	21 843.2	23.00	593.7	22 264.0	33.00
38 000	582.5	22 134.5	23.00	593.7	22 560.9	33.00

EFFECTIVITY: ALL

Table 2A – Center of Gravity Limits (Imperial Units)						
Weight	Forward Limit			Aft Limit		
	Xarm	Moment/ 1 000	%MAC	Xarm	Moment/ 1 000	%MAC
lb	in.	lb in.		in.	lb in.	
38 500	582.5	22 425.7	23.00	593.7	22 857.7	33.00
38 836	582.5	22 621.4	23.00	593.7	20 057.2	33.00
39 000	582.6	22 723.0	23.14	593.7	23 154.6	33.00
39 500	583.1	23 033.2	23.56	593.7	23 451.5	33.00
39 730	583.3	23 176.0	23.76	593.7	23 588.0	33.00
40 000	583.9	23 355.0	24.24	593.0	23 720.4	32.38
40 500	584.9	23 687.3	25.13	591.7	23 964.7	31.23
40 600	585.1	23 753.7	25.30	591.5	24 013.4	31.00
40 750	585.4	23 853.8	25.57	591.1	24 086.6	30.66

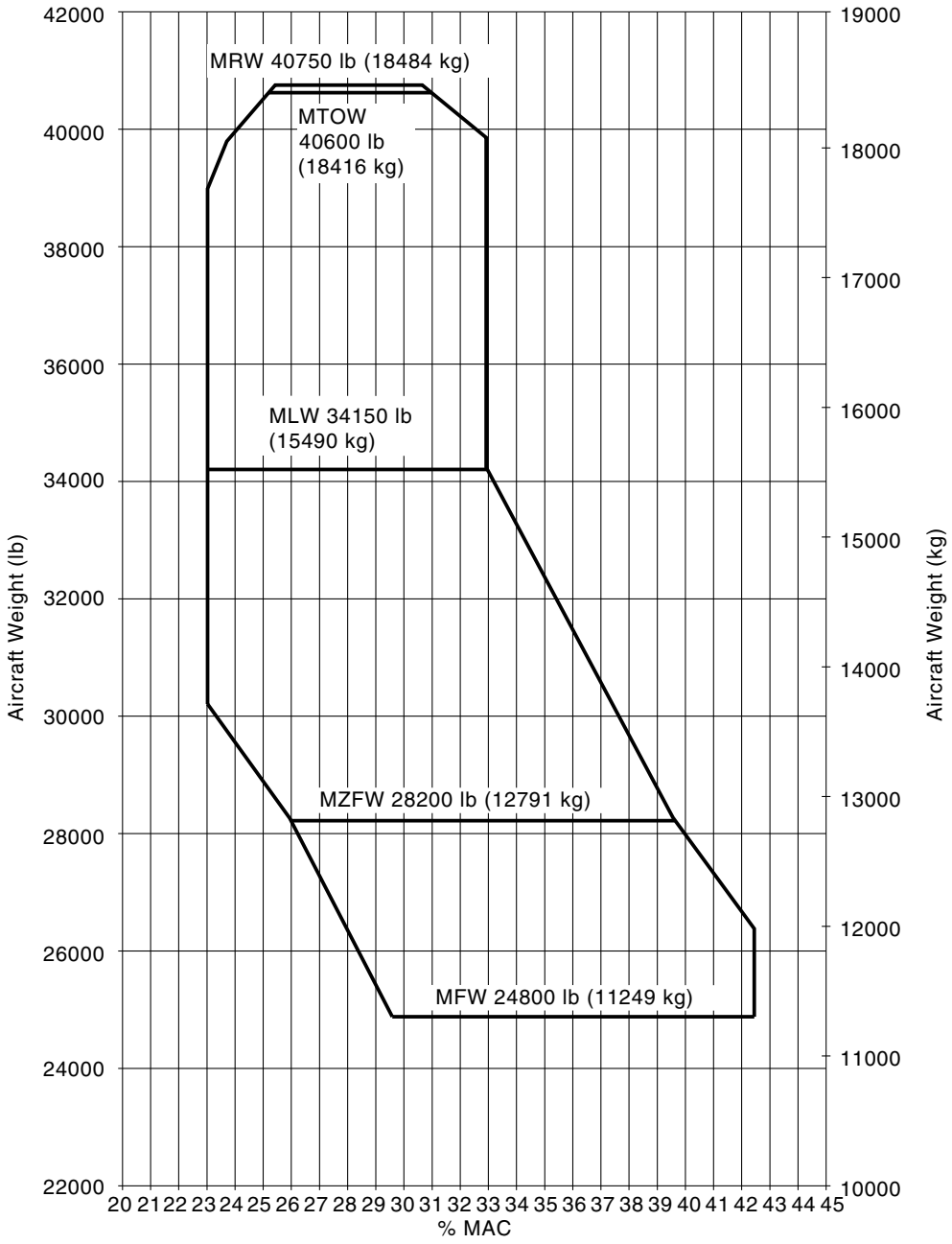
Table 2B – Center of Gravity Limits (SI Units)						
Weight	Forward Limit			Aft Limit		
	Xarm	Moment/ 1 000	%MAC	Xarm	Moment/ 1 000	%MAC
kg	m	kg m		m	kg m	
11 249	15.0	168.5	29.66	15.3	172.6	42.50
11 340	15.0	169.7	29.44	15.3	174.0	42.50
11 567	15.0	173.0	28.90	15.3	177.4	42.50
11 793	14.9	176.2	28.36	15.3	180.9	42.50
11 943	14.9	178.3	28.01	15.3	183.2	42.50
12 020	14.9	179.4	27.82	15.3	184.3	42.24
12 247	14.9	182.6	27.28	15.3	187.5	41.48

EFFECTIVITY: ALL

Table 2B – Center of Gravity Limits (SI Units)						
Weight	Forward Limit			Aft Limit		
	Xarm	Moment/ 1 000	%MAC	Xarm	Moment/ 1 000	%MAC
kg	m	kg m		m	kg m	
12 474	14.9	185.8	26.74	15.3	190.7	40.72
12 701	14.9	188.9	26.20	15.3	193.9	39.96
12 791	14.9	190.2	25.98	15.3	195.2	39.66
12 927	14.9	192.1	25.52	15.3	197.2	39.32
13 154	14.8	195.1	24.75	15.2	200.4	38.76
13 381	14.8	198.2	23.99	15.2	203.6	38.20
13 608	14.8	201.3	23.22	15.2	206.9	37.65
13 672	14.8	202.1	23.00	15.2	207.8	37.49
13 835	14.8	204.6	23.00	15.2	210.1	37.09
14 061	14.8	207.9	23.00	15.2	213.3	36.53
14 288	14.8	211.3	23.00	15.2	216.5	35.97
14 515	14.8	214.6	23.00	15.1	219.7	35.41
14 742	14.8	218.8	23.00	15.1	222.9	34.85
14 969	14.8	221.3	23.00	15.1	226.1	34.29
15 195	14.8	224.7	23.00	15.1	229.3	33.73
15 422	14.8	228.0	23.00	15.1	232.5	33.17
15 490	14.8	229.0	23.00	15.1	233.4	33.00
15 649	14.8	231.4	23.00	15.1	235.8	33.00
15 876	14.8	234.7	23.00	15.1	239.3	33.00
16 103	14.8	238.1	23.00	15.1	242.7	33.00
16 329	14.8	241.4	23.00	15.1	246.1	33.00

EFFECTIVITY: ALL

Table 2B – Center of Gravity Limits (SI Units)						
Weight	Forward Limit			Aft Limit		
	Xarm	Moment/ 1 000	%MAC	Xarm	Moment/ 1 000	%MAC
kg	m	kg m		m	kg m	
16 556	14.8	244.8	23.00	15.1	249.5	33.00
16 783	14.8	248.1	23.00	15.1	252.9	33.00
17 010	14.8	251.5	23.00	15.1	256.3	33.00
17 236	14.8	254.9	23.00	15.1	259.8	33.00
17 463	14.8	258.2	23.00	15.1	263.2	33.00
17 616	14.8	260.5	23.00	15.1	265.5	33.00
17 690	14.8	261.6	23.14	15.1	266.6	33.00
17 917	14.8	265.2	23.56	15.1	270.0	33.00
18 021	14.8	266.8	23.76	15.1	271.6	33.00
18 144	14.8	268.9	24.24	15.1	273.1	32.38
18 370	14.8	272.7	25.13	15.0	275.9	31.23
18 416	14.9	273.5	25.30	15.0	276.5	31.00
18 484	14.9	274.6	25.57	15.0	277.3	30.66



Longitudinal Center of Gravity Envelope
Figure 1

EFFECTIVITY: ALL

TAKE–OFF TRIM SETTINGS

1. General

The adjustment of stabilizer settings for take–off must agree with the related CG of the aircraft. Refer to Before Starting Engines subject in Chapter 4 of the Airplane Flight Manual to find the correct take–off trim settings.

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BALANCE EFFECT CAUSED BY MAJOR OPERATION

1. General

The operation of some systems changes the CG of the aircraft during flight, ground handling, take–off and landing operations. The Table 1 that follows shows the effect of these operations on the aircraft CG:

Table 1 – Balance Effect Caused by Major Operation

Items	Aircraft Delta Moment for Items Change from Fully Deployed to Fully Stowed Position	
	Moment/1000	
	lb in.	kg m
Gears Up Compared to Gears on Ground	–4.6	–0.053
Flaps Deployed Compared to Flaps Stowed	–4.0	–0.046
Thrust Reverser Deployed Compared to Thrust Reverser Stowed	Negligible (–0.06)	Negligible (–0.0007)

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FUEL

1. General

This section contains the subjects related to fuel that follow:

– Fuel Tanks Configuration and Capacities (Subject 01–20–10)

– Fuel Management (Subject 01–20–20).

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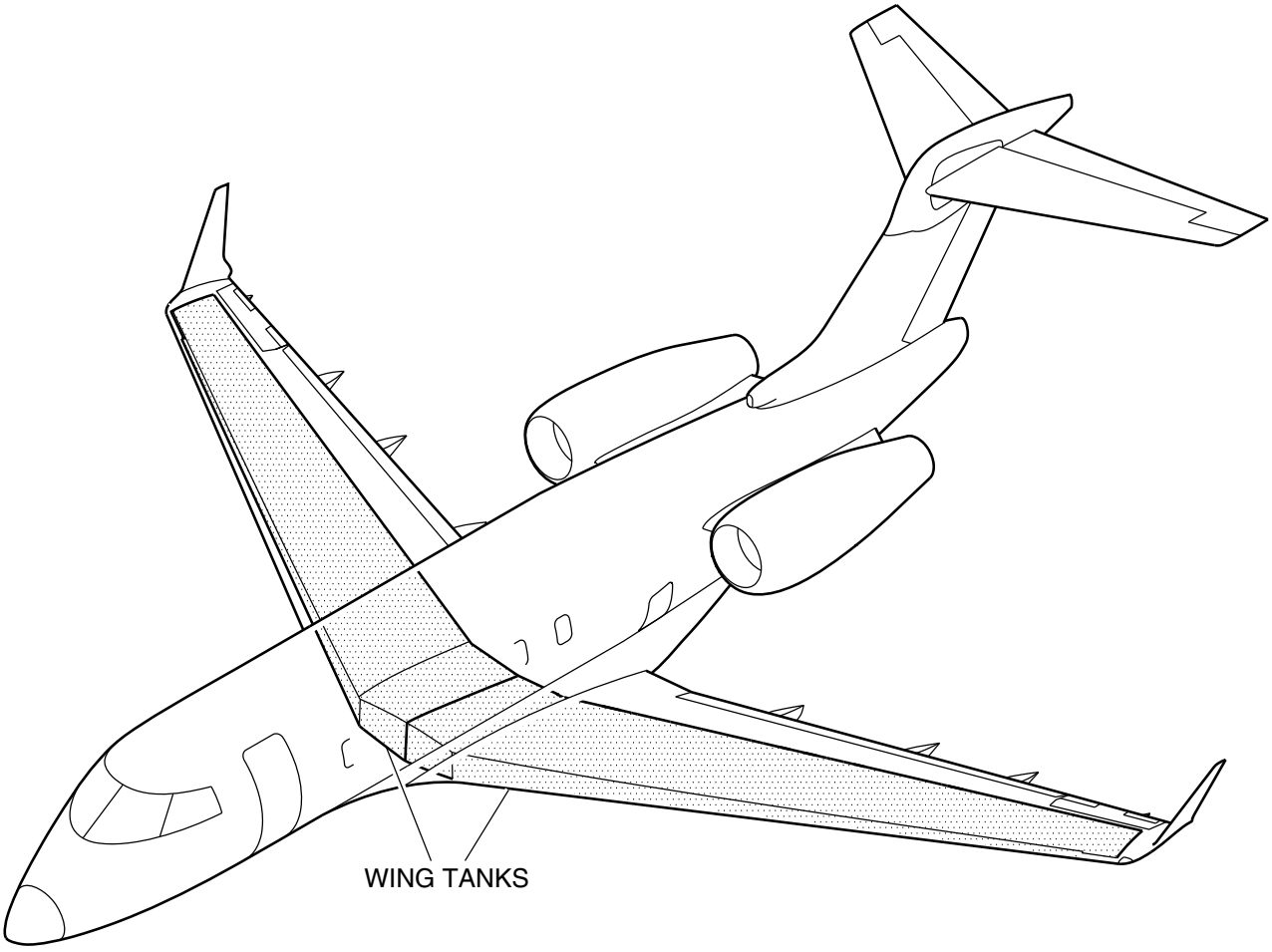
FUEL TANK CONFIGURATION AND CAPACITIES

1. Fuel Tank Configuration

Refer to Figure 1.

The fuel tanks configuration is as shown:

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EFFECTIVITY: ALL

2. Fuel Tank Capacities

The Table 1 that follows shows the total volume, weight, center of gravity (CG) and moment for the two fuel tanks:

Table 1 – Fuel Tank Capacities

Description	Volume		Weight [1]		CG		Moment/1 000	
	U.S. gal	L	lb	kg	in.	m	lb in	kg m
Main Tank	2 096	7 934	14 150	6 418	573.0	14.55	8 107.25	93.406
[1] Weight is calculated with a fuel density = 6.75 lb/U.S. gal (0.809 kg/L)								

3. Unusable Fuel

The unusable fuel is the sum of the residual and trapped fuel in all the fuel system.

The residual fuel is the quantity of fuel that the engines cannot use under normal conditions in flight. It is possible to drain this residual fuel through the draining points with the aircraft in the level position.

The trapped fuel is the fuel caught in the aircraft fuel system after the residual fuel is drained.

The Table 2 that follows shows the volume, weight, CG and moment values for the unusable fuel:

Table 2 – Unusable Fuel								
Description	**Volume**		**Weight [1]**		**CG**		**Moment/1 000**	
	U.S. gal	**L**	**lb**	**kg**	**in.**	**m**	**lb in.**	**kg m**
Residual Fuel								
Main Tanks	7.5	28.2	50.4	22.85	543.2	13.80	27.4	0.315
Total Residual Fuel	7.5	28.2	50.4	22.85	543.2	13.80	27.4	0.315
Trapped Fuel								
Main Tanks	2.0	7.6	13.5	6.12	576.4	14.64	7.8	0.090
Engines	1.5	5.8	10.4	4.72	738.9	18.77	7.7	0.089
Fuel Lines	2.8	10.5	18.8	8.53	669.0	16.99	12.6	0.145
APU	0.1	0.4	0.70	0.32	870.2	22.10	0.6	0.007
Total Trapped Fuel	6.4	24.3	43.4	19.69	660.2	16.77	28.6	0.330
Total Unusable Fuel	13.9	52.6	93.7	42.50	597.3	15.17	56.0	0.645
Note: [1] Weight is calculated with a fuel density = 6.75 lb/U.S. gal (0.809 kg/L)								

EFFECTIVITY: ALL

4. Usable Fuel

The usable fuel is the fuel available to operate the aircraft engines. The Table 3A (imperial units) and Table 3B (SI units) that follow show the volume, weight, CG and moment values for the usable fuel:

Table 3A – Usable Fuel (Imperial Units)

Volume	Weight	Main Tank (per side)	
		CG	Moment/1 000
U.S. gal	lb	in.	lb in.
0	0	543.1	0.0
50	338	544.3	183.7
100	675	545.6	368.3
150	1 013	547.1	553.9
200	1 350	548.6	740.6
250	1 688	550.2	928.4
300	2 025	551.8	1 117.3
350	2 363	553.3	1 307.2
400	2 700	554.8	1 498.0
450	3 038	556.2	1 689.5
500	3 375	557.6	1 881.7
550	3 713	558.8	2 074.6
600	4 050	560.0	2 268.0
650	4 388	561.1	2 462.0
683	4 610	561.9	2 590.3
700	4 725	562.2	2 656.6
709	4 786	562.4	2 691.7
750	5 063	563.4	2 852.0

Table 3A – Usable Fuel (Imperial Units)			
Volume	Weight	Main Tank (per side)	
		CG	Moment/1 000
U.S. gal	lb	in.	lb in.
800	5 400	564.5	3 048.4
850	5 738	565.8	3 246.2
900	6 075	567.2	3 445.7
950	6 413	568.8	3 647.6
1 000	6 750	570.8	3 852.6
1 048	7 075	573.0	4 053.7

Table 3B – Usable Fuel (SI Units)			
Volume	Weight	Main Tank (per side)	
		CG	Moment/1 000
L	kg	m	kg m
100	81	13.81	1.12
200	162	13.83	2.24
300	243	13.84	3.36
400	324	13.86	4.49
500	404	13.88	5.62
600	485	13.90	6.75
700	566	13.92	7.88
800	647	13.94	9.02
900	728	13.96	10.17
1 000	809	13.99	11.31
1 100	890	14.01	12.47

EFFECTIVITY: ALL

Table 3B – Usable Fuel (SI Units)			
Volume	Weight	Main Tank (per side)	
		CG	Moment/1 000
L	kg	m	kg m
1 200	971	14.03	13.62
1 300	1 052	14.05	14.78
1 400	1 133	14.07	15.94
1 500	1 214	14.09	17.10
1 600	1 294	14.11	18.26
1 700	1 375	14.13	19.43
1 800	1 456	14.15	20.60
1 900	1 537	14.16	21.77
2 000	1 618	14.18	22.94
2 100	1 699	14.20	24.12
2 200	1 780	14.21	25.30
2 300	1 861	14.23	26.47
2 400	1 942	14.24	27.66
2 500	2 023	14.26	28.84
2 600	2 103	14.27	30.02
2 700	2 184	14.29	31.21
2 800	2 265	14.30	32.40
2 900	2 346	14.32	33.59
3 000	2 427	14.33	34.79
3 100	2 508	14.35	35.99
3 200	2 589	14.37	37.20

Table 3B – Usable Fuel (SI Units)			
Volume	Weight	Main Tank (per side)	
		CG	Moment/1 000
L	kg	m	kg m
3 300	2 670	14.39	38.41
3 400	2 751	14.41	39.62
3 500	2 832	14.43	40.85
3 600	2 912	14.45	42.08
3 700	2 993	14.47	43.33
3 800	3 074	14.50	44.58
3 900	3 155	14.53	45.85
3 967	3 209	14.55	46.71

FUEL MANAGEMENT

1. Fuel Transfer System

If a lateral imbalance of fuel load occurs, it is possible to use the standby boost pump to make the fuel flow from wing to wing. It is also possible to open the shutoff valve (SOV) to make the fuel flow by gravity. When the SOV is open, the higher fuel head in the heavy wing will cause fuel to flow to the light wing.

2. Fuel Replenishment

To refuel the aircraft, follow the procedures given in Chapter 12 of the Aircraft Maintenance Manual (AMM TASK 12–11–00).

3. Fuel Burn Sequence

The usual fuel flow in flight is from the left wing to the left engine and from the right wing to the right engine. The fuel burns equally on the left and right sides from 100% capacity to 0% capacity when the APU is not in operation.

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FLUIDS

1. General

This section contains the subjects related to fluids that follow:

- System Fluids (Subject 01–30–10)
- Service Fluids (Subject 01–30–20).

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SYSTEM FLUIDS

1. System Fluid Capacities

The Table 1 that follows gives the volume, weight, center of gravity (CG) and moment for the system fluids:

Table 1 – System Fluid Capacities

Description	Volume		Weight [1]		CG		Moment/1 000	
	U.S. gal	L	lb	kg	in.	m	lb in.	kg m
Engine Fluids								
Engines (2) Oil Tank at 60 °F	4.0	14.99	30.1	13.65	728.2	18.50	21.92	0.252
Total	4.0	14.99	30.1	13.65	728.2	18.50	21.92	0.252

[1] Assuming an oil density of 1.9 lb/qt.

[1] Total Oil Volume includes 6.0 qts (5.68 l) in Left Engine, 5.0 qts (4.73 l) in Right Engine, plus oil inside ATS and trapped in engine lines.

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SERVICE FLUIDS

1. Service Fluid Capacities

Refer to Chapter 2, Aircraft Reports provided by the Completion Center for data related to the service fluids.

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PERSONNEL

1. General

This section contains the subjects related to personnel that follow:

- Flight Compartment (Subject 01–40–10)
- Passenger Compartment (Subject 01–40–20)
- Balance Changes Due to Movement (Subject 01–40–40).

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FLIGHT COMPARTMENT

1. General

This section contains data on the personnel in the flight compartment.

2. Crew Arrangement

The crew seats are installed side by side on seat tracks in the flight compartment. The pilot sits on the left side and the copilot sits on the right side of the flight compartment.

3. Crew Weight and Balance Arms

The Table 1 that follows shows the weight, center of gravity (CG) and moment for the pilot and copilot with the seats in the fully vertical position:

Table 1 – Pilot and Copilot Weight and CG and Moment

Items	Weight		Xarm		Moment/1 000	
	lb	kg	in.	m	lb in.	kg m
Pilot	190	86.18	305.2	7.75	57.99	0.668
Copilot	190	86.18	305.2	7.75	57.99	0.668
Total	380	172.37	305.2	7.75	115.98	1.336

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PASSENGER COMPARTMENT

1. General

Refer to Chapter 2, Aircraft Reports provided by the Completion Center for the data related to the passenger compartment.

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BALANCE CHANGES DUE TO MOVEMENT

1. General

The operation of some systems, passenger or crew movement can change the center of gravity (CG) during flight, ground handling, take–off and landing operations. Refer to Chapter 2, Aircraft Reports provided by the Completion Center for the data related to the effect of these movements on the aircraft CG.

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CARGO

1. General

This section contains the subjects related to cargo that follow:

– Cargo Compartments (Subject 01–60–10)

– Passenger Compartment Storage (Subject 01–60–20).

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EFFECTIVITY: ALL

CARGO COMPARTMENTS

1. General

Refer to Chapter 2, Aircraft Reports provided by the Completion Center for the data related to the cargo compartments.

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PASSENGER COMPARTMENT STORAGE

1. General

Refer to Chapter 2, Aircraft Reports provided by the Completion Center for the data related to the passenger compartment storage.

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GROUND OPERATIONS

1. General

This section contains the subjects related to ground operations that follow:

- Static Loads (Subject 01–80–20)
- Weighing Procedures (Subject 01–80–30)
- Balance Limits (Subject 01–80–60).

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STATIC LOADS

1. Maximum Permitted Jacking Weight

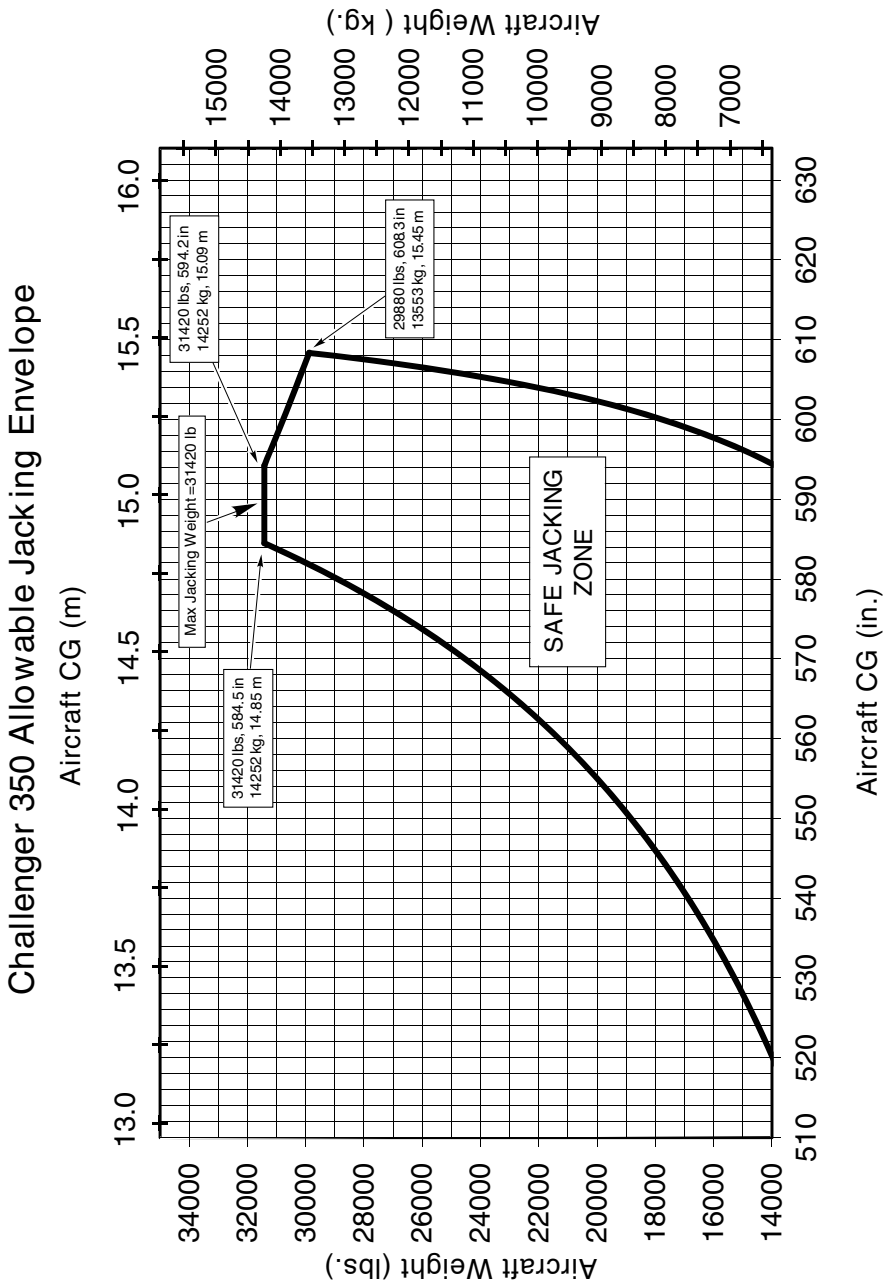
A. Jacking on Structure

The Table 1 that follows gives the maximum permitted aircraft jacking weight and the maximum permitted load for each structural jacking point.

Table 1 – Maximum Jacking Weight

Description	Maximum Static Load	
	lb	kg
Aircraft (Total Weight)	31 420	14 252
Nose Jacking Point	5 327	2 416
Wing (each side) Jacking Point	13 829	6 273

The following graph presents the safe jacking zone based on aircraft weight and CG when jacking on structure.



Allowable Jacking Envelope
Figure 1

EFFECTIVITY: ALL

B. Jacking on Landing Gear

The maximum aircraft weight when jacking on landing gear must not be more than the maximum ramp weight (MRW) (Subject 01–00–50).

2. Maximum Loading

When loading the aircraft, the load must not be more than the maximum load permitted in each area. The Table 2 that follows gives the maximum loading for each aircraft area:

Table 2 – Maximum Loading

Description	Zone	Loading	Capacity
Avionics Area [1]	FS326.0 to FS344.6	250 lb/Longitudinal ft (372 kg/Longitudinal m)	400 lb (181 kg)
Galley Area [2]	FS344.6 to FS394.6	150 lb/Longitudinal ft (223 kg/Longitudinal m)	625 lb (283 kg)
Passenger Compartment Area [2]	FS394.6 to FS630.0	200 lb/Longitudinal ft (297 kg/Longitudinal m)	3 920 lb (1 778 kg)
Cargo Hold [3]	FS630.0 to FS668.7	400 lb/Longitudinal ft (595 kg/Longitudinal m)	750 lb (340 kg)
Flight Compartment Allowance [4]			250 lb (113 kg)
Aft Equipment Bay Allowance	Aft of FS668.7		300 lb (136 kg)
Floor Structure		75 lb/ft² (366 kg/m²)	
Floor Panels		75 lb/ft² (366 kg/m²)	

Notes:

[1] Allowance in addition to type specification avionics.

[2] Allowance in addition to type specification interior and operating items.

[3] Maximum capacity = 750 lb (340 kg).

[4] Allowance includes ballast. This ballast weight is in addition to type specification operating items.

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WEIGHING PROCEDURES

1. General

This section gives the procedures to find the weight and the center of gravity (CG) of the aircraft.

The two different procedures to measure the weight of the aircraft are as follows:

– Weighing on Tripod Jacks Procedure
– Weighing on Platform Scales and Jack Procedure.

2. Job Set–Up Information

A. Tools and Equipment

Reference	Designation
GSE 07–10–01	Jacking Pads
GSE 07–10–02	Wing Jack
GSE 07–10–03	FWD Fuselage Jack
GSE 08–00–01	Leveling Kit
GSE 08–00–02	Aircraft Weighing Kit
GSE 09C–10–02	Aircraft Towbar
GSE 10–10–10	Wheel Chocks
Commercially Available	Platform Scale (50 000 lb (22 680 kg))

NOTE: For ground support equipment (GSE), refer to the ILLUSTRATED TOOL & EQUIPMENT MANUAL.

B. Reference Information

Reference	Designation
AMM TASK 12–00–00–867–803	Standard Aircraft Configuration for Maintenance
AMM TASK 12–11–09–650–801	Suction Defueling

Reference	Designation
AMM TASK 12–12–00–611–801	Servicing of the Hydraulic System Reservoirs
AMM TASK 12–14–01–612–801	Servicing of the Engine Oil Tank
AMM TASK 12–21–00–110–802	Cleaning of the Nontextile Floor Coverings
AMM TASK 12–21–00–110–803	Cleaning of the Textile Floor Coverings
AMM TASK 12–21–00–110–808	Cleaning of the External Surfaces of the Aircraft
AMM TASK 24–00–00–910–801	Electrical/Electronic Safety Precautions
AMM TASK 29–00–00–910–801	Hydraulic Safety Precautions
AMM TASK 29–00–00–910–802	Hydraulic Technical Precautions
AMM TASK 32–11–05–720–801	Functional Test of the Main Landing Gear (MLG) Shock–Strut Extension
AMM TASK 52–41–00–010–801	Opening of the Aft Equipment–Compartment Door (182GL)
AMM TASK 52–41–00–410–801	Closing of the Aft Equipment–Compartment Door (182GL)

C. Job Set–Up Procedure

CAUTION: WEIGH THE AIRCRAFT AND MAKE IT LEVEL IN A CLOSED HANGAR. IF YOU DO NOT DO THIS, AIR MOVEMENT CAN CAUSE INCORRECT RESULTS.

Do the steps that follow to prepare the aircraft for weighing:

(1) Do the suction defueling of the aircraft (AMM TASK 12–11–09–650–801).

(2) Park the aircraft in a closed hangar.

WARNING: OBEY THE PRECAUTIONS THAT FOLLOW WHEN YOU WEIGH THE AIRCRAFT ON JACKS:

- MAKE SURE THAT NO PERSONS OR TOOLS ARE ON OR IN THE AIRCRAFT.
- INSTALL THE LOCKPINS IN THE NOSE LANDING GEAR AND THE MAIN LANDING GEAR.
- REMOVE THE CHOCKS FROM THE WHEELS.
- RELEASE THE PARKING BRAKE.
- REMOVE THE REAR FUSELAGE SUPPORT.
- MAKE SURE THAT THE LOAD CELLS ARE INSTALLED CORRECTLY ON THE JACKS.
- MAKE SURE THAT THE JACKS ARE ALIGNED CORRECTLY BELOW THE JACKING PADS.
- MAKE SURE THAT THERE IS SUFFICIENT CLEARANCE AROUND THE AIRCRAFT.
- MAKE SURE THAT THERE IS NO SIDE LOAD ON THE LOAD CELLS.

THESE PRECAUTIONS CAN PREVENT INJURY TO PERSONS AND DAMAGE TO THE AIRCRAFT AND EQUIPMENT.

(3) Make sure that the hangar floor is hard, level and has no vibration.

(4) Obey the electrical/electronic safety precautions (AMM TASK 24–00–00–910–801).

(5) Obey the hydraulic safety precautions (AMM TASK 29–00–00–910–801).

(6) Obey the hydraulic technical precautions (AMM TASK 29–00–00–910–802).

(7) Open all fuel drain valves to let residual fuel drain during the weighing procedure.

(8) Make sure that the hydraulic system reservoirs are full (AMM TASK 12–12–00–611–801).

(9) Do the servicing of the engine oil tank (AMM TASK 12–14–01–612–801).

(10) Drain the water system.

(11) Drain the waste water system.

(12) Make sure that the aircraft is in the configuration that follows:

(a) The flaps and thrust reversers are retracted.

(b) All the flight controls are at the neutral position.

(c) All the doors, hatches, and access panels are closed.

(d) All the passenger seats are in take–off position.

(e) The internal surfaces of the aircraft are dry and clean (AMM TASK 12–21–00–110–802 and AMM TASK 12–21–00–110–803).

(f) The external surfaces of the aircraft are dry and clean (AMM TASK 12–21–00–110–808).

3. Weighing on Tripod Jacks Procedure

Do the steps that follow to weigh the aircraft on tripod jacks and calculate the center of gravity of the aircraft:

A. Weighing

Refer to Figure 1, Figure 2, Figure 3 and Figure 6.

Do the steps that follow to weigh the aircraft on tripod jacks:

(1) Do the Job Set–Up Procedure found in the Job Set–Up Information section.

(2) Remove the nylon plugs from the jacking points. Refer to Figure 2.

(3) Install the jack pads in the jacking points.

(4) Put the tripod jacks in position below the jacking points. Refer to Figure 1.

(5) Extend the jacks until they lightly touch the jack pads.

(6) Follow the manufacturer instructions to install the load cells between the jacks and the jacking points on the aircraft.

(7) Make sure that the load cell identification agrees with the related jacking point.

(8) Use a copy of the Aircraft Weighing Records – Tripod Jacks Method form to continue with this procedure. Refer to Figure 3.

(9) Record the load cell identification into the channel (Chn) column of the Aircraft Weighing Records – Tripod Jacks Method form.

CAUTION: DO NOT OPERATE THE ELECTRONIC WEIGHING KIT UNTIL IT IS SUFFICIENTLY WARM. IF THE ELECTRONIC WEIGHING KIT IS NOT SUFFICIENTLY WARM, YOU CAN GET INCORRECT INDICATIONS ON THE TEST EQUIPMENT.

(10) Let the load cells get warm for a minimum of 20 minutes.

(11) Follow the manufacturer instructions to calibrate the weighing kit to zero.

(12) Make sure that there is no weight on the load cells.

(13) Open the aft equipment–compartment door (182GL) (AMM TASK 52–41–00–010–801).

(14) Put the plumb line through the hole in the bracket at the top of the frame at FS755.50. Refer to Figure 6.

(15) Adjust the plumb line until the point of the plumb bob is approximately 0.5 in (1.27 cm) above the target.

NOTE: If the plumb bob is put higher than 0.5 in (1.27 cm) above the target, the result will not be accurate.

(16) Attach the end of the plumb line to the bracket.

CAUTION: LOWER/EXTEND THE JACKS EQUALLY TO PREVENT SIDE LOADS ON THE LOAD CELLS. THE EQUIPMENT CAN SHOW INCORRECT WEIGHTS, HAVE LOAD CELL FAILURE, OR YOU CAN CAUSE DAMAGE TO THE AIRCRAFT.

(17) Extend the jacks to lift the aircraft from 1.0 to 2.0 in (2.54 to 5.08 cm) until it is away from the ground.

(18) Make sure that the landing gears are fully extended.

(19) Make the aircraft level on the jacks.

(20) Fill the data in the form as follows:

(a) Find the weight at the nose jacking point as follows:

1 Get the indication from the load cell at the NLG tripod jack.

2 Record the value on your copy of the form in the Reading column.

(b) Find the weight at the left wing jacking point as follows:

1 Get the indication from the load cell at the left MLG tripod jack.

2 Record the value on your copy of the form in the Reading column.

(c) Find the weight at the right wing jacking point as follows:

1 Get the indication from the load cell at the right MLG tripod jack.

2 Record the value on your copy of the form in the Reading column.

(d) Find the weight of the aircraft as follows:

1 Do a sum of the three recorded values.

2 Record the result for Aircraft Total in the Reading Column.

CAUTION: LOWER/EXTEND THE JACKS EQUALLY TO PREVENT SIDE LOADS ON THE LOAD CELLS. THE EQUIPMENT CAN SHOW INCORRECT WEIGHTS, HAVE LOAD CELL FAILURE, OR YOU CAN CAUSE DAMAGE TO THE AIRCRAFT.

(21) Lower the aircraft until there is no load on the jacks and the load cells.

(22) Read the residual indication on each of the load cells.

(23) Record the residual load cell indications in the related field of the Zero column.

(24) Make sure that all of the recorded values are equal to zero:

(a) If the values are equal to zero, no change to the weight data is necessary. Copy the value recorded in the related Reading column into the Weight column.

(b) If the values are different than zero, change the weight data as follows:

1 If the value is more than zero, subtract it from the weight recorded in the related Reading column. Record the result in the related Weight column.

2 If the value is less than zero, add it to the weight recorded in the related Reading column. Record the result in the related Weight column.

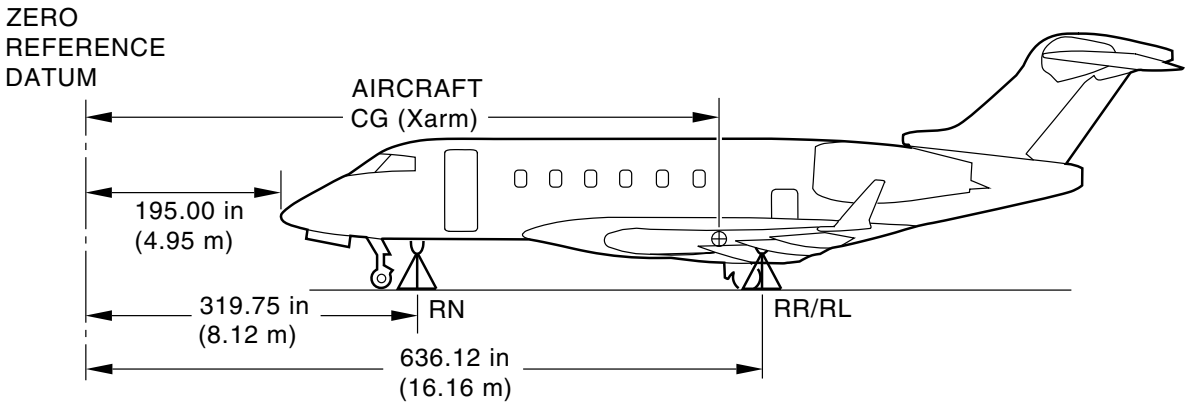
3 If the value is more than the permitted limit of the equipment, do as follows:

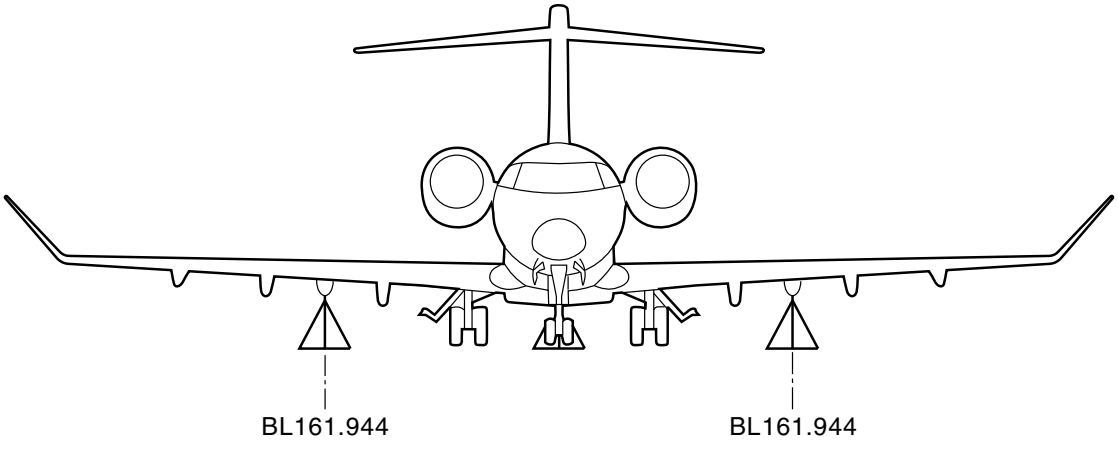
a Do the Weighing on Tripod Jacks Procedure again with load cells moved clockwise to the next jacking point.

b Do this until you get two indications, one after the other, that have the conditions that follow:

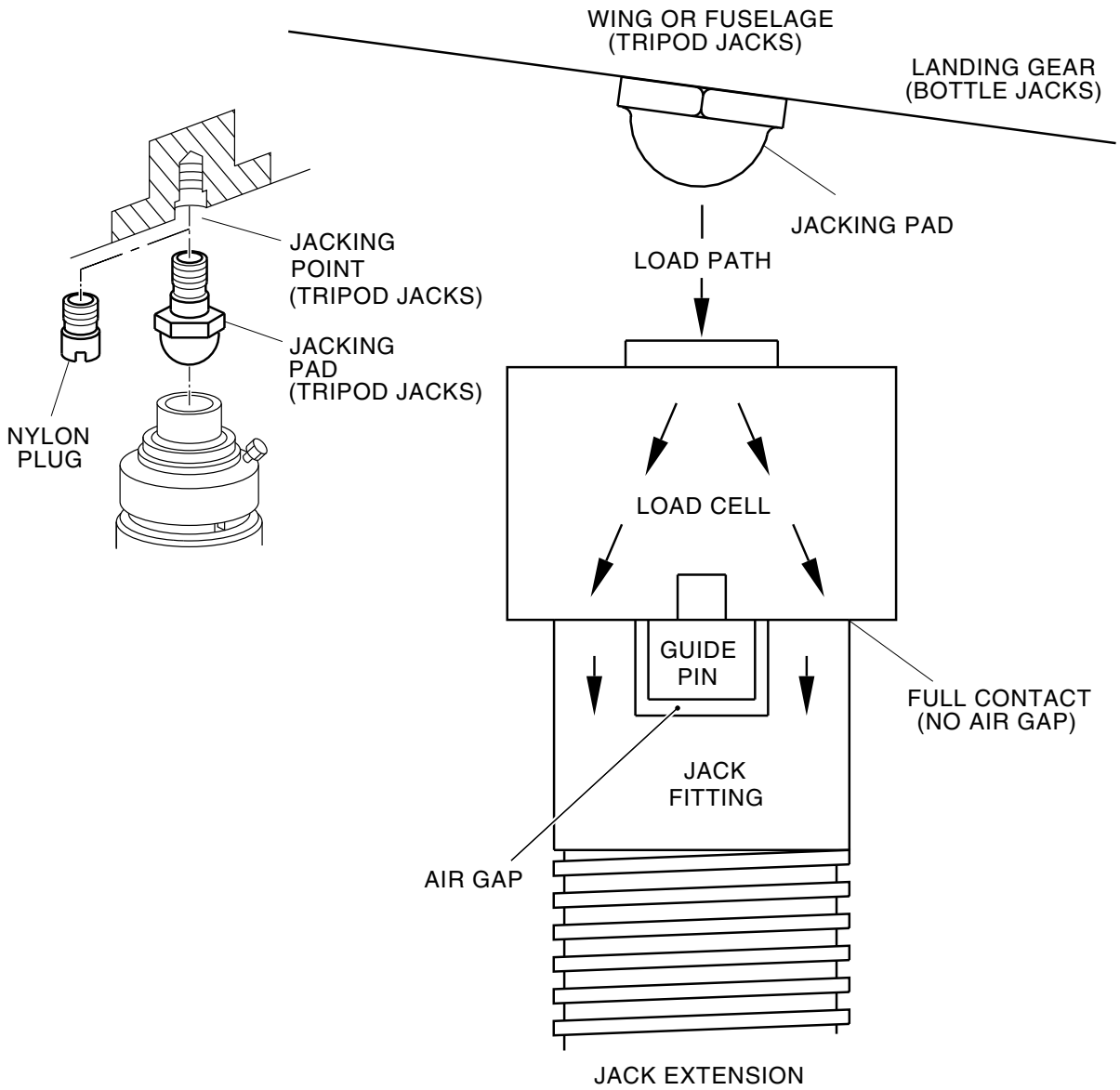
1) The residual indications are less than the permitted equipment limit.

2) The two indications that you get one after the other agree with the tolerance of the aircraft weighing kit.





EFFECTIVITY: ALL



Load Cell and Jacking Pad Arrangement
Figure 2

EFFECTIVITY: ALL

AIRCRAFT WEIGHING RECORDS – TRIPOD JACKS METHOD

DESCRIPTION		CHN	READING lb (kg)	ZERO lb (kg)	WEIGHT lb (kg)	Xarm in. (m)	MOMENT / 1 000 lb in. (kg m)
FIRST READING	LEFT MLG TRIPOD JACK						
	RIGHT MLG TRIPOD JACK						
	NLG TRIPOD JACK						
	AIRCRAFT TOTAL						
SECOND READING	LEFT MLG TRIPOD JACK						
	RIGHT MLG TRIPOD JACK						
	NLG TRIPOD JACK						
	AIRCRAFT TOTAL						
AVERAGE OF READINGS	LEFT MLG TRIPOD JACK						
	RIGHT MLG TRIPOD JACK						
	NLG TRIPOD JACK						
	AIRCRAFT TOTAL						

CG is calculated by equation: $Xarm_{CG}$ = [(Total Moment x 1 000) / Total Weight]

CG position measured in %MAC is calculated as follows:

%MAC = [($Xarm_{CG}$ – LEMAC) / MAC] x 100

Weighing Record Form – Tripod Jacks Method
Figure 3

EFFECTIVITY: ALL

B. Center of Gravity

Refer to Figure 1 and Figure 3.

Calculate the CG as follows:

NOTE: Do this procedure with the copy of the Aircraft Weighing Records – Tripod Jacks Method form used during the Weighing procedure. Refer to Figure 3.

(1) Record the CG of the nose and wing jacking points on the form in the related Xarm fields.

NOTE: The location of the jacking points is always the same unless specified differently.Refer to Figure 1.

(2) Calculate the moment for each jacking point with the formula:

Moment/1 000 = (Weight x Xarm) / 1 000

(3) Record the results on the form in the related Moment/1 000 fields.

(4) Add the weights from the Weight column and the moments from the Moment/1 000 column.

(5) Record the results on the form in the related Aircraft Total fields.

(6) Calculate the CG of the aircraft with the formula:

$Xarm_{CG}$ = [(Total Moment x 1 000) / Total Weight]

(7) Calculate the CG as a percentage of mean aerodynamic chord (%MAC) with the value of the CG of the aircraft calculated in the step above.

NOTE: The formula to calculate the CG position as a percentage of the MAC is:

%MAC (imperial) = [($Xarm_{CG}$ – 556.675) / 112.22] x 100

%MAC (SI) = [($Xarm_{CG}$ – 14.13) / 2.85] x 100

(8) Fill the Average of Readings section of the form as follows:

(a) In the Weight column, take the related jacking point values from the First Reading and the Second Reading sections.

(b) For each jacking point, divide the sum of the two values by two to find the average.

(c) Record the results in the related Average of Readings fields.

(d) Do the steps again for the Xarm column and Moment/1 000 column.

C. Example

The Table 1A (imperial units) and Table 1B (SI units) that follow give an example to calculate the aircraft weight and CG of the aircraft when you weigh it on tripod jacks:

Table 1A – Example to Calculate the Aircraft Weight and CG on Tripod Jacks (Imperial Units)

Description		Chn	Reading	Zero	Weight	Xarm	Moment/ 1 000
			lb	lb	lb	in.	lb in.
First Reading	Left MLG Tripod Jack	1	12 046	0	12 046	636.1	7 662.7
	Right MLG Tripod Jack	2	12 160	0	12 160	636.1	7 735.2
	NLG Tripod Jack	3	3 356	7	3 349	319.8	1 070.8
	Aircraft Total		27 562	7	27 555	597.7	16 468.7
Second Reading	Left MLG Tripod Jack	2	12 087	0	12 087	636.1	7 688.8
	Right MLG Tripod Jack	3	12 084	5	12 079	636.1	7 683.7
	NLG Tripod Jack	1	3 367	0	3 367	319.8	1 076.6
	Aircraft Total		27 538	5	27 533	597.4	16 449.1
Average (Avg) of Readings	Left MLG Tripod Jack				12 067	636.1	7 675.7
	Right MLG Tripod Jack				12 120	636.1	7 709.4
	NLG Tripod Jack				3 358	319.8	1 073.7
	Aircraft Total				27 544	597.5	16 458.9

CG is calculated by equation: $Xarm_{CG}$ = [(Total Moment x 1 000) / Total Weight]

First reading: $Xarm_{CG}$ = [(16 468.74 x 1 000) / 27 555] = 597.7 in.

Average reading: $Xarm_{CG}$ = [(16 458.89 x 1 000) / 27 544] = 597.5 in.

CG position measured in %MAC is calculated as follows:

%MAC = [($Xarm_{CG}$ – 556.675) / 112.22] x 100

Average %MAC = [(597.5 – 556.675) / 112.22] x 100 = 36.4%

Table 1B – Example to Calculate the Aircraft Weight and CG on Tripod Jacks (SI Units)							
Description		Chn	Reading	Zero	Weight	Xarm	Moment/ 1 000
			kg	kg	kg	m	kg m
First Reading	Left MLG Tripod Jack	1	5 464	0	5 464	16.16	88.299
	Right MLG Tripod Jack	2	5 516	0	5 516	16.16	89.134
	NLG Tripod Jack	3	1 522	3	1 519	8.12	12.335
	Aircraft Total		12 502	3	12 499	15.18	189.768
Second Reading	Left MLG Tripod Jack	2	5 483	0	5 483	16.16	88.599
	Right MLG Tripod Jack	3	5 481	2	5 479	16.16	88.541
	NLG Tripod Jack	1	1 527	0	1 527	8.12	12.401
	Aircraft Total		12 491	2	12 489	15.18	189.541
Average of Readings	Left MLG Tripod Jack				5 473	16.16	88.449
	Right MLG Tripod Jack				5 497	16.16	88.837
	NLG Tripod Jack				1 523	8.12	12.368
	Aircraft Total				12 494	15.18	189.655
CG is calculated by equation: $Xarm_{CG}$ = [(Total Moment x 1 000) / Total Weight] First reading: $Xarm_{CG}$ = [(189.8 x 1 000) / 12 499] = 15.18 m Average reading: $Xarm_{CG}$ = [(189.7 x 1 000) / 12 494] = 15.18 m CG position measured in %MAC is calculated as follows: %MAC = [($Xarm_{CG}$ – 14.13 / 2.85) x 100] Average %MAC = [(15.18 – 14.13 / 2.85) x 100] = 36.8%							

4. Weighing on Platform Scales and Jack Procedure

Do the steps that follow to weigh the aircraft on platform scales and jack and calculate the center of gravity of the aircraft:

A. Weighing

Refer to Figure 4, Figure 5 and Figure 6.

Do the steps that follow:

(1) Do the Job Set–Up Procedure from the Job Set–Up Information section.

(2) Align the three platform scales and ramps with the left and right main landing gears (MLG) and the nose landing gear (NLG).

(3) Make sure that the platform scales are leveled and on a level floor.

(4) Verify and record the platform scale identifications with the corresponding wheel location.

(5) Put the related wheel chocks on their platform scale and set the scales to zero.

(6) Remove the wheel chocks from the platform scales.

(7) Remove the rear fuselage support.

(8) Open the aft equipment–compartment door (182GL) (AMM TASK 52–41–00–010–801).

(9) Put the plumb line through the hole in the bracket at the top of the frame at FS755.50. Refer to Figure 6.

(10) Adjust the plumb line until the point of the plumb bob is approximately 0.5 in (1.27 cm) above the target.

NOTE: If the plumb bob is put higher than 0.5 in (1.27 cm) above the target, the result will not be accurate.

(11) Attach the end of the plumb line to the bracket.

(12) Attach the towbar to the aircraft.

(13) Move the aircraft slowly up the ramps and on the platform scales with a tow vehicle.

WARNING: MAKE SURE THAT THE WHEEL CHOCKS ARE PUT AT THE NOSE WHEEL/TIRE ASSEMBLIES. MOVEMENT OF THE AIRCRAFT CAN CAUSE INJURY TO PERSONS AND DAMAGE TO THE EQUIPMENT.

WARNING: MAKE SURE THAT THE WHEEL CHOCKS ARE PUT AT THE MAIN WHEEL/TIRE ASSEMBLIES. MOVEMENT OF THE AIRCRAFT CAN CAUSE INJURY TO PERSONS AND DAMAGE TO THE EQUIPMENT.

(14) Put the wheel chocks in front of and behind the MLG and NLG wheels. Use the same wheel chocks used to put the platform scales to zero and in the same locations.

(15) Disconnect the towbar from the aircraft.

(16) Do not set the parking brake.

(17) Use a copy of the Aircraft Weighing Records – Platform Scales and Jack Method form to continue with this procedure. Refer to Figure 5.

(18) Find the weight at the NLG platform scale as follows:

(a) Read the NLG weight data from the platform scale.

(b) Record the value on your copy of the form (see table 2A or 2B) in the “Scale Reading” column.

(19) Find the weight at the left and right MLG platform scales as follows:

(a) Read the weight data from each of the MLG platform scales.

(b) Record the related values on your copy of the form (see table 2A or 2B) in the Scale Reading column.

(20) Make the aircraft level as follows:

(a) Remove the nylon plug from the nose jacking point.

(b) Move the ramp away from the NLG platform scale.

(c) Install the jack pad in the nose jacking point.

(d) Put the jack below the nose jack pad.

(e) Extend the jack until it lightly touches the jack pad.

(f) Move the NLG wheel chocks away from the NLG wheels. Do not remove the NLG chocks from the platform scales.

(g) Extend the jack until the aircraft is level in the longitudinal direction.

NOTE: The NLG wheels may or may not be completely off the platform scale.

(h) Lock the jack extension locknut.

(i) Adjust the MLG shock struts to laterally make the aircraft level.

(21) Read the weight data from the left and right MLG platform scales and weight data from the NLG platform scale.

(22) Record the three related values on your copy of the form (see table 2A or 2B) in the “MLG/NLG Weight at Level” column.

(23) Calculate the sum of the left and right MLG readings from the “MLG/NLG Weight at Level” column and record the result on the “MLG Total” line under “MLG Weight Total at Level”.

(24) Calculate the Xarm value for the center line position of the MLG wheel axle as follows:

NOTE: The MLG Xarm position varies with a change in aircraft weight.

(a) Measure the exposed chrome length on each MLG schock strut.

(b) Take the average chrome length of the two measures. This value is called DIMX.

(c) Find the MLG center–line position Xarm with the formula:

Xarm (imp) = $(-0.00123\ DIMX^3 - 0.05209\ DIMX^2 + 0.05661\ DIMX + 620.609)$

Xarm (SI) = $(-0.00051\ DIMX^3 - 0.00854\ DIMX^2 + 0.00365\ DIMX + 15.76349)$

(25) Record the MLG Xarm value on the “MLG Total” line, under “Xarm”, on your copy of the form.

(26) Lift the aircraft sufficiently to release the jack extension locknuts.

(27) Release the jack extension locknuts.

(28) Lower the aircraft slowly until the NLG wheels are fully supported by the platform scale.

(29) Remove the jack from the jack pad and the aircraft.

(30) Remove the jack pad from the jacking point.

(31) Install the nylon plug in the jacking point.

(32) Do an extension check and adjustment of the shock strut as follows:

(a) Make sure that the shock struts of the MLG are set to the correct pressure (AMM TASK 32–11–05–720–801).

(33) Remove the chocks from the MLG wheels.

(34) Put the ramp in position against the platform scale.

(35) Attach the towbar to the aircraft.

(36) Tow the aircraft off the platform scales and down the ramps.

(37) Disconnect the towbar from the aircraft.

(38) Put the same wheel chocks on the same platform scales.

(39) Record the weight indications from all three platforms in the “Scale Residual” column on your copy of the form (see table 2A or 2B).

(40) Verify if all of the recorded “Scale Residual” values are equal to zero:

(a) If the values are equal to zero, no change to the weight data is necessary. Copy the value recorded in the related “Scale Reading” column into the “Weight” column.

(b) If the values are different than zero, change the weight data as follows:

1 If the value is less than zero, add it to the weight recorded in the related “Scale Reading” column. Record the result in the related “Weight” column.

2 If the value is more than zero, substract it from the weight recorded in the related “Scale Reading” column. Record the result in the related “Weight” column.

3 If the value is more than the permitted limit of the equipment, do as follows:

a Do the Weighing on Platform Scales and Jack Procedure again with platform scales turned clockwise to the next wheel location.

b Do this until you get two indications, one after the other, that have the conditions that follow:

1) The residual indications are less than the permitted equipment limit.

2) Consecutive readings are within the manufacturer’s tolerance of the weighing kit.

(41) Calculate the sum of the “Weight” column and record it on the “Aircraft Total” line on your copy of the form (see table 2A or 2B).

(42) Rotate each platform scale clockwise to the next wheel location and repeat the weighing procedure again by completing all pertinent steps between (2) and (41) above until you get two consecutive readings that satisfy the conditions that follow:

(a) The residual readings are less than permitted limit of the equipment.

(b) Consecutive readings are within the tolerance of the manufacturer’s weighing kit.

(43) Fill out the Average (Avg) of Readings section on your copy of the form as follows:

(a) In the “Weight” column, take the related values for the MLG and NLG from the First Reading and Second Reading fields.

(b) Calculate the average of these values.

(c) Record the result in the related “Average (Avg) of Readings” fields.

(d) Repeat the steps (a) to (c) for the related values in the “MLG/NLG Weight at Level” and the ”MLG Weight Total at Level” column.

(e) Calculate the average $Xarm_{MLG}$ with the formula below:

(f) $Xarm_{MLG} = \Sigma MLG_{Weight\ Total}(Level) \times X_{arm} / \Sigma MLG_{Weight\ Total}(Level)$

(g) Record the result on the “MLG Total” line, under the “Xarm” column.

(h) Go to “Section B –Center of Gravity” to calculate the Aircraft CG.

B. Center of Gravity

Refer to Figure 5.

Calculate the Aircraft CG position as follows:

(1) Use the values from the Total Weight and Total MLG Weight columns of the Average (Avg) of Readings fields to continue with this procedure.

(2) Find the Xarm with the formula below:

$Xarm_{(imp)} = 319.75 + [MLG_{Weight\ Total\ Avg}(Level) \times (MLG_{Xarm\ Total\ avg} - 319.75) - NLG_{Weight\ Avg}(Level)\ (32.65) / Total\ Avg\ Weight]$

$Xarm_{(SI)} = 8.12 + [MLG_{Weight\ Total\ Avg}(Level) \times (MLG_{Xarm\ Total\ Avg} - 8.12) - NLG_{Weight\ Avg}(Level)\ (0.83) / Total\ Avg\ Weight]$

(3) Record the Xarm value in the “Aircraft Weight and CG” line on your copy of the Aircraft Weighing Records – Platform Scales and Jack Method form.

C. Example

Table 2A (imperial units) and Table 2B (SI units) that follow give an example to calculate the weight and CG of the aircraft when using the platform scales and jack method.

Table 2A – Example to calculate the Aircraft Weight and CG on Platform Scales and Jack (Imperial Units)

Description		Chn	Scale Reading	Scale Residual	Weight	MLG/ NLG Weight at Level	MLG Weight Total at Level	Xarm
			lb	lb	lb	lb	lb	in.
First Reading	Left MLG Platform Scale	1	14 216	0	14 216	14 216	n/a	n/a
	Right MLG Platform Scale	2	14 790	0	14 790	14 780	n/a	n/a
	NLG Platform Scale	3	1 948	10	1 938	1802	n/a	n/a
	Aircraft Total		n/a	n/a	30 944	n/a	n/a	n/a
	MLG Total		n/a	n/a	n/a	n/a	28 996	620.6
Second Reading	Left MLG Platform Scale	1	14 200	0	14 200	14 200	n/a	n/a
	Right MLG Platform Scale	3	14 796	0	14 796	14 806	n/a	n/a
	NLG Platform Scale	2	1 938	0	1 938	1 798	n/a	n/a
	Aircraft Total		n/a	n/a	30 934	n/a	n/a	n/a
	MLG Total		n/a	n/a	n/a	n/a	29 006	620.6
Average (Avg) of Readings	Left MLG Platform Scale		n/a	n/a	14 208	n/a	n/a	n/a
	Right MLG Platform Scale		n/a	n/a	14 793	n/a	n/a	n/a
	NLG Platform Scale		n/a	n/a	1 938	1800	n/a	n/a
	MLG Total		n/a	n/a	n/a	n/a	29 001	620.6
	Aircraft Weight and CG		n/a	n/a	30 939	n/a	n/a	599.9

EFFECTIVITY: ALL

Table 2A – Example to calculate the Aircraft Weight and CG on Platform Scales and Jack (Imperial Units)							
Description	**Chn**	**Scale Reading**	**Scale Residual**	**Weight**	**MLG/ NLG Weight at Level**	**MLG Weight Total at Level**	**Xarm**
		lb	**lb**	**lb**	**lb**	**lb**	**in.**
Aircraft CG is calculated by equation as follows: Xarm = 319.75 + [(MLG Weight Total Avg at Level x (MLG Xarm Total Avg – 319.75) – NLG Weight Avg at Level x 32.65) / Total Avg Weight] Xarm = 319.75 + [(29 001 x (620.6 – 319.75) – 1 800 x 32.65) / 30 939] = 599.9 in.							
Conversion of CG position measured to %MAC is calculated as follows: %MAC = [((Xarm – 556.675) / 112.22) x 100] = [((599.9 – 556.675) / 112.22) x 100] = 38.5 Main Landing Centerline–Position is calculated as follows: Main Landing Centerline–Position Xarm = [–0.00123 $DIMX^3$ – 0.05209 $DIMX^2$ + 0.05661 DIMX + 620.609] Where DIMX = Average of the two MLG chrome lengths.							

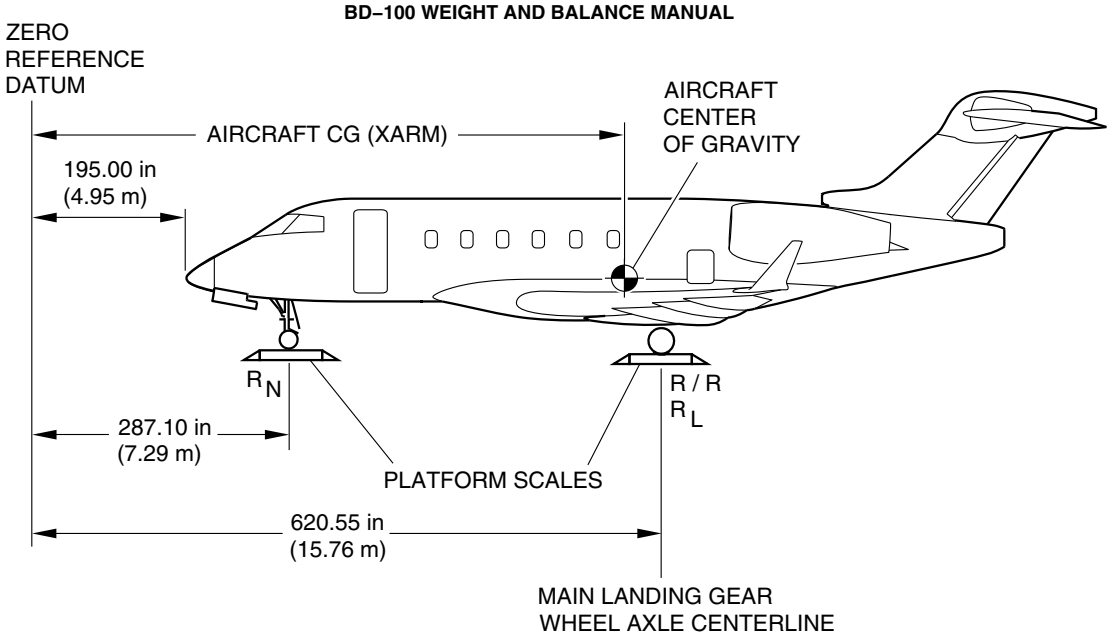
Table 2B – Example to calculate the Aircraft Weight and CG on Platform Scales and Jack (SI Units)

Description		Chn	Scale Reading	Scale Residual	Weight	MLG/ NLG Weight at Level	MLG Weight Total at Level	Xarm
			kg	kg	kg	kg	kg	m
First Reading	Left MLG Platform Scale	1	6 448	0	6 448	6 448	n/a	n/a
	Right MLG Platform Scale	2	6 708	0	6 708	6 704	n/a	n/a
	NLG Platform Scale	3	884	5	879	817	n/a	n/a
	Aircraft Total		n/a	n/a	14 035	n/a	n/a	n/a
	MLG Total		n/a	n/a	n/a	n/a	13 152	15.76
Second Reading	Left MLG Platform Scale	3	6442	0	6442	6 441	n/a	n/a
	Right MLG Platform Scale	2	6 712	0	6 712	6 716	n/a	n/a
	NLG Platform Scale	1	879	0	879	815	n/a	n/a
	Aircraft Total		n/a	n/a	14 033	n/a	n/a	n/a
	MLG Total		n/a	n/a	n/a	n/a	13 157	15.76
Average (Avg) of Readings	Left MLG Platform Scale		n/a	n/a	6 445	n/a	n/a	n/a
	Right MLG Platform Scale		n/a	n/a	6 710	n/a	n/a	n/a
	NLG Platform Scale		n/a	n/a	879	816	n/a	n/a
	MLG Total		n/a	n/a	n/a	n/a	13 155	15.76
	Aircraft Weight and CG		n/a	n/a	14 034	n/a	n/a	15.24

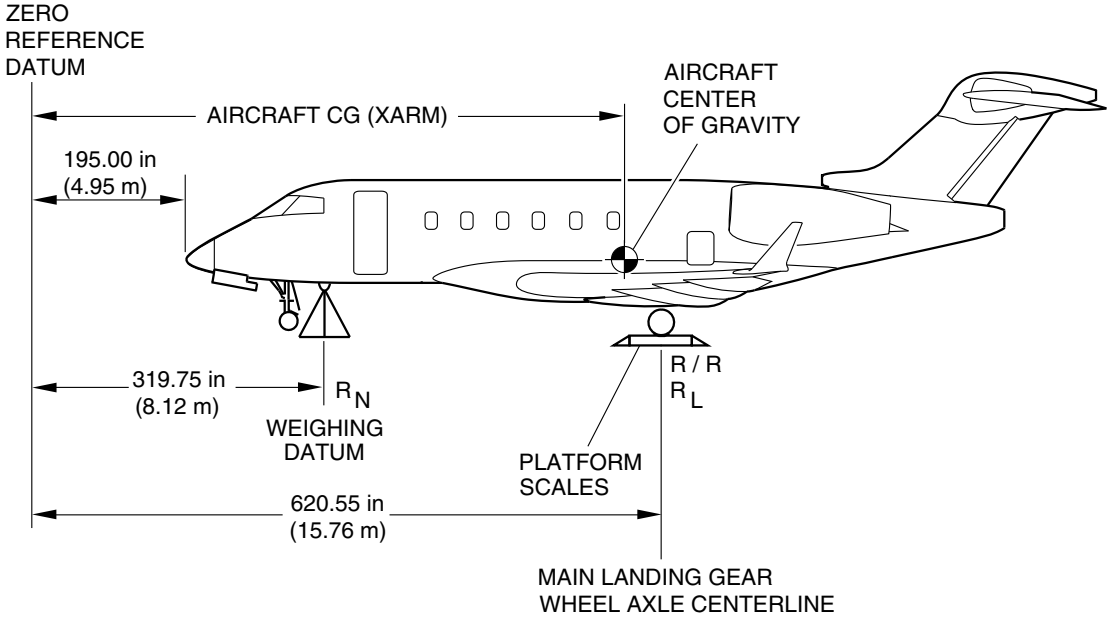
Aircraft CG is calculated by equation:

EFFECTIVITY: ALL

Table 2B – Example to calculate the Aircraft Weight and CG on Platform Scales and Jack (SI Units)							
Description	**Chn**	**Scale Reading**	**Scale Residual**	**Weight**	**MLG/ NLG Weight at Level**	**MLG Weight Total at Level**	**Xarm**
		kg	**kg**	**kg**	**kg**	**kg**	**m**
Xarm = 8.12 + [(MLG Weight Total Avg at level x (MLG Xarm Total Avg – 8.12) – NLG Weight Avg at level x 0.83) / Total Avg Weight] Xarm = 8.12 + [13 155 x (15.76 – 8.12) – 816 x (0.83) / 14 034] = 15.24 m Conversion of CG position measured to %MAC is calculated as follows: %MAC = [(Xarm – 14.13 / 2.85) x 100] = [(15.24 – 14.13 / 2.85) x 100] = 38.8 Main Landing Centerline Position is calculated as follows: Main Landing Position (m) = [–0.00051 $DIMX^3$ – 0.00854 $DIMX^2$ + 0.00365 DIMX + 15.76349] Where DIMX = Average of the two MLG chrome lengths (cm).							



PART 1 OF THE PROCEDURE



PART 2 OF THE PROCEDURE

Weighing on Platform Scales and Jack
Figure 4

EFFECTIVITY: ALL

Aircraft Weighing Records - Platform Scales and Jack Method								
Description		Chn	Scale Reading	Scale Residual	Weight	MLG/NLG Weight at Level	MLG Weight Total at Level	Xarm
			lb (kg)	lb (kg)	lb (kg)	lb (kg)	lb (kg)	in (m)
First Reading	Left MLG Platform Scale						-	-
	Right MLG Platform Scale						-	-
	NLG Platform Scale						-	-
	Aircraft Total		-	-		-	-	-
	MLG Total		-	-	-	-		
Second Reading	Left MLG Platform Scale						-	-
	Right MLG Platform Scale						-	-
	NLG Platform Scale						-	-
	Aircraft Total		-	-		-	-	-
	MLG Total		-	-	-	-		
Average (Avg) of Readings	Left MLG Platform Scale		-	-		-	-	-
	Right MLG Platform Scale		-	-		-	-	-
	NLG Platform Scale		-	-			-	-
	MLG Total		-	-	-	-		
	Aircraft Weight and CG		-	-		-	-	

Aircraft CG is calculated by equation:

Xarm(imp) = 319.75 + [(MLG Weight Total Avg at level x (MLG Xarm Total Avg – 319.75) - NLG Weight Avg at level x 32.65) / Total Avg Weight]
Xarm(SI) = 8.12 + [(MLG Weight Total Avg at level x (MLG Xarm Total Avg – 8.12) - NLG Weight Avg at level x 0.83) / Total Avg Weight]

Conversion of CG position measured to %MAC is calculated as follows:

%MAC(imp) = [(Xarm – 556.675 / 112.22) x 100]

%MAC(SI) = [(Xarm – 14.14 / 2.85) x 100]

Main Landing Centerline Position is calculated as follows:

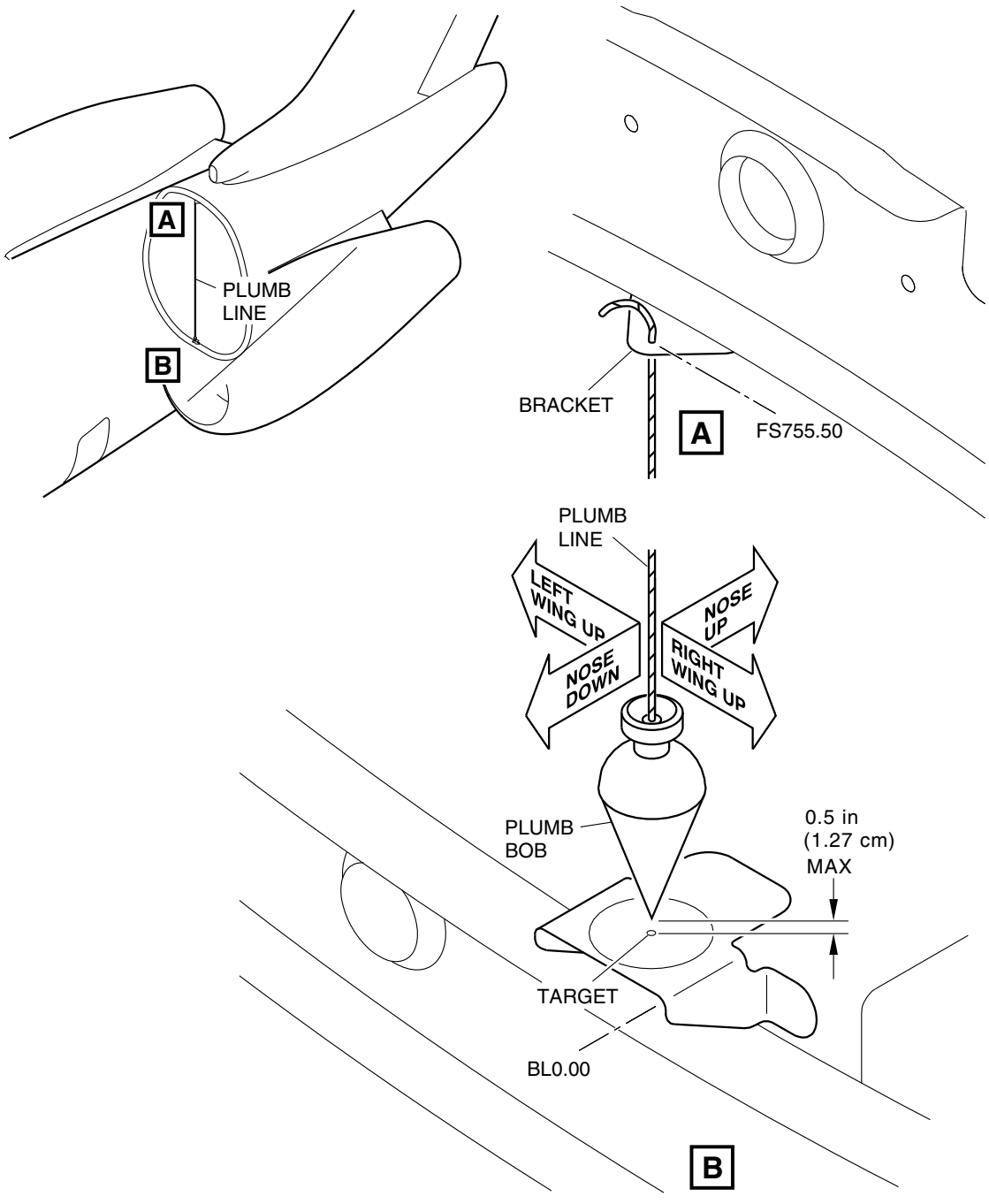
Main Landing Position(imp) = [-0.00123 $DIMX^3$ – 0.05209 $DIMX^2$ + 0.05661 DIMX + 620.609]

Main Landing Position(SI) = [-0.00051 $DIMX^3$ – 0.00854 $DIMX^2$ + 0.00365 DIMX + 15.76349]

Where DIMX = Average of the two MLG chrome lengths.

Weighing Record Form – Platform Scales and Jack Method
Figure 5

EFFECTIVITY: ALL



Weighing Procedures – Leveling with the Plumb Bob
Figure 6

EFFECTIVITY: ALL

5. Close Out

Refer to Figure 6.

A. Do the close out as follows:

(1) Remove the plumb bob from the aft equipment compartment.

(2) Close the aft equipment–compartment door (182GL) (AMM TASK 52–41–00–410–801).

(3) Remove all tools, equipment, and unwanted material from the work area.

(4) Make sure to close all the fuel drain valves.

(5) Put the aircraft back to the standard configuration for maintenance (AMM TASK 12–00–00–867–803).

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BALANCE LIMITS

1. Static Stability

Refer to Figure 1, Figure 3 and (AMM TASK 32–21–05–210–801).

A change in the configuration of the aircraft can cause the aircraft to be in a tip over condition. The changes can include one or more of those that follow:

- Added equipment
- Removal of equipment
- Moved equipment
- Unusual ground equipment
- Snow
- Wind
- Other conditions.

A. Before you complete a configuration change to the aircraft, do the steps that follow to make sure that the aircraft will stay stable:

(1) Make an analysis of the aircraft weight and balance moment impact due to the change in configuration.

(2) Do a check of the new weight and center of gravity of the aircraft as a result of the change in configuration (Subject 01–90–20).

(3) Make sure that the applicable configuration will stay in the safe region.

Refer to Figure 1.

(4) You must take more precautions when there is fresh fallen snow on the horizontal stabilizer and pylons (Refer to Table 1).

(5) You can use the Table 1 that follows for weight and balance calculations for static stability:

Table 1 – Snow Weight and Moment [1]

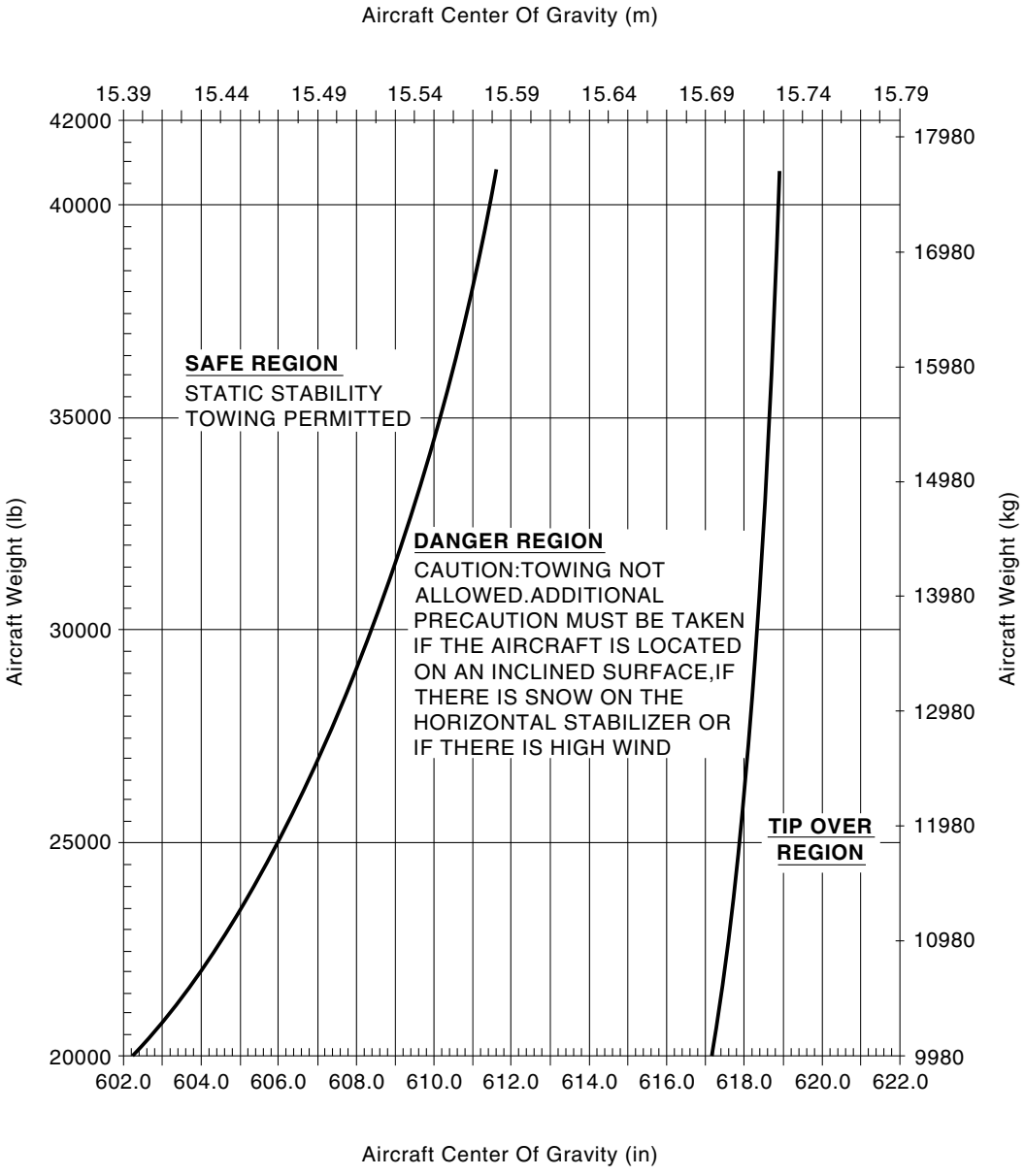
Depth		Weight [2]		Moment/1 000	
in.	m	lb	kg	lb in.	kg m
2	0.05	272	123	240	2.764
4	0.10	544	247	480	5.529
6	0.15	817	371	720	8.293

Table 1 – Snow Weight and Moment [1]					
Depth		Weight [2]		Moment/1 000	
in.	m	lb	kg	lb in.	kg m
8	0.20	1 089	494	960	11.057
10	0.25	1 361	617	1 200	13.821
12	0.30	1 633	741	1 440	16.586
14	0.36	1 906	865	1 679	19.350
16	0.41	2 178	988	1 919	22.114
18	0.46	2 450	1 111	2 159	24.879
20	0.51	2 722	1 235	2 399	27.643
Notes: [1] Fresh fallen snow on horizontal stabilizer and pylon. [2] Assuming snow density of 8 lb/ft³ (128 kg/m³)					

B. If the applicable configuration causes the aircraft to be in the tip over region, do as follows:

(1) Change the configuration in the flight compartment and passenger compartment until the CG is back to a permitted limit.

(2) Obey the load limits of the floor structure and floor panels of the flight compartment and passenger compartment, and the load limits of the fuselage. The values of the load limits are given in Table 2 (Subject 01–80–20).



Balance Limit
Figure 1

EFFECTIVITY: ALL

2. Towing

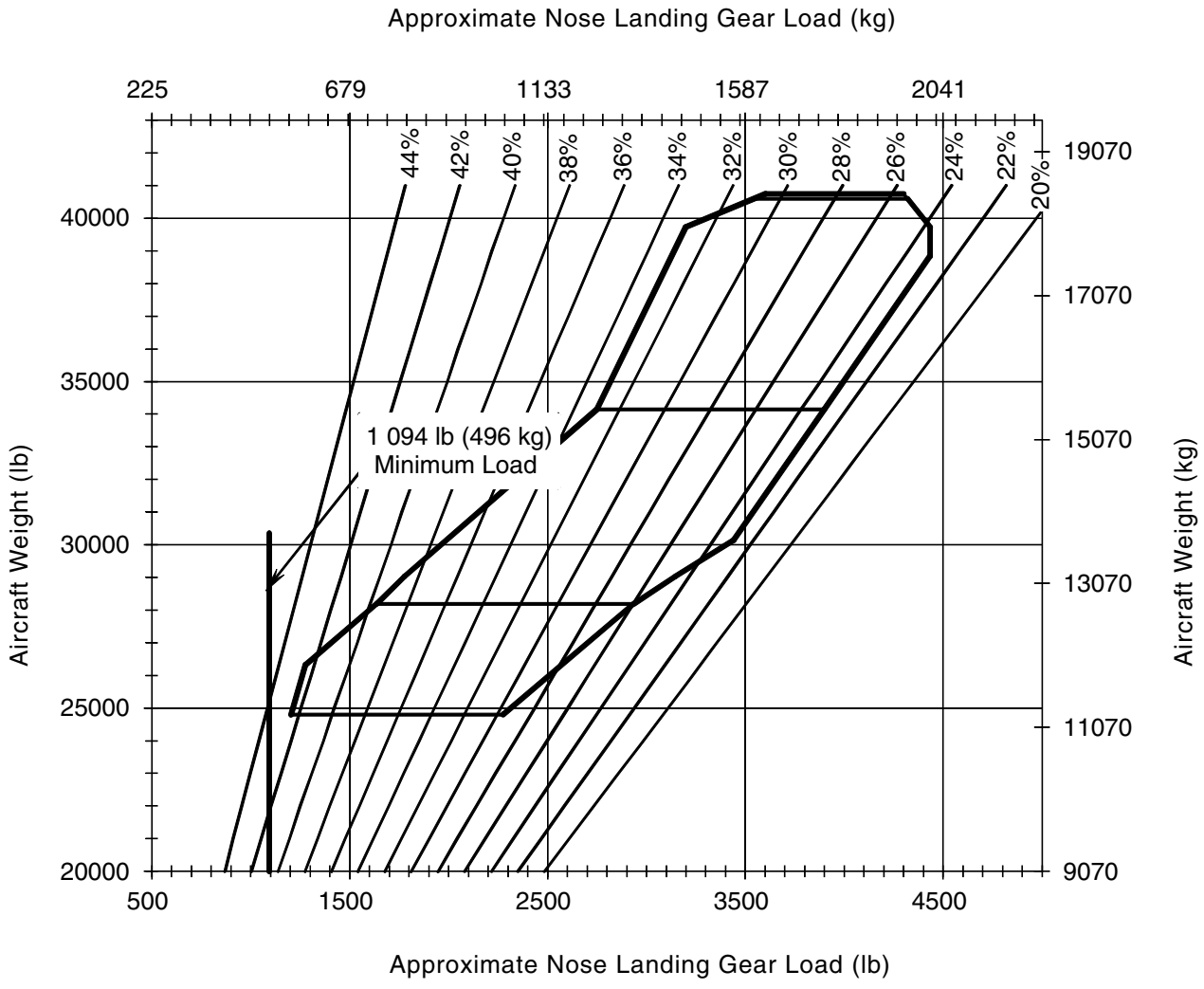
Refer to Figure 2 , Figure 3 and (AMM TASK 32–21–05–210–801).

When you tow the aircraft, you must keep a minimum load on the nose landing gear (NLG). Refer to the applicable ground static–load envelope to find the approximate NLG load related to the aircraft weight and CG.

A. Do the steps that follow when the NLG load is less than the minimum load:

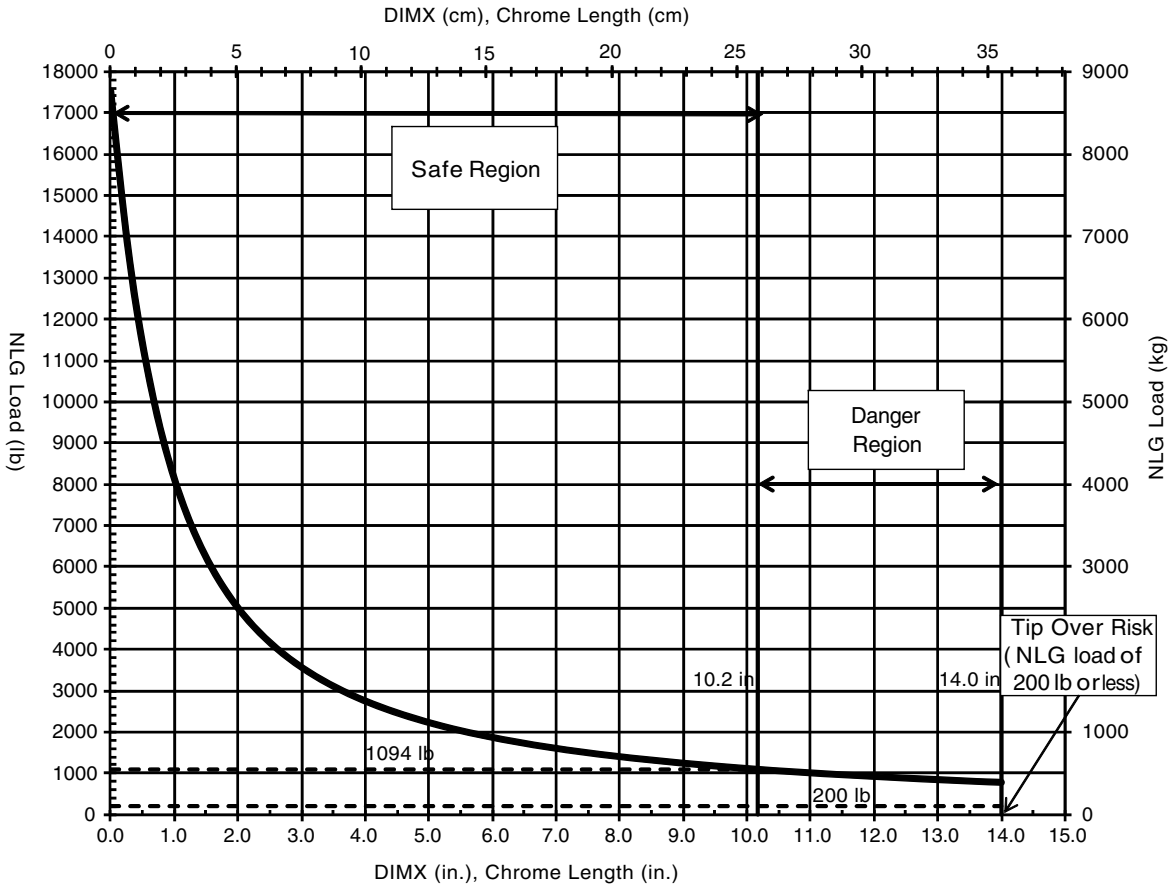
(1) Add ballast in the flight compartment and passenger compartment, as applicable.

(2) Obey the load limits of the floor structure and floor panels, of the flight compartment and passenger compartment, and the load limits of the fuselage. The values of the load limits are given in Table 2 (Subject 01–80–20).



Ground Static–Load Envelope
Figure 2

EFFECTIVITY: ALL



Chrome Length vs Nose–Landing–Gear Load
Figure 3

EFFECTIVITY: ALL

LOADING PROCEDURES AND EXAMPLES

1. General

This section contains the subjects that follow related to loading procedures and examples:

- Operating Weight Empty (Subject 01–90–10)
- Weight Build–Up (Subject 01–90–20)
- CG Slide Method (Subject 01–90–50).

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OPERATING WEIGHT EMPTY

1. General

This section shows how to calculate the operating weight empty (OWE) and center of gravity (CG) of an aircraft for a given loading scenario. To find the OWE, it is necessary to add the values of the operating items to the true empty weight (TEW). It is necessary to know the value of the OWE to calculate the ramp weight (RW), take–off weight (TOW) and landing weight (LW) with the different procedures given (Subject 01–90–20).

2. Procedure

Refer to Figure 1 and Figure 2.

A. Do the steps that follow to calculate the OWE:

(1) Refer to the example in Table 1. Use a copy of the OWE Calculation Form to continue with this procedure. Refer to Figure 1.

(2) Find the values for the TEW in Chapter 2, Aircraft Reports.

(3) Record these values on the form in the related fields.

(4) Refer to the example in Table 2. Use a copy of the Multiple Item Form (Refer to Figure 2) to calculate the sums for multiple items.

(5) Record the sums of the multiple items on your copy of the OWE Calculation Form.

(6) Do the applicable operations (OP) as shown in Table 1.

OWE CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1 000 lb in (kg m)	%MAC	REFERENCE	NOTE
TRUE EMPTY WEIGHT (TEW)						LAST WEIGHING RESULT	[1] [2]
OPERATING ITEMS							
FLIGHT COMPARTMENT CREW	+					01–40–10	
CREW BAGGAGE	+					01–40–10	
FLIGHT MANUALS / MAGAZINES	+					01–40–10	
OPERATING WEIGHT EMPTY (OWE)	=						[1]

NOTES:
[1] %MAC (imperial) = [(Xarm – 556.675) / 112.22] x 100
%MAC (SI) = [(Xarm – 14.13) / 2.85] x 100
[2] Last weighing result for TEW given in Chapter 2, Aircraft Reports.

OWE Calculation Form
Figure 1

CWB0190100_001

EFFECTIVITY: ALL

MULTIPLE ITEM FORM			
ITEM	WEIGHT	Xarm	MOMENT / 1 000
	lb (kg)	in (m)	lb in (kg m)

CWB0190100_010

Multiple Item Form
Figure 2

EFFECTIVITY: ALL

3. Example

The example given in the Table 1 and Table 2 that follow shows how to calculate the OWE:

Table 1 – OWE Calculation (Example) [3]

Item	Op	Weight	Xarm	Moment/ 1 000	%MAC	Reference	Note
		lb (kg)	in (m)	lb in (kg m)			
True Empty Weight (TEW)		24 350 (11 045)	606.3 (15.40)	14 763.4 (170.093)	44.2	Last Weighing Result	[1] [2]
Operating Items							
Flight Compartment Crew	+	380 (172)	305.2 (7.75)	116.0 (1.336)		01–40–10	
Crew Baggage	+	40 (18)	383.1 (9.73)	15.3 (0.177)		01–40–10	
Flight Manuals / Magazines	+	30 (14)	320 (8.13)	9.6 (0.111)		01–40–10	
Operating Weight Empty (OWE)	=	24 800 (11 249)	601.0 (15.26)	14 904.3 (171.7)	39.5		[1]

Notes:

[1] %MAC (imperial) = [(Xarm – 556.675) / 112.22] x 100

%MAC (SI) = [(Xarm – 14.13) / 2.85] x 100

[2] Last weighing result for TEW given in Chapter 2, Aircraft Reports.

[3] Information found here is for example only.

Table 2 – Multiple Items (Example) [1]			
Item	**Weight**	**Xarm**	**Moment/1 000**
	lb (kg)	**in (m)**	**lb in (kg m)**
Pilot	190 (86.18)	305.2 (7.75)	58.0 (0.6681)
Copilot	190 (86.18)	305.2 (7.75)	58.0 (0.6681)
Total	380 (172.36)	305.2 (7.75)	116.0 (1.3362)
Pilot Baggage	20 (9.07)	383.1 (9.73)	7.7 (0.0883)
Copilot Baggage	20 (9.07)	383.1 (9.73)	7.7 (0.0883)
Total	40 (18.14)	383.1 (9.73)	15.3 (0.1766)
NOTE: [1] information found here is for example only.			

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BD–100 WEIGHT AND BALANCE MANUAL

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WEIGHT BUILD–UP

1. General

This section shows how to use the weight build–up procedure to calculate the weight and center of gravity (CG) for a given loading scenario. The weight of the passengers and baggage is added to the operating weight empty (OWE) to get the zero fuel weight (ZFW). Then the necessary fuel is added to calculate the ramp weight (RW), take–off weight (TOW), fuel–curve–boundary–points (FCBP) and landing weight (LW).

2. Procedure

Refer to Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9.

A. ZFW Calculation

Refer to Figure 1, Figure 2, Figure 8 and Figure 9.

Do the steps that follow to calculate the ZFW:

(1) Refer to the example in the Table 1 that follows for the calculation of the ZFW:

Table 1 – Weight Build–Up – ZFW Calculation Example [4]

Item	Op	Weight	Xarm	Moment/ 1 000	%MAC	Reference	Note
		lb (kg)	in (m)	lb in (kg m)			
Operating Weight Empty (OWE)	=	24 800 (11 249)	601.0 (15.26)	14 904.3 (171.716)	39.5	01–90–10	[1] [2]
Payload Items							
Check–in Baggage or Cargo	+	80 (36)	650.0 (16.51)	52.0 (0.599)		01–60–00	
Adjustment							
Adjustment	+					01–40–10	[3]
Zero Fuel Weight – ZFW (Gear Down)							
Zero–Fuel–Weight Gear Down (ZFW Gear Down)	=	24 880 (11 285)	601.1 (15.27)	14 956.3 (172.315)	39.6	01–00–50	[2]

Table 1 – Weight Build–Up – ZFW Calculation Example [4]							
Item	**Op**	**Weight**	**Xarm**	**Moment/ 1 000**	**%MAC**	**Reference**	**Note**
		lb (kg)	**in (m)**	**lb in (kg m)**			
Gear Up	+			–4.6 (–0.053)		01–00–80	
Zero Fuel Weight – ZFW (Gear Up)							
Zero–Fuel–Weight Gear Up (ZFW Gear Up)	=	24 880 (11 285)	601.0 (15.26)	14 951.7 (172.262)	39.5	01–00–50	[2]
Notes: [1] Results from previous sum. [2] %MAC (imperial) = [($Xarm_{CG}$ – 556.675) / 112.22] x 100 %MAC (SI) = [($Xarm_{CG}$ – 14.14) / 2.85] x 100 [3] To use when necessary. [4] Information found here is for example only.							

(2) Use a copy of the Weight Build–Up – ZFW Calculation Form to continue with this procedure (Refer to Figure 2).

(3) Refer to the example in Table 1 (Subject 01–90–10).

(4) Take the values for OWE from your copy of the OWE Calculation Form (Figure 1 (Subject 01–90–10)).

(5) Record these values in the applicable fields of your Weight Build–Up – ZFW Calculation Form.

(6) Refer to the example in Table 7.

(7) Use a copy of the Payload Item Form to calculate the sum of payload items (Refer to Figure 8).

(8) Record the sums of the payload items on your Weight Build–Up – ZFW Calculation Form.

(9) Do the applicable operations (Op) as shown in Table 1.

(10) Use a copy of the Weight Build–Up Envelope to continue with this procedure:

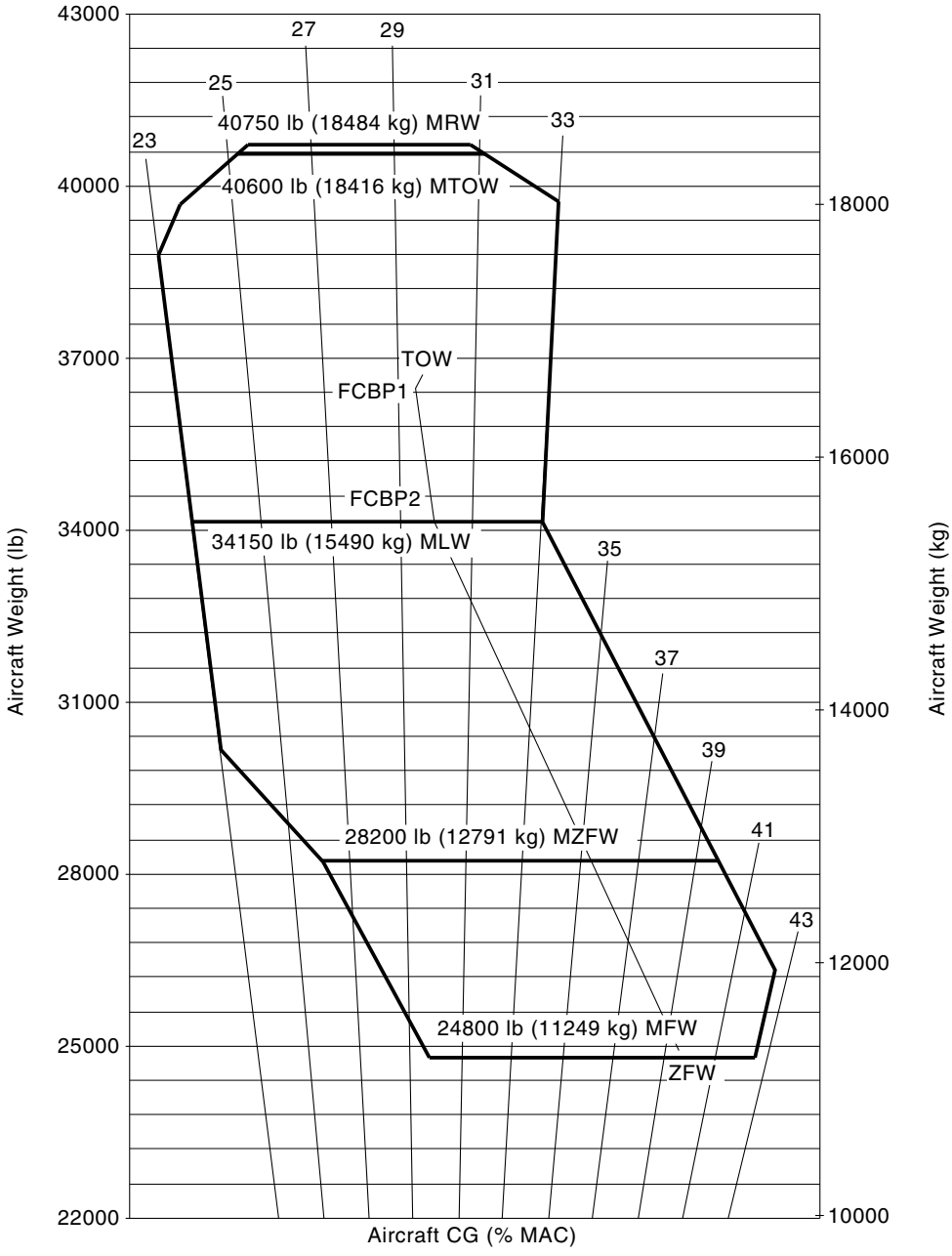
– Refer to Figure 1.

(11) Make sure that the value of ZFW is not more than the maximum zero fuel weight (MZFW).

(12) Refer to the example:

– Refer to Figure 1.

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Weight Build–Up Envelope
Figure 1

EFFECTIVITY: ALL

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WEIGHT BUILD–UP – ZFW CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1000 lb in (kg m)	%MAC	REFERENCE	NOTE
OPERATING WEIGHT EMPTY (OWE)	=					01–90–10	[1] [2]
PAYLOAD ITEMS							
CHECK–IN BAGGAGE OR CARGO	+					01–60–00	
ADJUSTMENT							
ADJUSTMENT	+					01–40–10	[3]
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[2]
GEAR UP	+			–4.6 (–0.053)		01–00–80	
ZERO FUEL WEIGHT – ZFW (GEAR UP)							
ZERO–FUEL–WEIGHT GEAR UP (ZFW GEAR UP)	=					01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [(Xarm $_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [(Xarm $_{CG}$ – 14.13) / 2.85] x 100
[3] To use when necessary.

Weight Build–Up – ZFW Calculation Form
Figure 2

B. RW Calculation

Refer to Figure 1 and Figure 3.

Do the steps that follow to calculate the RW:

(1) Refer to the example in the Table 2 that follows for the calculation of the RW:

Table 2 – Weight Build–Up – RW Calculation Example [3]

Item	Op	Weight	Xarm	Moment/ 1 000	%MAC	Reference	Note
		lb (kg)	in (m)	lb in (kg m)			
Zero Fuel Weight – ZFW (Gear Down)							
Zero–Fuel–Weight Gear Down (ZFW Gear Down)	=	24 880 (11 285)	601.0 (15.26)	14 952.4 (172.270)	39.5	01–00–50	[1] [2]
Fuel							
Fuel Tank	+	12 000 (5 443)	566.9 (14.40)	6 802.8 (78.377)		01–20–10	
Ramp Weight – RW (Gear Down)							
Ramp–Weight Gear Down (RW Gear Down)	=	36 880 (16 728)	589.9 (14.98)	21 755.2 (250.647)	29.6	01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [($Xarm_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [($Xarm_{CG}$ – 14.14) / 2.85] x 100
[3] To use when necessary.

(2) Use a copy of the Weight Build–Up – RW Calculation Form to continue with this procedure (Refer to Figure 3).

(3) Record the values found for the ZFW gear down.

(4) Record the values for the fuel.

(5) Do the applicable operations as shown in Table 2.

(6) Make sure that the value of RW is not more than the maximum ramp weight (MRW) shown on your copy of the Weight Build–Up Envelope.

(7) Refer to the example:

– Refer to Figure 1.

WEIGHT BUILD–UP – RW CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1 000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
FUEL TANK	+					01–20–10	
RAMP WEIGHT – RW (GEAR DOWN)							
RAMP–WEIGHT GEAR DOWN (RW GEAR DOWN)	=					01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = $[(Xarm_{CG} – 556.675) / 112.22] \times 100$
%MAC (SI) = $[(Xarm_{CG} – 14.13) / 2.85] \times 100$

Weight Build–Up – RW Calculation Form
Figure 3

EFFECTIVITY: ALL

C. TOW Calculation

Refer to Figure 1 and Figure 4.

Do the steps that follow to calculate the TOW:

(1) Refer to the example in the Table 3 that follows for the calculation of the TOW:

Table 3 Weight Build–Up – TOW Calculation Example [3]

Item	Op	Weight	Xarm	Moment/ 1 000	%MAC	Reference	Note
		lb (kg)	in (m)	lb in (kg m)			
Zero Fuel Weight – ZFW (Gear Down)							
Zero–Fuel–Weight Gear Down (ZFW Gear Down)	=	24 880 (11 285)	601.0 (15.26)	14 952.4 (172.270)	39.5	01–00–50	[1] [2]
Fuel							
Remaining Fuel Prior Take–Off	+	11 850 (5 375)	566.5 (14.39)	6 713.0 (77.342)		01–20–10	
Take–Off Weight – TOW (Gear Down)							
Take–Off–Weight Gear Down (TOW Gear Down)	=	36 730 (16 660)	589.9 (14.98)	21 665.4 (249.612)	29.6	01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [($Xarm_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [($Xarm_{CG}$ – 14.13) / 2.85] x 100
[3] To use when necessary.

(2) Use a copy of the Weight Build–Up – TOW Calculation Form to continue with this procedure (Refer to Figure 4).

(3) Record the values found for the ZFW gear down.

(4) Record the values for the fuel.

(5) Do the applicable operations (Op) as shown in Table 3.

(6) Make sure that the value of TOW is not more than the maximum take–off weight (MTOW) shown on your copy of the Weight Build–Up Envelope.

(7) Refer to the example:

– Refer to Figure 1.

WEIGHT BUILD–UP – TOW CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT 1 000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
REMAINING FUEL PRIOR TAKE–OFF	+					01–20–10	
TAKE–OFF WEIGHT – TOW (GEAR DOWN)							
TAKE–OFF–WEIGHT GEAR DOWN (TOW GEAR DOWN)	=					01–00–50	[2]

Notes:

[1] Results from previous sum.

[2] %MAC (imperial) = $[(Xarm_{CG} - 556.675) / 112.22] \times 100$

%MAC (SI) = $[(Xarm_{CG} - 14.13) / 2.85] \times 100$

Weight Build–Up – TOW Calculation Form
Figure 4

D. FCBP1 Calculation

Refer to Figure 5.

Do the steps that follow to calculate the FCBP1:

(1) Refer to the example in the Table 4 that follows for the calculation of the FCBP1:

Table 4 – Weight Build–Up – FCBP1 Calculation Example [3]

Item	Op	Weight	Xarm	Moment/ 1 000	%MAC	Reference	Note
		lb (kg)	in (m)	lb in (kg m)			
Zero Fuel Weight – ZFW (Gear Down)							
Zero–Fuel–Weight Gear Down (ZFW Gear Down)	=	24 880 (11 285)	601.0 (15.26)	14 952.4 (172.270)	39.5	01–00–50	[1] [2]
Fuel							
Fuel Quantity for Fuel–Curve Boundary–Point	+	11 660 (5 289)	566.1 (14.38)	6 600.7 (76.049)		01–20–10	
Fuel–Curve Boundary–Point 1 – FCBP1 (Gear Down)							
Fuel–Curve Boundary–Point 1 – FCBP1 (Gear Down)	=	36 540 (16 574)	589.8 (14.98)	21 553.1 (248.318)	29.6		[2]
Add Gear Retraction Moment	+			–4.6 (–0.053)		01–00–80	[4]
Fuel–Curve Boundary–Point 1 – FCBP1 (Gear Up)							
Fuel–Curve Boundary–Point 1 – FCBP1 (Gear Up)	=	36 540 (16 574)	589.7 (14.98)	21 548.5 (248.265)	29.5	01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [($Xarm_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [($Xarm_{CG}$ – 14.14) / 2.85] x 100
[3] Information found here is for example only.
[4] The total aircraft moment decreases by approximately 4 600 lb in (53 kg m) when the landing gears are retracted.

(2) Use a copy of the Weight Build–Up – FCBP1 Calculation Form to continue with this procedure (Refer to Figure 5).

(3) Record the values found for the ZFW gear down.

(4) Do the applicable operations (Op) as shown in Table 4.

NOTE: The values found for the FCBP1 will be used to complete your weight build–up envelope (Refer to Figure 1).

WEIGHT BUILD–UP – FCBP1 CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
FUEL QUANTITY FOR FUEL–CURVE BOUNDARY–POINT	+	11660 (5289)	566.1 (14.38)	6600.7 (76.049)		01–20–10	
FUEL–CURVE BOUNDARY–POINT 1 – FCBP1 (GEAR DOWN)							
FUEL–CURVE BOUNDARY–POINT 1 – FCBP1 (GEAR DOWN)	=						[2]
ADD GEAR RETRACTION MOMENT	+			–4.6 (–0.053)		01–00–80	[3]
FUEL–CURVE BOUNDARY–POINT 1 – FCBP1 (GEAR UP)							
FUEL–CURVE BOUNDARY–POINT 1 – FCBP1 (GEAR UP)	=					01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [(Xarm $_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [(Xarm $_{CG}$ – 14.13) / 2.85] x 100
[3] The total aircraft moment decreases by approximately 4600 lb in (53 kg m) when the landing gears are retracted.

Weight Build–Up – FCBP1 Calculation Form

EFFECTIVITY: ALL

E. FCBP2 Calculation

Refer to Figure 6.

Do the steps that follow to calculate the FCBP2:

(1) Refer to the example in the Table 5 that follows for the calculation of the FCBP2:

Table 5 Weight Build–Up – FCBP2 Calculation Example [3]

Item	Op	Weight	Xarm	Moment/ 1 000	%MAC	Reference	Note
		lb (kg)	in (m)	lb in (kg m)			
Zero Fuel Weight – ZFW (Gear Down)							
Zero–Fuel–Weight Gear Down (ZFW Gear Down)	=	24 880 (11 285)	601.0 (15.26)	14 952.4 (172.270)	39.5	01–00–50	[1] [2]
Fuel							
Fuel Quantity for Fuel–Curve Boundary–Point	+	9 310 (4 223)	562.0 (14.27)	5 232.2 (60.282)		01–20–10	
Fuel–Curve Boundary–Point 2 – FCBP2 (Gear Down)							
Fuel–Curve Boundary–Point 2 – FCBP2 (Gear Down)	=	34 190 (15 508)	590.4 (15.00)	20 184.6 (232.552)	30.0		[2]
Add Gear Retraction Moment	+			–4.6 (–0.053)		01–00–80	[4]
Fuel–Curve Boundary–Point 2 – FCBP2 (Gear Up)							
Fuel–Curve Boundary–Point 2 – FCBP2 (Gear Up)	=	34 190 (15 508)	590.2 (14.99)	20 180.0 (232.499)	29.9	01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [($Xarm_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [($Xarm_{CG}$ – 14.14) / 2.85] x 100
[3] Information found here is for example only.
[4] The total aircraft moment decreases by approximately 4 600 lb in (53 kg m) when the landing gears are retracted.

(2) Use a copy of the Weight Build–Up – FCBP2 Calculation Form to continue with this procedure (Refer to Figure 6).

(3) Record the values found for the ZFW gear down.

(4) Do the applicable operations (Op) as shown in Table 5.

NOTE: The values found for the FCBP2 will be used to complete your weight build–up envelope (Refer to Figure 1).

WEIGHT BUILD–UP – FCBP2 CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
FUEL QUANTITY FOR FUEL–CURVE BOUNDARY–POINT	+	9310 (4223)	562.0 (14.27)	5232.2 (60.282)		01–20–10	
FUEL–CURVE BOUNDARY–POINT 2 – FCBP2 (GEAR DOWN)							
FUEL–CURVE BOUNDARY–POINT 2 – FCBP2 (GEAR DOWN)	=						[2]
ADD GEAR RETRACTION MOMENT	+			–4.6 (–0.053)		01–00–80	[3]
FUEL–CURVE BOUNDARY–POINT 2 – FCBP2 (GEAR UP)							
FUEL–CURVE BOUNDARY–POINT 2 – FCBP2 (GEAR UP)	=					01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [(Xarm $_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [(Xarm $_{CG}$ – 14.13) / 2.85] x 100
[3] The total aircraft moment decreases by approximately 4600 lb in (53 kg m) when the landing gears are retracted.

BWB0190200_031

Weight Build–Up – FCBP2 Calculation Form
Figure 6

F. LW Calculation

Refer to Figure 1 and Figure 7.

Do the steps that follow to calculate the LW:

(1) Refer to the example in the Table 6 that follows for the calculation of the LW:

Table 6 – Weight Build–Up – LW Calculation Example [3]

Item	Op	Weight	Xarm	Moment/ 1 000	%MAC	Reference	Note
		lb (kg)	in (m)	lb in (kg m)			
Zero Fuel Weight – ZFW (Gear Down)							
Zero–Fuel–Weight Gear Down (ZFW Gear Down)	=	24 880 (11 285)	601.0 (15.26)	14 952.4 (172.270)	39.5	01–00–50	[1] [2]
Fuel							
Remaining Fuel at Landing	+	2 200 (998)	547.4 (13.90)	1 204.3 (13.875)		01–20–10	
Landing Weight – LW (Gear Down)							
Landing–Weight Gear Down (LW Gear Down)	=	27 080 (12283)	596.6 (15.15)	16 156.7 (186.145)	35.6	01–00–50	[2]

Notes:
[1] Results from previous sum.
[2] %MAC (imperial) = [($Xarm_{CG}$ – 556.675) / 112.22] x 100
%MAC (SI) = [($Xarm_{CG}$ – 14.14) / 2.85] x 100
[3] Information found here is for example only.

(2) Use a copy of the Weight Build–Up – LW Calculation Form to continue with this procedure (Refer to Figure 7).

(3) Record the values found for the ZFW gear down.

(4) Record the values for the fuel.

(5) Do the applicable operations as shown in Table 6.

(6) Make sure that the value of LW is not more than the maximum landing weight (MLW) shown on your copy of the Weight Build–Up Envelope.

(7) Refer to the example:

– Refer to Figure 1.

WEIGHT BUILD–UP – LW CALCULATION FORM							
ITEM	OP	WEIGHT lb (kg)	Xarm in (m)	MOMENT / 1 000 lb in (kg m)	%MAC	REFERENCE	NOTE
ZERO FUEL WEIGHT – ZFW (GEAR DOWN)							
ZERO–FUEL–WEIGHT GEAR DOWN (ZFW GEAR DOWN)	=					01–00–50	[1] [2]
FUEL							
REMAINING FUEL AT LANDING	+					01–20–10	
LANDING WEIGHT – LW (GEAR DOWN)							
LANDING–WEIGHT GEAR DOWN (LW GEAR DOWN)	=					01–00–50	[2]

Notes:

[1] Results from previous sum.

[2] %MAC (imperial) = $[(Xarm_{CG} - 556.675) / 112.22] \times 100$

%MAC (SI) = $[(Xarm_{CG} - 14.13) / 2.85] \times 100$

Weight Build–Up – LW Calculation Form
Figure 7

EFFECTIVITY: ALL

G. Payload Item Calculation

Refer to Figure 8.

Do the steps that follow to calculate the payload items:

(1) Refer to the example in the Table 7 that follows for the calculation of the payload items:

Table 7 – Payload Item Calculation Example [1]

Item	Weight	Xarm	Moment/1 000
	lb (kg)	in (m)	lb in (kg m)
Cargo	80 (36)	650.0 (16.51)	52.0 (0.594)
Total	80 (36)	650.0 (16.51)	52.0 (0.594)

NOTE: [1] Information found here is for example only.

(2) Use a copy of the Payload Item Form to continue with this procedure (Refer to Figure 8).

(3) Record the applicable values for each of the payload items on your copy of the Payload Item Form.

(4) Calculate the sum of payload items as shown in Table 7.

NOTE: The sum of payload items is used for the calculation of the ZFW.

PAYLOAD ITEM FORM			
ITEM	WEIGHT	Xarm	MOMENT / 1 000
	lb (kg)	in (m)	lb in (kg m)

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Payload Item Form
Figure 8

EFFECTIVITY: ALL

H. Weight Build–Up Envelope

Refer to Figure 1 and Figure 9.

Do the steps that follow to complete the weight build–up envelope:

(1) Refer to the example:
- Refer to Figure 1.

(2) Use a copy of the Weight Build–Up Envelope to continue with this procedure.

Refer to Figure 9.

(3) Make four points on your copy of the Weight Build–Up Envelope to show the coordinates for the ZFW, TOW, FCBP1 and FCBP2.

(4) Make lines to attach the four points in sequence TOW, FCBP1, FCBP2 and ZFW.

(a) Do not include the fuel–curve boundary–points (FCBP) if they are heavier than the TOW:

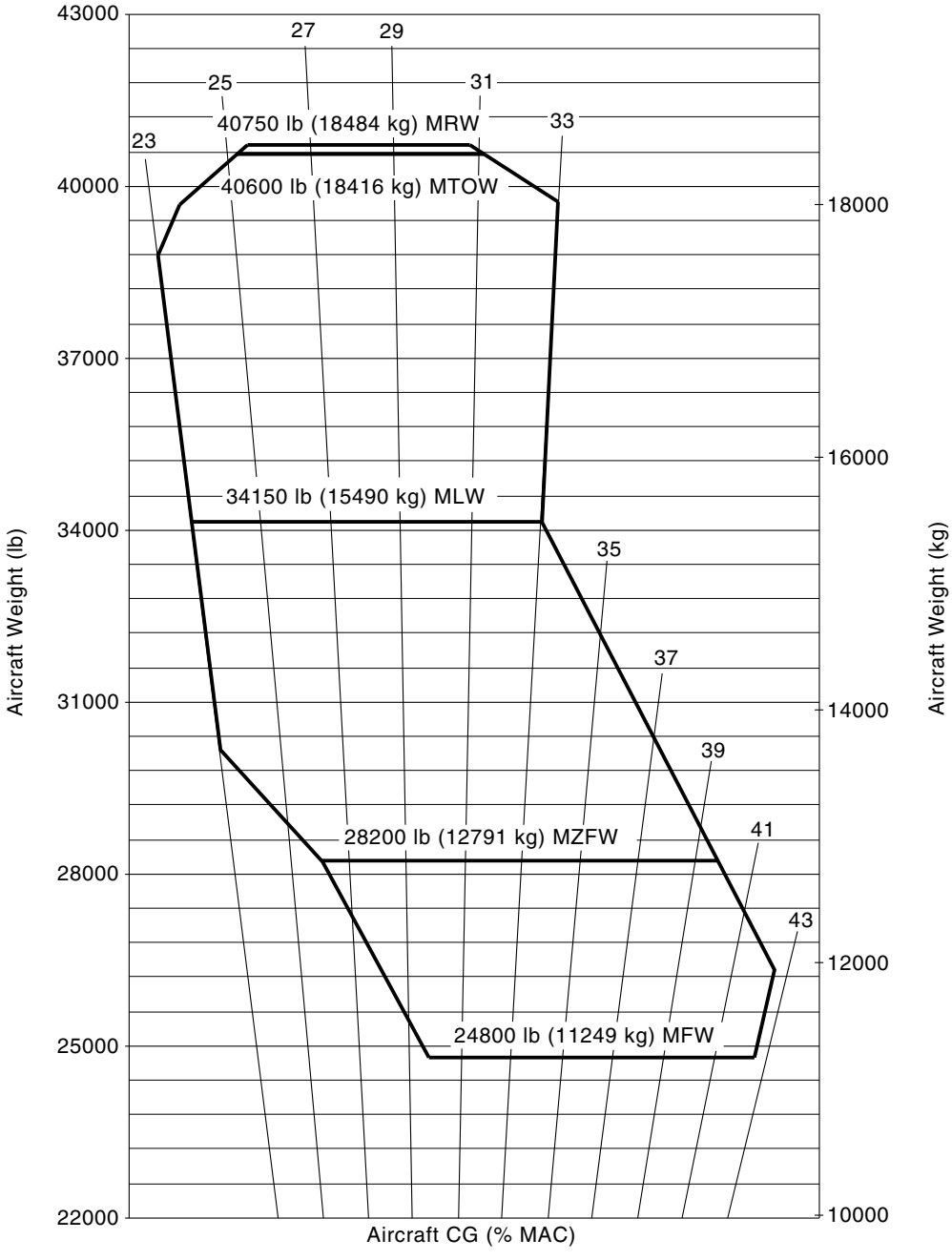
1 If FCBP1 is heavier than the TOW make only lines to attach the TOW, FCBP2 and ZFW points, in sequence.

2 If FCBP1 and FCBP2 are heavier than the TOW make only lines to attach the TOW and ZFW points.

(5) Make sure that the curve obtained is in the inner area of the envelope limits:

(a) If the curve is in the inner area of the envelope limits, the aircraft is safe for take–off.

(b) If a part of the curve is out of the envelope limits, the aircraft is not safe for take–off. You must move, add or remove payload or ballast until the weight and CG of the aircraft are into the envelope limits.



Weight Build–Up Envelope
Figure 9

EFFECTIVITY: ALL

CG SLIDE METHOD

1. Procedure

The SLIDE–A transparent charts are used as an alternative procedure to graphically get the approximate weight and longitudinal CG position during flight.

NOTE: The transparent SLIDE–A – Longitudinal Center of Gravity Envelope and SLIDE–A – Fuel Curve used for this procedure are at the end of this section.

A. Do the steps that follow to correctly use the CG Slide Method:

(1) Calculate the ZFW and longitudinal CG position (%MAC) (Refer to the ZFW Calculation procedure (Subject 01–90–20)).

(2) Make a copy of the applicable SLIDE–A – Longitudinal Center of Gravity Envelope. On your copy, make a point to record the coordinates for ZFW and %MAC.

(3) Put the transparent SLIDE–A – Fuel Curve squarely on top of the transparent SLIDE–A – Longitudinal Center of Gravity Envelope.

(4) Align the bottom point of the fuel curve with the point that you made on the SLIDE–A – Longitudinal Center of Gravity Envelope.

NOTE: The fuel curve that you get with this procedure shows the set of weight and longitudinal CG points along the fuel burn path. In other words, the highest point of the fuel curve shows an aircraft with full fuel tanks. During the flight, the point moves down the fuel curve as the fuel burns.

If the fuel tanks do not contain the maximum of fuel, it is necessary to use only the applicable part of the fuel curve. The applicable part goes from the ZFW point to the point equivalent to the RW of the aircraft for the flight.

(5) Find the weight and longitudinal CG position as a result of the fuel load for the flight.

WARNING: THERE MUST BE NO PART OF THE FUEL CURVE OUT OF THE LONGITUDINAL CG ENVELOPE LIMITS. IT IS NOT SAFE TO OPERATE THE AIRCRAFT IF PART OF THE FUEL CURVE IS OUT OF THE LONGITUDINAL CG ENVELOPE LIMITS. THIS COULD CAUSE INJURY TO PERSONS AND DAMAGE TO THE AIRCRAFT.

(6) Make sure that all of the applicable part of the fuel curve is in the inner area of the longitudinal CG envelope limits.

B. Example

This procedure shows an example of how to use the CG Slide Method. This example uses the values found in the ZFW Calculation procedure (Refer to Table 1 (Subject 01–90–20)). Do the steps that follow:

(1) The values for the example are ZFW=24 880 lb (11 285 kg) and %MAC=39.5.

(2) Make a copy of the applicable transparent SLIDE–A – Longitudinal Center of Gravity Envelope. On your copy, make a point to record the coordinates for ZFW and %MAC.

(3) The aircraft fuel tanks are full. The weight of the fuel load is 14 150 lb (6 418 kg). This fuel load added to the aircraft weight gives an approximate TOW of 39 030 lb (17 703 kg).

(4) From this TOW of 39 030 lb (17 703 kg) the CG Slide Method procedure is used to find that %MAC=30.5 approximately.

(5) It is safe to operate the aircraft because all of the applicable part of the fuel curve is in the inner area of the longitudinal CG envelope limits.

2. SLIDE–A Longitudinal Center of Gravity Envelope 40 750 lb (18 484 kg)

A. For the 40 750 lb (18 484 kg) SLIDE–A Longitudinal Center of Gravity Envelope, Refer to Figure 1.

3. SLIDE–A Fuel Curve Transparency

A. For the SLIDE–A fuel curve, refer to the transparency Refer to Figure 2.

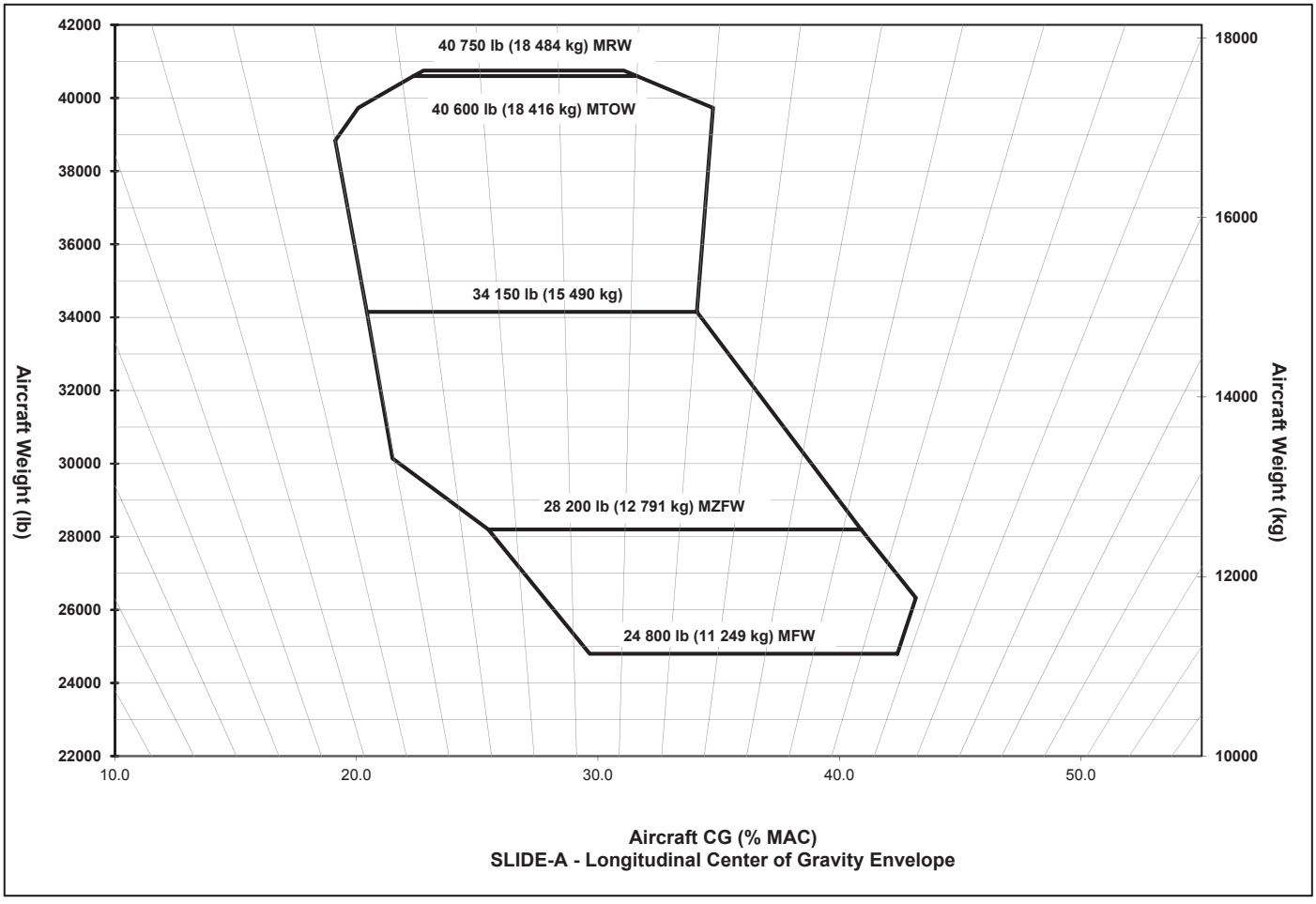

42000
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
Aircraft Weight (lb)
18000
16000
14000
12000
10000
Aircraft Weight (kg)
40 750 lb (18 484 kg) MRW
40 600 lb (18 416 kg) MTOW
34 150 lb (15 490 kg)
28 200 lb (12 791 kg) MZFW
24 800 lb (11 249 kg) MFW
10.0
20.0
30.0
40.0
50.0
Aircraft CG (% MAC)
SLIDE-A - Longitudinal Center of Gravity Envelope

Figure 1

BD-100 WEIGHT AND BALANCE MANUAL



Figure 2

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CL-350



CL-350 SUPPLEMENTAL MANUAL

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SECTION 1
INTRODUCTION

INTRODUCTION

The purpose of this ROPAT (Recommended Operational Procedures And Techniques) section is to provide recommendations and procedural guidance for operation of the Challenger 350 airplane. If the information contained herein conflicts with the approved Airplane Flight Manual (AFM), the AFM shall take precedence.

The scope of this manual is limited. Absolute numbers and variables covering all conditions are impossible to present. For example, power settings and airspeeds are may be approximate. A common sense approach to any given situation is stressed. Information contained within is subject to change. The latest revision should be referenced.

The guidance presented is intended to facilitate the safe and efficient operation of the Challenger 350. The airplane is very sophisticated with high levels of system integration. There may be several alternative means for accomplishing some actions/procedures. Generally, the examples used in this section represent the preferred, recommended method(s). An attempt is made to highlight where other, alternate means are available and acceptable.

Airmanship and its best practices are implied and not usually called out specifically as substantiating reasons for particular procedures or recommendations.

The procedures outlined should not be taken as Standard Operating procedures (SOPs). Each operator is responsible for developing and implementing their own SOPs. The guidance presented in this manual may be used to facilitate such development.

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SECTION 2
NORMAL PROCEDURES & TECHNIQUES

GENERAL

The ROPAT in this manual is not intended to be mandatory or to supersede any individual company SOPs. They are provided as examples of good operating practices.

Furthermore, SOPs can not address every circumstance in flight and the pilot may deviate from SOPs for that reason. A good CRM technique is to preface any non−standard operations with the call “Non−Standard”.

e.g.: ATC request you to slow to Vref 15nm from the straight in runway for spacing. Where gear down would normally be called perhaps an extra flap setting without gear deployment would be preferred in order not to drag the gear for that long a time. Before requesting the said flap setting, you should use the term “Non−Standard”.

RESPONSIBILITIES

The pilot−in−command (PIC) is designated by the company and is responsible for the conduct and safety of the flight. The second−in−command (SIC) is responsible for assisting the PIC in accomplishing the same goal. The pilot flying (PF) controls the aircraft with respect to heading, altitude, airspeed, and directs the necessary operations to safely accomplish the flight. The pilot monitoring (PM) maintains ATC communications, obtains clearances, accomplishes checklists, makes altitude and deviation callouts, and other tasks as directed by the PF. The crew must work together as a team. Both crew members should always maintain situational awareness. They should communicate and complement each other to enhance the efficiency and safety of the flight.

CREW COORDINATION

Efficient crew coordination is an absolute necessity for operating the aircraft with utmost safety. Crew coordination and teamwork are essential in performing Normal, Non−Normal, and Emergency procedures, as well as in the division of cockpit workload. Areas enhanced by good crew coordination are situational awareness, visual observation of other traffic, use of checklists, airspeed, altitude and deviation callouts, handling of communication, navigation radios, use of flight guidance panel (FGP), display controllers (DCP/CCP), operation of gear and flaps, departures, and approaches.

When an action is noted as not completed but the PM suspects it may have been forgotten due to workload or other, a good CRM technique would be to prompt the PF for the impending checklist or item via a question.

e.g.:

“Would you like... the Descent Checklist?”

“Would you like... flaps 20?”

SECTION 2
NORMAL PROCEDURES & TECHNIQUES

CHECKLISTS

The checklist creates an efficient motion sequence or flow in the cockpit. The Normal checklist follows a normal sequence from preflight to shutdown. The Emergency and Non–Normal checklists allow the crew to quickly turn to the appropriate checklist by matching the engine indicating and crew alerting system (EICAS) indexes to the corresponding CAS message displayed. In many cases when using these checklists, there is no need to return to the Normal checklist. Once a Non–Normal Landing checklist has been initiated, it guides the crew to landing.

EICAS indexes in the Quick Reference Handbook (QRH) 2 – appear exactly as the CAS messages appear. The checklists are arranged by color and alphanumerical order by system. In addition, they are portrayed in the same nomenclature as the EICAS messages for ease of reference.

The QRH2 is fitted with links/hyperlinks to facilitate checklist flows when cross referencing other procedures.

We urge operators to be vigilant when using links/hyperlinks to ensure they direct the user to the intended destination (page/procedure). Operators are to confirm that the referenced procedure title on the origin page is the same as the procedure title on the destination page.

PF: Calls for procedure by its title.

PM: Locates and Reads the title aloud to confirm.

PF: Acknowledges correct procedure has been chosen.

This applies to all cross referenced procedures as well.

e.g.: If an amber GEAR DISAGREE CAS message is displayed (supported by a single chime and flashing master caution lights), the flight crew should reference the GEAR DISAGREE checklist located within the Caution Procedures in the QRH 2 GEAR / BRAKES section.

NOTE: For efficient use of QRH 2 and its associated Quick Reference Card (QRC), refer to the QRH2 introduction chapter.

Flow patterns are not used for non–normal or emergency procedures. During an emergency, with or without reference to the Quick Reference Card (QRC) accomplish any immediate actions items, then call for the proper checklist. It should be noted that the QRC was developed to be used by crew to more efficiently perform the Immediate Action Items without relying solely on memory. Not using the QRC could cause omission or commission errors and thus is a good confirmation tool. Maintain control of the airplane with one pilot always flying while the other reviews all the items of the appropriate emergency procedure. The PM reads out loud both the challenge and the response. Do not proceed to the next item until both pilots confirm completion of each item.

If the checklist was overlooked, good cockpit resource management requires the PM to ask the PF if the checklist should be started. After the completion of any checklist, the PM states that the specific “checklist is complete”. This increases the PF situational awareness and prompts the PF to call for the next appropriate checklist when required.

Some checklist procedures call for the movement or manipulation of controls or switches critical to safety of flight (e.g.: Engine fire switches, Generators, Engine Run switches). Prior to initiating the action, the pilot performing the action verifies with the other pilot that the correct control or switch is being moved.

Any checklist action pertaining to a specific control, switch, or equipment that is duplicated in the cockpit is read to include its relative position and the action required (e.g.: Left Thrust Lever – IDLE, Left Fuel Pump – OFF).

PILOT INCAPACITATION (TWO CHALLENGE RULE)

If the PM observes and challenges a flight deviation or critical situation, the PF should respond immediately usually by either “correcting” or “check”. If the PF does not respond by oral communication, the PM must issue a second challenge that is loud and clear. If the PF does not respond after the second challenge, the PM must assume the PF has become incapacitated. PM must announce “I have control” and then take the necessary action.

This can be a difficult concept to convey but in light of cultural norms in some countries where the PM may have far lesser qualifications and the Captain is thought of as not challengeable. Too many accidents have occurred where the lowly copilot who didn't take control was actually the one who was right.

If the incapacitated PF is able to, they should respond immediately “you have control”. Any normal transfer of control should be done with the same verbiage.

FLOW PATTERNS

For normal procedures, a flow pattern is an efficient method for accomplishing the cockpit setup for each phase of flight. After using the flow pattern, accomplish the checklist to verify the proper setup of the cockpit. Under this concept, a normal checklist is a “done list” instead of a “do list”.

RADIO TUNING AND COMMUNICATION

The PM accomplishes navigation and communication radio tuning, identification of proper signal, ground contacts, and clearances. Before changing any navigation radio, the flight crew confirms the change does not affect autopilot or airplane control, and then selects the new frequency. This confirmation helps coordinate and use proper sequences with the autopilot, FMS, and other aids. After the NAVAID is tuned and identified, the PM announces, “(Facility) tuned and identified”.

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NORMAL PROCEDURES & TECHNIQUES

CHECKLISTS

The checklist creates an efficient motion sequence or flow in the cockpit. The Normal checklist follows a normal sequence from preflight to shutdown. The Emergency and Non–Normal checklists allow the crew to quickly turn to the appropriate checklist by matching the engine indicating and crew alerting system (EICAS) indexes to the corresponding CAS message displayed. In many cases when using these checklists, there is no need to return to the Normal checklist. Once a Non–Normal Landing checklist has been initiated, it guides the crew to landing.

EICAS indexes in the Quick Reference Handbook (QRH) 2 – appear exactly as the CAS messages appear. The checklists are arranged by color and alphanumerical order by system. In addition, they are portrayed in the same nomenclature as the EICAS messages for ease of reference.

The QRH2 is fitted with links/hyperlinks to facilitate checklist flows when cross referencing other procedures.

We urge operators to be vigilant when using links/hyperlinks to ensure they direct the user to the intended destination (page/procedure). Operators are to confirm that the referenced procedure title on the origin page is the same as the procedure title on the destination page.

PF: Calls for procedure by its title.

PM: Locates and Reads the title aloud to confirm.

PF: Acknowledges correct procedure has been chosen.

This applies to all cross referenced procedures as well.

e.g.: If an amber GEAR DISAGREE CAS message is displayed (supported by a single chime and flashing master caution lights), the flight crew should reference the GEAR DISAGREE checklist located within the Caution Procedures in the QRH 2 GEAR / BRAKES section.

NOTE: For efficient use of QRH 2 and its associated Quick Reference Card (QRC), refer to the QRH2 introduction chapter.

Flow patterns are not used for non–normal or emergency procedures. During an emergency, with or without reference to the Quick Reference Card (QRC) accomplish any immediate actions items, then call for the proper checklist. It should be noted that the QRC was developed to be used by crew to more efficiently perform the Immediate Action Items without relying solely on memory. Not using the QRC could cause omission or commission errors and thus is a good confirmation tool. Maintain control of the airplane with one pilot always flying while the other reviews all the items of the appropriate emergency procedure. The PM reads out loud both the challenge and the response. Do not proceed to the next item until both pilots confirm completion of each item.

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PREFLIGHT BRIEFINGS

The PIC should conduct a preflight briefing prior to each flight. This briefing should address flight details:

Anticipated weather: Low weather conditions and what is the plan in case of an engine failure,

Potential problems: Delays, Unruly Passengers,

Safety considerations: Aircraft evacuation, number of passengers,

Operational issues: Deicing and expiration of HOT, Performance limited airports (Gradients, Take off from short runways), and any potential Threats, etc.

Preflight briefings should include all crewmembers to enhance and set the tone for the flight. The briefing may be formal or informal but should include some standard items such as: “Advise me” of any abnormality and company operational procedures (if required).

A technique used for multi–day pairings is to discuss and focus on one emergency per day expanding on that emergency between legs on the same day. This tends to bring the crew together, help create open dialog, refresh procedures and help build crew confidence in dealing with possible issues.

EMERGENCY EVACUATION PLAN

During the preflight briefing with the Flight Attendant (if applicable), in addition to the items listed in the previous paragraph, it is good practice to go over the emergency evacuation contingency plan. Typically, the evacuation checklist is a two crew procedure. Additionally, if the flight is planned without an F/A, the copilot will have to assume the F/A duties. For example: During an emergency evacuation, the copilot leaves the cockpit upon the evacuation command, opens the proper emergency exit, informs the pilot of the exit, and takes the passengers upwind and away from the airplane to a rendezvous point. The copilot then counts the number of people on the airplane, including the pilots. The pilot completes the emergency evacuation checklist, and then joins the other occupants and copilot outside the airplane.

ADVISING OF AIRCRAFT CONFIGURATION CHANGE

A crewmember about to make an aircraft control or configuration change should alert the other crewmember. If time permits, the crewmember should announce any abrupt flight path changes so there is always a mutual understanding of the intended flight path. Sometimes a PA announcement to the passengers is advised before maneuvers involving unusual pitch or bank angles.

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CRITICAL MALFUNCTIONS IN FLIGHT

In flight, the observing crewmember positively announces an indication of a malfunction. If the PM is the first to observe any indication of a critical failure, the PM should announce what is seen and attempt to identify the malfunction to the PF.

After verifying the malfunction, the PIC announces a decision and commands or accomplishes any checklist or Immediate action items. The PF monitors the PM during the accomplishment of those tasks that have been assigned.

NONCRITICAL MALFUNCTIONS IN FLIGHT

Procedures for recognizing and verifying a noncritical malfunction or impending malfunction are the same as for time–critical situations. Time, however, is not as critical and allows a more deliberate response to the malfunction.

NON–NORMAL/EMERGENCY PROCEDURES

The preflight briefing includes a discussion of non–normal or emergency conditions. When a crewmember recognizes this situation:

- Who controls the aircraft?
- Who performs the tasks?
- What items should be monitored?

Following these designations, the PF calls for the appropriate checklist. The designated crewmember accomplishes the checklist items with the appropriate challenge and response.

Both pilots must be able to respond to an emergency that requires immediate action. The QRC can be used by the crew to more efficiently perform the Immediate Action Items without relying solely on memory, thus reducing the possibility of omission or commission errors. This does not negate the importance of a thorough understanding of the QRC/QRH and can validate the items done from memory.

Crewmembers must make every effort to confirm and identify a malfunction before initiating any non–normal or emergency action. Use positive oral communication and it is good practice to reference graphic tools (Synoptic Pages) to identify and direct the proper response.

REJECTED TAKEOFFS

Every takeoff must be regarded as a possible rejected takeoff (RTO) and is, therefore, a planned event. Both pilots may call for a rejected takeoff after the decision is made, the crew applies the proper procedure, brings the aircraft to a full stop, and follows with either the ”Rejected Takeoff” or “Engine Failure below V_1“ Checklist.

The PF should execute an abort prior to 80 KIAS for any abnormality observed. Between 80 KIAS and V_1, a takeoff can be rejected for critical situations such as:

- Loss of directional control
- Master Warning
- Safety of flight

DEVIATIONS DURING FLYING

The PM shall call out any deviation from normal and accepted Standard Operating Procedures during various phases of flight.

As an example, during the approach phase of flight: "Drifting left of course". These announcements should be specific and timely.

Deviations include:

- Courses – left or right ±5°
- Altitudes – climbing or descending from assigned altitude ±100 ft
- Airspeed – exceeding desired or assigned speed ±10 kt (also above and below VREF)
- Descent rates – descending greater than 1,000 fpm on the final approach phase
- Leaving DH/DA – one–quarter scale deflection of glideslope/localizer
- MDA – descending below selected altitude.

Some deviations calls would look like:

“Left of Course.....Correcting”

“Localizer.....Correcting”

ENGINE INDICATION AND CREW ALERTING SYSTEM

When CAS messages are displayed, always consider collateral indications. For example, an amber **L GEN FAIL** CAS message appears on the EICAS. In addition to a single aural chime and flashing master caution lights, the other indications can verify this condition:

- OFF appears in the L GEN switch and the BUS TIE may close.
- Review the ELECTRICAL and/or SUMMARY pages on the MFD and verify the parameters for the respective side in question
  - The generator outline is amber
  - The voltage/ amperage on the respective generator should be zero
  - Confirm that all electrical busses are still powered (or not)

By using system knowledge and looking at collateral indications, the crew can verify the anomaly, thus confirming the CAS message.

NOTE: It is good operational awareness to consult the Aircraft Minimum Equipment List (MEL) should a technical issue occur in flight because once landed, you may not be able to dispatch again. In those cases where the issue does not allow further dispatch and maintenance is not available at destination, a diversion to a more suitable airport may have been a better operational decision.

FLIGHT GUIDANCE SYSTEM/FLIGHT DIRECTOR

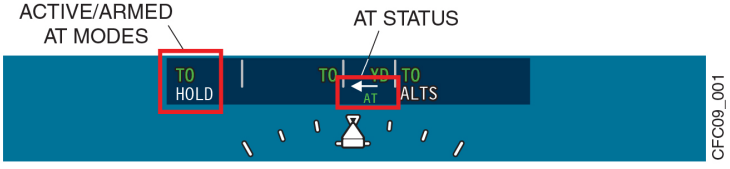
The flight guidance system (FGS) and flight director (FD) have lateral and vertical modes to manage navigation, climb, cruise, and descent. The FD is a valuable tool in helping the crew make accurate maneuvers and approaches, especially in adverse weather conditions. Remember the FD does not think ahead or anticipate, conversely it is a computer that calculates drift corrections based on track results. Consequently, the FD could command S–turns during the early part of a final approach. The crew should be aware of this, especially if given a tight or quick radar vector to an approach course. With this in mind, pilots should attempt to follow the command bars precisely to allow the FD to make accurate calculations. These computations command very gentle, slow, and deliberate corrections toward interception of a track and/or glideslope. An autopilot–coupled approach illustrates this capability. Following the command bars closely results in an accurate and well–stabilized approach.

AUTOTHROTTLE (AT) SYSTEM

The Challenger 350 Autothrottle (AT) System provides automatic thrust management to the flight crew for all phases of flight.

Thrust Mode is associated with vertical Flight Director (FD) Modes of FLC, TO and GA and the AT Speed Mode is associated with all other vertical FD Modes.

The Autothrottle can also be used with or without the Flight Director/Autopilot active. If the FD is selected Off, the AT can be engaged in Speed Mode. It is also permitted to be engaged in single–engine operations (refer to AFM for specific single–engine Limitations).



AT Modes and Status Display
Figure 09–12–1

AT ENGAGE AND DISENGAGE

The AT System is Armed/Engaged by the crew via the ENGAGE switch on the aft side of either Thrust Lever. Manual Disengagement of the AT by the crew is via the DISENGAGE button on the forward side of either Thrust Lever Knobs. When the AT is Manually Disengaged by the crew, the AT Mode(s) will clear, the AT Status will flash amber for 2 seconds and an “AUTOTHROTTLE” aural will be heard once.

If the AT detects a condition that does not meet the engage criteria, the AT will Automatically Disengage. An Auto Disengage will be noted by; all AT Modes will be removed from the FMA, the AT Status will continuously flash amber and an “AUTOTHROTTLE – AUTOTHROTTLE” aural will be continuously heard. The crew will need to acknowledge the Auto Disengage by pressing either AT DISENGAGE button on the Thrust Lever Knobs. This will cease the flashing amber AT Status and silence the associated aural.

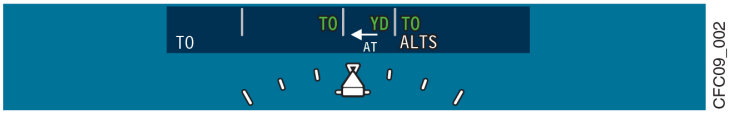
AT MODE AND STATUS INDICATIONS

The AT active modes are displayed in green on the top left–hand line of the FMA, and the AT armed modes are displayed in white on the bottom left–hand line. When an armed mode becomes active, it will flash for 5 seconds then becomes steady green.

Changes in AT Modes and Status should be confirmed by the crew by verifying the active Mode on the Flight Mode Annunciator (FMA) in the same manner as Flight Director and Autopilot statuses are confirmed.

TAXI

In order to conduct an AT assisted takeoff, the AT must be Armed prior to initiating the Takeoff roll. The AT can only be Armed after Takeoff Flaps are set, Vspeeds posted to the PFD and FD selected to TO/TO. The AT is Armed by pressing either AT ENGAGE switch. It is good practice to simultaneously press TOGA and arm the Autothrottle, when taxiing into takeoff position. Crews should confirm AT Mode displays TO (white) on the left side of the FMA and the AT Status displays AT (white) in the center of the FMA. Confirm proper FMA indications upon AT arming. (TO/TO/AT/YD//TO/ALTS).



AT Modes – TO Armed Mode
Figure 09–12–2

TAKEOFF

When the aircraft has been cleared for takeoff and aligned with the runway, the PF smoothly advances the thrust levers until the AT engages (approximately midpoint of thrust levers range). AT Engagement is confirmed by the AT Mode changing to TO (green) with HOLD (white) armed. AT Status also changes to AT (green) and the AT automatically advances the thrust levers to the TO detent (takeoff).



AT Modes – TO/HOLD Mode
Figure 09–12–3

When the aircraft accelerates above 60 KIAS and the Thrust Levers are in the TO detent, the AT Mode will change to HOLD (green) with TO (white) as the Armed Mode. The crew must confirm that the AT Mode is HOLD (green) prior to 80 KIAS. When HOLD (green) is the active AT Mode, servo commands cease, and the Thrust Levers will be maintained in the TO Detent until reaching 400 ft Above Airport Elevation (AAE).



AT Modes – HOLD/TO Mode
Figure 09–12–4

INITIAL CLIMB

Once the aircraft is safely airborne, the crew will select a lateral and FLC mode and set the speed bug as required. Upon selection of FLC, the AT will arm THRUST (white) mode. When the aircraft passes 400 ft AAE, the AT will command the Thrust Levers back to the CLB Detent and will maintain that position until ALTS CAP or an AT SPD mode becomes active.



AT Modes – HOLD/THRUST Mode
Figure 09–12–5

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GENERAL PROTOCOLS

When flying in a technologically advanced flight deck, each pilot must understand basic protocols. When these protocols are followed, each crewmember should understand their responsibilities. This greatly enhances situational awareness. The following procedures promote efficiency and avoid confusion:

1. The FMS should never replace judgement or the ability to revert to non−FMS navigation within a moment's notice. Flight management systems have come a long way in accuracy and ability to find themselves, but they are only as good as the programmer.
2. One crewmember should always keep a heads−up discipline and actively monitor the aircraft. This cannot be overemphasized. It is not uncommon to occasionally find both pilots looking down (in the FMS) and no one looking outside. Avoid FMS programming in critical phases of flight or low level altitudes. If the flight crew is unsure of which approach will be assigned, wait until the assigned approach or the approach to expect is given.
3. Divide the cockpit in half. All switches to the left are the responsibility of the left−seat pilot. All switches to the right are the responsibility of the right−seat pilot. When making any switch selection, inform the other pilot.
4. Automatic Flight Control System (AFCS) — Communication regarding who is controlling the autopilot is essential between the pilots and should be confirmed. Confirmation by both pilots is necessary when there is a transfer of control. Additionally, the PF must inform the PM when the autopilot is turned on or off.
5. Flight Guidance Panel — The aircraft has a single flight Guidance Panel (FGP). When the autopilot is on the PF has control and makes selections. When the autopilot is off the PM makes the selections at the request of the PF.
6. All active FD mode changes shall be confirmed on the FMA and verbalized by the crewmember managing the FCP. Normally the PF announces the change with a confirmation from the PM. However, if the PM observes the change and no call is made by the PF, the PM will verbalize the change, expecting confirmation by the PF.
7. Landing Gear and Flap Handles: Should be moved by the PM but only at the command of the PF. The PM moving either handle on his own on an approach instead of at the direction of the PF, shows a break down of cockpit discipline.
8. Heading bug — When the autopilot is on, the PF manipulates the heading bug. When the autopilot is off, the PM may manipulate the heading bug at the instruction of the PF.

9. Altitude selector — Altitude preselector is always operated by the PM. That said, some SOPs may require it to be set by the PF when the autopilot is on only.
10. Precision approach — When cleared for the approach and at the glide–slope (GS) intercept altitude, set the altitude preselect to the missed approach altitude but preferably once the GS is captured. If the missed approach altitude is below the GS intercept altitude, the aircraft flies through the altitude (rather than capturing it) provided the flight director (FD) captured the GS.
11. LPV approach/ (VGP)__ VNAV should be engaged. When cleared for the approach and at the vertical glide–path (VGP) intercept altitude, set the altitude preselector to the missed approach altitude but preferably once the VGP is captured. If the missed approach altitude is below the VGP intercept altitude, the aircraft flies through the altitude (rather than capturing it) provided the flight director (FD) captured the VGP.
12. Nonprecision approach — When cleared for the approach, select the next lower stepdown altitude at each intermediate altitude. Do not select the next lower altitude until a green ALTS illuminates. At the MDA, set the altitude preselect for the missed approach.
13. Nonprecision approach (VPATH) — When cleared for the approach, select the MDA (Minimum Descent Altitude). Monitor the vertical descent profile while respecting any approach altitude constraints. At the MDA, set the altitude preselector for the missed approach and continue to the MAP (Missed approach point).

Similarly, should this be a VMDA approach, prior to passing the FAF (Final Approach Fix) a technique is to deselect VNAV and select VS (Vertical speed) thereby respecting the AFM limitations and assuredly capturing the MDA while maintaining a constant descent rate which matches the original VPATH profile.

TRAINING AIRSPEEDS AND POWER SETTINGS

The following table is an example of power settings for a 34,000 lb airplane in standard (ISA) conditions. Power settings will vary due to aircraft weight, passengers, temperature, and pressure altitude and the following table is referenced for training targets only.

FLIGHT PHASE	AIRSPEED KNOTS/MACH	N_1
Takeoff and Climb		
– Takeoff and Rotate	V_R	Takeoff detent
– Flaps 0	V_2+ 15 (flaps 10) V_2+ 25 (flaps 20)	CLB detent or power as required

FLIGHT PHASE	AIRSPEED KNOTS/MACH	N_1
– Climb (Class D)	200	CLB detent or power as required to hold speed with current pitch attitude
Normal Climb		
– 3,000 – 10,000 ft – Normal	250	CLB detent or power as required to hold speed with current pitch attitude
– 10,000 – Cruise – Normal	250/0.75 250/280/0.80 250/310/0.82	CLB detent or power as required to hold speed with current pitch attitude
Cruise		
– Below 10,000 ft	200	~52%
Miscellaneous Airspeeds		
– Below 10,000 ft	250	~59%
– 10,000 to FL250	250	~70%
– FL410 Cruise – Normal	0.80	~84%
Steep Turns		
– 45° Bank – 15,000 ft	250	Increase 2% before turn ~68%
Slow Flight		
– Flaps 0 – Gear Up	1.23 V_S .8 AOA	~48%
– Flaps 20 – Gear Up	1.23 V_S .8 AOA	~52%
– Flaps 20 – Gear Down	1.23 V_S .8 AOA	~56%

FLIGHT PHASE	AIRSPEED KNOTS/MACH	N_1
– Flaps 30 – Gear Down – Level	V_{REF}	~58%
Approach to Stalls		
– Clean	–1 kt per second	IDLE
– Takeoff and Approach	–1 kt per second	50% – 55%
– Landing	–1 kt per second	50% – 55%
Holding		
– 14,000 ft and Below (1 Minute Legs)	180	50%
– Above 14,000 ft (1.5 Minute Legs)	200	59%
Approaches		
– Flaps 0–Gear Up	200 – 180	~51%
– Flaps 10–Gear Up	160	~54%
– Flaps 20–Gear Down	140	~62%
– Flaps 30–Gear Down	V_{REF}	~59%
Normal Descent to Landing		
On GS	V_{REF}	~46%
Level Flight – MDA	V_{REF}	~59%
Level Flight – Circling	V_{REF} + 10	~60%
Landing		
Final for Landing	V_{REF} +½ Gust Factor (max 10 kts)	

FLIGHT PHASE	AIRSPEED KNOTS/MACH	N_1
50 ft above Runway	V_{REF}	Idle

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PILOT TAKEOFF BRIEFING

Action: It is recommended that the takeoff briefing be accomplished before requesting the STARTING ENGINES checklist assuming no delays for take off, so that it does not interfere with last minute takeoff preparations. A good takeoff briefing should include, but is not limited to, the following, as applicable:

- Takeoff runway and SID
- SID details, altitude/Speed restrictions, gradients, etc.
- Calculated Takeoff distance vs. runway available
- Taxi plan (when required) RVO/ LVO considerations, hotspots, etc.
- Takeoff FLAP setting
- Bleed / Anti–Ice requirements
- Takeoff weight (based on planned takeoff weight)
- N_1 Thrust setting value
- V_1 / V_R / V_2 / V_{FTO}
- Noise abatement procedures (if applicable)
- Acceleration altitude
- Standard takeoff callouts
- Transition altitude
- FGP Modes
- Non–Normal / emergency briefing (including rejected takeoff criteria)
- Emergency evacuation plan
- Weather
- Any deviations from standard
- Threats

Ask if any questions

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SAMPLE TAKEOFF BRIEFING T–S–R–E–D (EMERGENCY BRIEFING)

This sample takeoff briefing is based on a dry runway, 38,000 lbs (17,237 kg) airplane: A potentially useful Mnemonic, TSRED, may aid in the recall of required briefing items.

T — Type of takeoff with associated parameters

S — Standard calls

R — Reject items

E — Emergency plan

D — Departure

T	Type of Takeoff V–Speeds and Thrust	This will be a Flaps 10, rolling takeoff on runway 24 right, length 11,000 ft, takeoff distance required is 4,833 ft. (plus 100 ft for rolling takeoff = 4933 ft). V_1 is 128 V_R is 132 V_2 is 139 V_{FTO} is 157 N_1 is 88.6
S	Standard Calls	Calls are “Airspeed alive”, “N_1 set”, “80 kts crosscheck”, “V_1“, “V_R“, and “Positive rate”
R	Reject Items	“Takeoff will be rejected prior to 80 kts for any abnormality. Between 80 kts and V_1, I will reject for: • Master warnings • Directional control problems • Safety of flight issues”
E	Emergency Plan	In the event of an engine failure after V_1, we will continue the takeoff. We will plan to remain VFR and return for a visual approach runway 24 right.
D	Departure	This will be a Montreal One departure using Noise Abatement Procedure NADP1/ NADP2. Runway heading to 5,000 ft.
	Ask for questions	

NOTE: Some companies also brief which Flight Guidance Panel modes will be selected for takeoff (Lateral and vertical modes) which is always a good idea.

HOLDING SHORT OF RUNWAY

ABBREVIATED PILOT TAKEOFF BRIEFING

Action: This abbreviated pilot takeoff briefing could be used as a review briefing before entering the runway of key points. It should cover the essential items that could have changed during the taxi phase (i.e. change of a runway, flaps setting, fuel check, etc).

- Takeoff runway and SID review
- Calculated Takeoff distance vs. runway available
- Takeoff FLAP setting
- Takeoff minimum fuel quantity required vs. fuel on−board
- Cabin notified of imminent departure

Select TOGA to activate the Flight Director (FD) when taxiing into takeoff position. Additionally, to avoid AT deactivation during runway engagement while using differential thrust, it is suggested to arm the autothrottle once aligned with the runway under these conditions. The AT is armed by pressing either engage switch, located at the aft base of either thrust levers. The TO (white) should appear in the left−hand corner of the FMA as well as a AT (white) in the bottom center of the FMA indicator window.

Confirm proper FMA indications upon AT arming. (TO/TO/AT/YD/TO/ALTS)

NOTE: When the thrust levers are advanced past the 23 degrees travel (midpoint), the AT servo will engage and carry the levers to the TO detent (provided pre−conditions are met. See AT section & FCOM2 for further details).

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STANDARD CALLOUTS

PF	PM
TAKEOFF	
Cleared for takeoff	
Call:"Runway Lineup checklist" Arm AT if installed	
	Action: Complete Runway Lineup checklist
	Call:"Runway Lineup checklist complete"
Action: Place hand on thrust levers. Move up two clicks to the TO detent. If AT installed, advance past 23 degrees TLA (approx. mid–point travel) until servos engage.	
Call:"Set N_1"	**Call:**"N_1set"
Action: Verify Thrust levers in the TO detent	**Action:**At first sign of airspeed
	Call:“Airspeed alive”
	Action: At 80 KIAS
	Call:"80 knots" “crosscheck”
	Action: Confirm green HOLD mode if autothrottle equipped
Call:"Check"	
	Call:"V_1"
Action: Move hand from thrust levers to control wheel	
Call:"Rotate" or “V_R“	
Action: Rotate to the takeoff attitude	
	Action: When the VSI is showing positive climb and the indicated altitude is increasing
	Call:"Positive rate"

PF	PM
Call:"Gear up"	
	Call:"Gear up"
	Action: When all gear lights extinguished:
	Call:"Gear indicating up"
	Call:"V_2+15 (Flaps 10) "V_2+25 (Flaps 20)
Action: Above 400 ft AGL and clear of obstacles:	
Call:"Flaps up, After Takeoff Checklist"	
	Call:"Flaps up"
	Action: Verify flap position indication up
	Call:"Indicating up"
	Above 700 ft
	“Autopilot is available”
“Autopilot On”	
	Action: After contacting departure control or the next radar center, do the After Takeoff checklist after the PF calls for it
	Call:"After Takeoff checklist complete"
	Action: Pressurization check every 10,000 ft
Call:"CLIMB Check"	**Call:**"Climb Check complete"
CLIMB	
Call:"Climb – Transition checklist"	
	Action: Complete Climb – Transition checklist
	Call:"Climb – Transition checklist complete"
	Call:"_____ (altitude) climbing _____ (altitude)" (e.g., "8,000 climbing 12,000”)
Call:"_____ (altitude) climbing _____ (altitude)"	

PF	PM
At all altitude changes, PF acknowledges the new altitude setting.	
Cruise altitude	
Call:"Cruise checklist"	**Action:**Complete the Cruise checklist **Call:**"Cruise Checklist complete"
DESCENT **Call:**"Descent checklist"	 **Action:**Complete the Descent checklist **Call:**"Descent Checklist complete"
Call:"Descent – Transition checklist"	 **Action:**Complete Descent – Transition checklist **Call:**"Descent – Transition checklist complete" **Call:**"_____ (altitude) descending _____ (altitude)" (e.g., "12,000 descending 8,000")
At 1,000 ft before assigned altitude	
	Call:"_____ (altitude) descending _____ (altitude)" (e.g., "9,000 descending 8,000")
Call:"_____ (altitude) descending _____ (altitude)"	
PRIOR TO BEGINNING THE PRECISION APPROACH (ILS or LPV)	
Prior to 31 nm from destination or below FL180	
Accomplish approach planning and briefing during the cruise or initial descent, if possible, or at the latest when called for in the Approach checklist. **Entering the terminal area (31nm):** Select within the FMS an approach. If performing an LPV approach, verify the PFD A1 line is showing “LPV ARM” and 1 nm scaling. **Call:**"Approach checklist"	 **Action:**Initiate the Approach checklist **Call:**"Approach check complete"

PF	PM
NOTE: **Once on vectors, sequence the FMS.** **Recall the 3–2–1 rule:** Within controlled airspace of 3 = 3000', 2 = maximum 200 kts, and 1 = within 10 nm. For LOC based approaches, if the PFD is selected to ROSE format a dotted cyan preview of the HSI inbound course is displayed and superimposed on the active Magenta HSI. Verification of the LOC frequency should also be done. Within the airport environment and the course deviation indicator of the approach captured, verify the PFD A1 line for “LPV ARM” and the FMA vertical GP is armed. This confirms VNAV is engaged if required.	
Call:"Flaps 10"/160 kts	
	Call:"Speed check; flaps 10" **Call:**"Indicating 10"
At initial convergence of course deviation indicator	
	Call:"Localizer alive/Course alive"
Call:" Localizer/Course alive"	
When course deviation indicates captured and tracking inbound	
	Call:"Localizer/Course captured"
Call:" Localizer/Course captured"	
At **initial** downward movement of the glidesope/glidepath	
Call:"glideslope/glidepath alive"	
	Call:"glideslope/glidepath alive"
2 dots prior glideslope/glidepath	
Call:"Flaps 20"/140 kts	
	Call:"Speed check"
	Call:"Flaps 20, indicating 20"
1 dot below glideslope/glidepath	
Call:"Gear down"	
	Call:"Gear down"
	Call:"Gear down, three green"
Call:"Gear down three green"	
At glideslope/glidepath capture	

PF	PM
Call:"Flaps 30, before landing checklist"/ Vref	
	Call: Speed check; flaps 30"
	Call:"Indicating 30"
Call:"Glideslope/glidepath captured" "Set missed approach altitude"	
	Call:"Check" "Missed approach altitude set"
	Action: If not already accomplished, complete the Before Landing checklist **Call:**"Before Landing Checklist complete"
Verify the PFD A1 line for ”LPV APPR” message and not “NO APPR”	
At the Final Approach (FAF)	
	Action:
	Start timing, if needed
	Visually crosscheck that altimeters agree with crossing altitude
	Set missed approach altitude
	Call the tower
	Look for runway environment
At 1,000 ft above DH	
	Call:"1,000 above minimums"
If IMC, should be stable at 1000' above minimums If VMC, should be stable at 500' above minimums	
Call:"Check/Stable" if IMC	
At 500 ft above DH	
	Call:"500 above minimums"
Call:"Check/Stable" if VMC "No flags"	
At 100 ft above DH	
	Call:"Approaching minimums"

PF	PM
Call:"Check"	
At minimums or when the runway environment is in sight	
	Call:“Minimums” or “Runway (or visual references) _____ o'clock (lead–in lights)"
Call:"Visual Landing"	
Call:"Autopilot disconnect"	
	Call:“Check"
After touchdown	
Action: Brakes applied and thrust reversers as required	
	NOTE: Spoilers automatically extend after touchdown. Monitor both the thrust reversers and spoilers.
	Call:"Spoilers extended, TRs deployed"
	Call:"Airspeeds during deceleration" (e.g.: 80, 60, 40 kt)
After clearing the active runway	
Call:"After Landing/Clearing Runway checklist"	
	Action: Complete After Landing/Clearing Runway checklist
	Call:"After Landing/Clearing Runway checklist complete"
PRECISION MISSED APPROACH	
At minimums and no runway environment in sight	
Call:"Go–Around Set N1"	**Call:**"Minimums, Go–Around"
Action: Press the go–around TO/GA button, advance Thrust to Takeoff (TO) detent unless AT is engaged, Flight Spoilers retract (if extended), Pitch up to the command bars.	
	Action: Verify the N_1 setting for go–around

PF	PM
	Call:"N1 Set"
Call:"Flaps 10"	
	Call:"Flaps 10"
	Call:"Indicating 10"
	Action: When the VSI is showing positive climb and the indicated altitude is increasing
	Call:"Positive rate"
Call:"Gear up"	
	Call:"Gear up"
	Call:"Gear indicating up"
NOTE: If an FMS approach was flown, the FMS will auto sequence into the missed approach and only a vertical mode on the FGP is required for navigation purposes. If a LOC based approach is flown, the NAV source must be changed from Green to Magenta source and then the appropriate FGP selections (NAV and Vertical mode) can be made to sequence into the missed approach.	
Missed approach procedures	
	Action: Announce initial heading and altitude for missed approach
	Clear of obstacles
	Call:"V_{GA}+15 KIAS"
Call:"Flaps 0"	**Call:**"Flaps 0"
	Call:"Indicating 0"
	When at safe altitude and time permitting, accomplish a Go–Around checklist
Call:"Go–Around checklist"	
	Call:"Go–Around checklist complete"
NON PRECISION APPROACH	
Prior to 31 nm from destination or below FL180	

PF	PM
Accomplish approach planning and briefing during the cruise or initial descent, if possible, or at the latest when called for in the Approach checklist. Within the terminal area (31nm) select an approach in the FMS. Verify the PDF A1 line is showing “RNP ARM” and 1 nm Scaling.	
Call:"Approach checklist"	
	Action: Initiate the Approach checklist
	Call:"Approach checklist complete"
NOTE: **Once on vectors, sequence the FMS.** **Recall the 3 – 2 – 1 rule:** Within controlled airspace of 3 = 3000', 2 = maximum 200 kts, 1 = within 10 nm. Within the airport environment and the course deviation indicator of the approach captured, verify the PFD A1 line for “RNP ARM” and the FMA vertical GP is armed. This confirms VNAV is engaged if required.	
After level–off intermediate approach segment	
Call:"Flaps 10"/160 kts	
	Call:"Speed check; flaps 10" "Indicating 10"
At initial convergence of course deviation indicator	
	Call:"Course alive"
Call:"Course alive"	
When course deviation indicates captured and tracking inbound	
	Call:"Course captured"
Call:"Course captured"	
NOTE: Verify the PFD A1 line for the “RNP APPR” message. Also verify the FMA vertical mode GP is armed. This confirms VNAV is engaged if required. Should only a path exist the altitude preselector will have to be set lower for the PATH (FMA) to appear and the PFD A1 line should display (REF APPR). If unfamiliar with these types of approaches VS mode may be the preferred method while deselecting VNAV.	
5 nm prior to final approach fix (FAF) or 2 dots below VGP	
Call:“Flaps 20“/140 kts	
	Call:"Speed check; flaps 20"

PF	PM
	Call:"Indicating 20"
At one DOT below VGP	
Call:"Gear down"	
	Call:"Gear down"
	Call:"Gear down three green"
Call:"Gear down three green"	
Prior to the FAF, confirm the PFD A1 line is indicating “RNP APPR”	
1 nm prior to final approach fix (FAF) or VGP intercept	
Call:“Flaps 30”“Before Landing Check”, Vref	
	Call:"Speed check, flaps 30"
	Call:"Indicating 30" Complete the Landing Checklist
	Call:"Landing Checklist Complete"
At Final Approach Fix (FAF)	
	Action:
	Start timing
	Visually crosscheck that both altimeters agree
	Set MDA (to nearest 10 ft **above**) in Preselected Altitude
At 1,000 ft above MDA	
In IMC should be stable at 1000' above minimums In VMC should be stable at 500' above minimums	
	Call:"1,000 above minimums"
Call:"Check/Stable" if IMC	
At 500 ft above MDA	
	Call:"500 above minimums"
Call:"Check/Stable" if VMC	
At 100 ft above MDA	
	Call:"Approaching minimums"

PF	PM
Call:"Checked"	
At minimum descent altitude (MDA)	
	Call:"Minimums, (time) or (remaining distance) to go"
Call:"Checked"	
At point where the runway or runway environment is in sight	
	Call:"Runway (or visual references) _____ o'clock (lead–in lights)"
Call:"Visual"	
Call:"Autopilot disconnect"	
	Call:"Check"
After touchdown	
Action: Maintain runway alignment. Brakes applied and thrust reversers as required	
	NOTE: Spoilers automatically extend after touchdown. Monitor the thrust reversers.
	Call:"Spoilers extended, TRs deployed"
	Call:"Airspeeds during deceleration" (i.e.: 80, 60, 40 kt)
After clearing the active runway	
Call:"After Landing/Clearing Runway checklist"	
	Action: Complete After Landing/Clearing Runway checklist
	Call:"After Landing/Clearing Runway checklist complete"
NON PRECISION MISSED APPROACH	
At MAP and no runway environment in sight	
Call:"Go–Around, set N1"	**Call:**"Minimums (or MAP), Go–Around"

PF	PM
Action: Press the go–around TO/GA button. Advance Thrust to the Takeoff (TO) Detent unless AT engaged, Flight Spoilers Retract (if extended). Pitch up to the command bars.	
	Action: Verify the N_1 setting for go–around
	Call:"N_1 set"
Call:"Flaps 10"	
	Call:"Flaps Selecting 10"
	Call:"Indicating 10"
	Action: When the VSI is showing positive climb and the indicated altitude is increasing
	Call:"Positive rate"
Call:"Gear up"	
	Call:"Gear up"
	Call:"Gear indicating up"
Missed approach procedures	
	Action: Announce initial heading and altitude for missed approach
	Clear of obstacles
	Call:"V_{GA} + 15 KIAS"
Call:"Flaps 0"	
	Call:"Flaps 0"
	Call:"Indicating 0"
Call:"Go–Around checklist"	
	Action: When at safe altitude and time permitting, accomplish the Go–Around checklist
	Call:"Go–Around check complete"

SECTION 2
NORMAL PROCEDURES & TECHNIQUES

COCKPIT RECOMMENDED SET UP

PFD SETUP	PF	PM
FORMAT	ROSE*/PPOS	ROSE*/PPOS
NAV SOURCE	FMS 1	FMS 2
POINTERS	AS REQ'D	AS REQ'D
TRAFFIC (TCAS)	OVERLAY SELECTED	OVERLAY SELECTED
TERRAIN	SELECTED	SELECTED
WEATHER	NOT SELECTED	NOT SELECTED
RANGE	10 NM OR AS REQ'D	10 NM OR AS REQ'D

MFD SETUP	PF	PM
UPPER WINDOW	EICAS	SUMMARY
LOWER WINDOW	PPOS	PPOS
MFD DATA WINDOWS	VNAV	ON
POINTERS	AS REQ'D	AS REQ'D
TRAFFIC (TCAS)	OVERLAY SELECTED	OVERLAY SELECTED
TERRAIN	NOT SELECTED	NOT SELECTED
WEATHER	SELECTED	SELECTED

FMS SETUP	PF	PM
FMS PAGE	LEGS PAGE	TUNE PAGE

* means preferred

For departures typically the speed bug is set to 200kts based on the 3–2–1 rule of controlled airspace:

- 3 = within 3000'
- 2 = maximum 200 kts
- 1 = within 10 nm of an airport

SECTION 2
NORMAL PROCEDURES & TECHNIQUES

PRETAKEOFF

The FD should be setup in the TO/TO mode complemented with any lateral mode armed (eg: LNAV) that may be required as per a departure procedure. Standard Instrument Departure (SID) procedures assume a standard rate turn and a 3.3 % (200 ft/nm) climb gradient, more if stated or depicted on the SID. Appropriate navigation modes should be set up at this time. Both pilots should be aware of which pilot is in command of the FD by verifying the position of the FD couple arrow on the top center of both PFDs.

Determine which navigation source (FMS or VHF) should be used and set up both PFDs accordingly. Tune appropriate frequencies, set courses, and select bearing pointers as desired.

Before entering the runway environment, the crew should scan the PFDs and EICAS, review displayed information, and ensure CAS messages are appropriate for the configuration. Confirm V–speeds are posted, Speed bug set to 200 kts or as required, HDG bug as required, FMA modes set for departure and pre–selected altitude as per clearance.

The PM is responsible for several areas of attention and some areas overlap with the PF. Throughout the takeoff, the PM monitors the EICAS. The normal flap setting for takeoff is flaps 10 due to the increased climb capability in the second segment. Flaps 20 can be used for short field considerations when obstacle clearance is not a factor.

Takeoff procedures, such as a Static takeoff versus a rolling takeoff should be discussed before departure. Runway length, runway conditions, and prevailing/anticipated weather are among the deciding factors.

Takeoff from a Static start must be accomplished when the computed takeoff distance is at or near actual runway length. Hold the brakes as thrust is advanced to the takeoff detent and takeoff power is achieved, and then release the brakes smoothly. Only by using this procedure can computed takeoff and climb performance figures be met.

A rolling takeoff may be accomplished when actual runway length is at least 300 ft longer than computed takeoff distance and obstacle clearance is not a factor. As the aircraft is aligned on the runway, advance the thrust levers smoothly to the takeoff detent. A rolling takeoff adds 100 ft to the takeoff field length.

Additionally, The extra runway required for a rolling takeoff depends on how long it takes to set the takeoff thrust and how far the airplane moves down the runway before takeoff thrust is set. Because of the numerous different CAS messages that could be displayed, an added safety feature is the CAS takeoff and landing inhibit mode. Distractions can complicate the critical phases of flight, mostly takeoff, final approach, and landing. For this reason, restrictions have been built into the CAS messaging logic to inhibit certain warning, caution, and advisory CAS messages until the takeoff or landing phase is completed. This mode also prevents the master caution or warning light and chime from activation should one of the selected CAS messages be detected.

SECTION 2
NORMAL PROCEDURES & TECHNIQUES

TAKEOFF PROCEDURES

When cleared for takeoff (Fig. 2–1), the PF should call for “RUNWAY LINEUP checklist”. The PM completes and calls “RUNWAY LINEUP checklist complete; cleared for takeoff”. The PF smoothly advances thrust levers to the takeoff (TO) detent unless AT is armed and the travel occurs automatically past approximately 23 degrees TLA (midpoint) and tracks the runway centerline. The PM confirms the throttle levers are in the TO detent and the N_1 setting matches the N_1 bugs and calls, "N_1 set."

As airspeed becomes active, the PM verifies airspeed increasing on both PFDs and calls “airspeed alive”. The PM calls “80 kts crosscheck” to which the PF responds “check”. The purpose of the 80 kt cross check is for the PM to cross check both PFDs for airspeed indications matching, a general scan of MFD 1 and all 4 displays for anything abnormal. This call also serves as an incapacitation verification, denotes a marked transition for rejected take off criteria and CAS inhibit logic

NOTE: If autothrottle equipped, the crew must confirm that the AT has achieved the required takeoff thrust setting prior to 80 KIAS with the annunciation of “HOLD” on the FMA. At this point the “HOLD” will be indicated as active until 400 ft AAE and no further adjustments are made by the autothrottle, (AFM limitation).

At V_1 speed, the PM calls, “V_1“. The PF releases the thrust levers and puts both hands on the control wheel. At V_R the PM calls, “V_R or Rotate”. Under normal circumstances with two engines running, the PF rotates the aircraft at 3 to 4° per second to the command bars.

When a positive rate of climb is achieved, the PM calls, “Positive rate” to which the PF responds “gear up”. The PM moves the gear handle to the up position and monitors the gear lights while the gear is retracting. The PF should then call for appropriate flight director modes (e.g.: HDG/NAV and FLC).

When clear of obstacles and accelerated, upon the PF's request, the PM initiates flap retraction. The PM positions the flap handle to the 0 position and monitors the flap indicator for the correct setting.

Flaps 0 can be initiated

V_2 + 15 for flaps 10 or

V_2 + 25 for flaps 20.

After contacting departure control, the PF calls for the After Takeoff checklist. The PM should then complete the After Takeoff checklist and announce “Flaps up, After Takeoff checklist complete”. When able to continue the climb after takeoff, the PF will set the thrust levers to maximum climb power (CLB) and select the desired climb schedule or technique. Above 700 ft Autopilot may be engaged.

CLIMB AND CRUISE PROCEDURES

The PM announces all assigned altitudes and sets them in the altitude preselect window. The PM also calls out 1000 ft above or below all assigned altitudes and any altitude restrictions. For example:

“Through 9000 ft, climbing 10 000 ft,” or “Through FL 400, climbing FL 410”.

The PM also announces other significant altitudes, such as,

“10000 feet, 18000 feet and/or Transition Altitude”

Passing through 10 000 ft, the CLIMB check should be completed. This is also a reminder for those operators who subscribe to a sterile cockpit (no distractions or extraneous conversations) below 10 000 ft, that sterile cockpit procedures can be ended. Since the aircraft can climb to altitudes in excess of FL 410 in a very short time, it is recommended the crew check the pressurization system (pressure differential vs. cabin altitude) at each 10 000 ft interval throughout the climb.

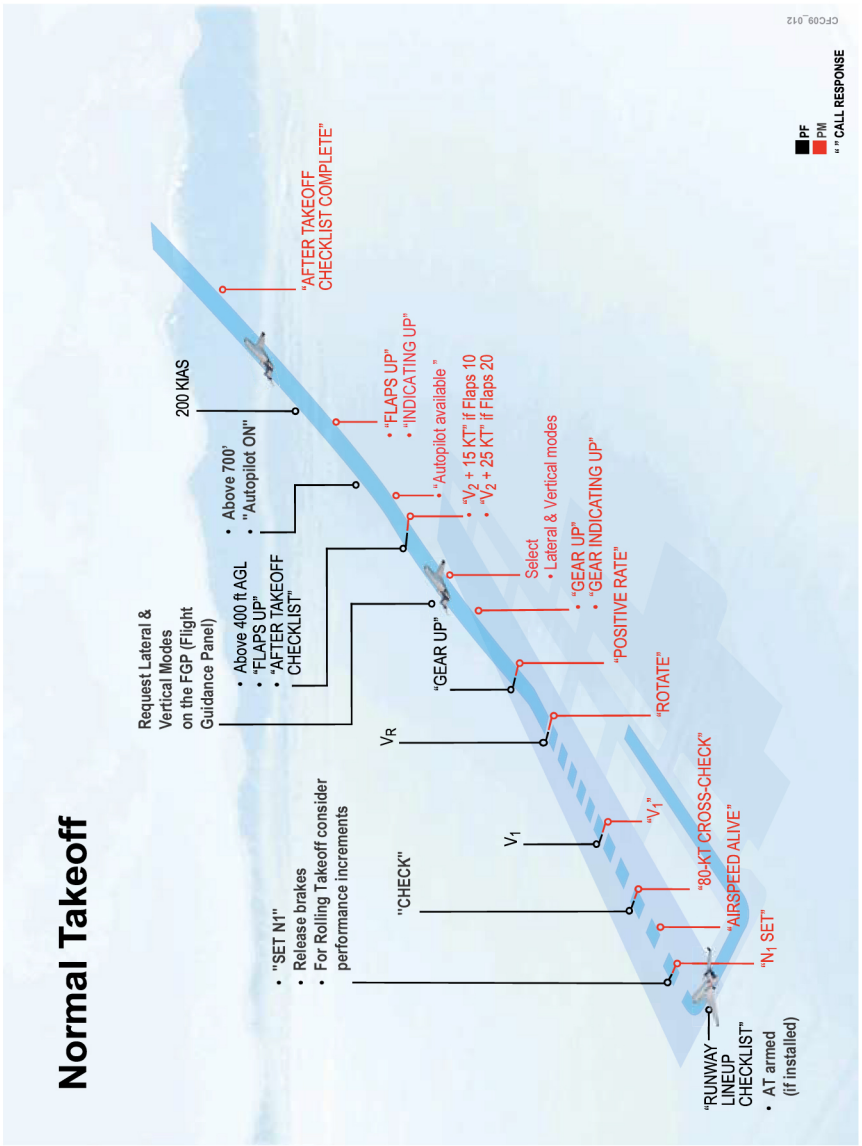
FLC is the recommended vertical mode for any normal climbs. During climbs in FLC mode at higher altitudes (high FL 300s and above), it is possible that air mass variations may contribute to slight pitch variations. These variations are more noticeable in the flight compartment than in the cabin. If pitch variations are deemed to be excessive, an alternative vertical mode (Vs) may be used with caution. Another exception may occur where low level level offs are required after take off or multiple step climbs as seen in the London area or Teterboro NY. Of course this technique must consider minimum departure climb gradients, noise abatement procedures and so forth.

"When safe, practical, and in accordance with the carrier's approved operating procedures, pilots should limit vertical speeds to 1,500 fpm or less when within 2,000 feet of assigned altitudes. This procedure will reduce the frequency of unnecessary RAs and be in conformance with the ICAO guidance contained in PANS−OPS. In summary, there are certain incompatibilities between TCAS and ATC procedures or airspace design that exist today that will not change with TCAS Version 7.1. To mitigate their effects, improvements in airspace and procedure development as well as flight training and procedures will be needed."

(Refer: Introduction to TCAS II Version 7.1, FAA HQ−111358, Feb28, 2011)

Additionally, when operationally viable, climbing in FLC mode may lead to high climb rates and may cause altitude capture deviations. To manage the energy in a climb for proper capture of an altitude, VS should be used to reduce the closure rate of capture. Typically, 2000 ft/min should be attained within 2000 ft of assigned capture altitude and 1000 ft/min attained within 1000 ft of capture altitude.

When balancing fuel from wing to wing, use a hands−on technique on the appropriate fuel panel switch as a reminder to prevent an imbalance from occurring to the opposite side. The Cruise checklist should be completed when the final cruising altitude is reached.



Normal Takeoff – Standing or Rolling
Figure 09–12–9

DESCENT PROCEDURES

STARS should be setup on the navigation equipment prior to beginning the letdown and then can be programmed into the FMS. This should be done above 10 000 ft. Below 10 000 ft, maintain a visual scan For normal planning purposes, the aircraft should be down to 10 000 ft, 30 miles from the airport. Additionally, the 3 to 1 rule of thumb works very well. For every 3 nm calculate 1000 feet and that should give an approximate 3 degree glide path. In actuality the numbers are 320'/nm but 3/1 rule of thumb is just easier to calculate and is a good estimate.

The VNAV function in the FMS: See VNAV section.

When the descent is initiated, the PF calls for the “Descent checklist”. The PM accomplishes the Descent checklist, as directed by the PF, and makes the appropriate altitude callouts. However, as with any other checklist, should the PF fail to call for the appropriate checklist, the PM should prompt the PF by calling, “Standing by for the.....checklist”.

To ensure adequate obstacle clearance, temperature corrections shall be applied to the published procedure altitudes, including minimum sector altitudes, DME arcs, FAF crossing, MDA/DA and missed approach altitudes when operating in a non−radar environment. When operating under ATC control, altitudes inside the FAF shall be corrected to ensure adequate obstacle clearance.

Corrections apply with an OAT below ISA (or as required by your Authority), and must be calculated before commencing the approach brief.

For precision approaches with a published glidepath angle, such as ILS or LPV, the DA (H) shall be temperature compensated when temperature compensation is required.

Baro minimums shall be set to compensated altitudes when temperature compensation is used.

FMS altitude compensations are done via the TEMP COMP feature located in the FMS INDEX menu. The MDA/DA must be manually set to the temperature compensated altitude. There is a requirement to advise ATC when flying with temperature compensated altitudes.

APPROACH PLANNING AND BRIEFING

Approach planning and briefing should be accomplished during cruise or initial descent, if possible, or at the latest when called for in the Approach checklist. Review of hazardous Terrain, Minimum Enroute Altitudes (MEAs), and Minimum Sector Altitudes (MSAs) should be accomplished. During the early part of the descent, the PM should obtain destination weather.

The PF normally assumes ATC communications during this period. After checking the weather, the destination weather should be briefed, along with the expected approach and any other significant information. At this point, the type of approach can be selected and programmed into the FMS.

The PF normally transfers aircraft control to the PM during the approach briefing. This does not necessarily mean to select the XFER button for such a short period of time. Complete and review performance data to include V_{REF}/V_{GA} speeds and landing distance. Once the briefing is complete, both pilots must ensure the AP/FD XFR arrow is pointing to the appropriate side. In addition to the above items, the following should also be addressed in the approach briefing:

- Approach to be flown and backup approach, if available
- AFCS modes to be used and expected FMA indications
- Special procedures during the approach, such as circling approach (Missed approach from different points), interception of a radial from an arc, VDP, etc.
- Altitudes of IAF, FAF, step–downs, sector altitudes, and obstacles
- BARO or RA Minimums set and select on temperature compensation requirements
- Missed approach point, procedures, and timing to MAP/VDP
- NAV aid setup desired to the side from which the approach is flown
- Anti–icing requirements
- Specific PM duties and callouts: standard 1000, 500, 100 above, minimums
- Procedure for transitioning to visual flight
- None essential information: Planned runway exit point and taxi routes/ gate – Request for, “Any questions?” directed to the PM
- Threats

Some like to use acronyms to do their briefings and Transport Canada has provided one but there are many in the aviation world: AMORTS

A – Approach

M – Minima

O – Overshoot

R – Radios

T – Timing

S – Speeds and Supplementary Remarks & Threats

For those who use Jepp Charts, the flow of reading the approach plate generally covers the requirements. Coupled to a review of the FMS approach briefing page on the MFD, you are simply left with Remarks and Threats analysis.

Either method is acceptable but the importance of a thorough and complete briefing can not be overemphazied especially during complex maneuvers such as circlings. Previous accident investigations have found the lack of proper briefings (especially Remarks and Threats) to be contributing factors to some accidents.

The remarks and threats can be related to possible windshear, icing conditions (accretion rates and effects), MELs. They could easily extend to pilots feeling fatigued after a long day and requiring extra meticulousness and diligence to details. All of these are merely some examples but the list could be much longer on what the PF determines relevant at the time.

ADDITIONALLY FOR VISUAL APPROACH

The PF should call the Transition and Approach checklists when descending out of FL 180 or when within 50 miles of the destination airport. The checklist is accomplished so as not to interfere with the visual scan for traffic.

Configuration changes during the approach should be accomplished using the same crew coordination techniques used after takeoff. The PF calls for a configuration change, and the PM acknowledges the change, selects the switch position, monitors, and reports when the configuration is in the selected position. The Approach checklist is completed and the airplane slowed to 200 kt or less and configured to flaps 10 when entering the terminal airspace.

Approximately seven miles from the runway, the PF should slow the airplane to Flaps10/160 kts when deemed appropriate (typically 5 NM from the FAF) and then call, “Flaps 20, gear down”. And slow to Flaps 20/140 kts. Both crew members should verify the gear down indications. Within two to three miles from the FAF for a straight−in two−engine approach, the PF calls for flaps 30/ Before Landing Checklist and slows the airplane to Flaps 30/ V_{REF}+10 then begins a descent and slows to V_{REF}. The PM also confirms the communication and navigation radios are set properly, checks the flight instruments, airspeed bugs, preselect altitude display, and displays on both PFDs. After confirmation that Flaps are set to 30, the PM subsequently reports “Before Landing checklist complete”. While in the terminal airspace, a vigilant visual scan should be maintained by both crew members. During the approach, the PM should also make airspeed and vertical speed calls as requested by the PF.

NORMAL APPROACH FOR LANDING

The last mile (at least) of the final approach should approximate an ILS glideslope with a rate of descent of approximately 600 to 800 fpm. A widely recognized rule for computing an acceptable sink rate is (GS x 10)/2 equals sink rate in feet per minute (i.e., add a zero to the end of the airspeed value and divide by 2):

$$\frac{130 \text{ kt} \times 10}{2} = 650$$

Maintaining V_{REF} on final approach is important to obtain the calculated landing distances. Each knot over the calculated V_{REF} can cause excessive runway usage and must be accounted for. Flying the final approach slower than V_{REF} causes extremely hard and/or premature touchdowns and is never recommended. V_{REF} must be incremented as per the AFM for gusty conditions but the required landing distance should be incremented as well to compensate for the higher approach speed.

Use of autothrottle is recommended to reduce crew workload during the approach and landing. Approaches in turbulent conditions may be treated similarly to gusty conditions. Adjust V_{REF} such that speed fluctuations occur from V_{REF} and up.

For example: if turbulence is causing the speed to dip 3 kts below V_{REF} then compensate by adding 3 kts to the approach speed to ensure adequate speed margin. It is highly likely that turbulence and gusts may be coincident.

Should the aircraft be in strong gusty conditions where the autothrottle begins chasing the speed (e.g.: continuously adjusting above and below the selected speed), desengage the AT system and manually set the power setting to avoid chasing or to stay above the required speed.

The previously mentioned practices are for an optimal approach to landing. If operating in a busy terminal airspace, the speeds and procedures should be adjusted accordingly. That being said, ATC may sometimes request higher approach speeds to accommodate their traffic volume but it is incumbent upon the pilot to refuse such requests late in the game when a stabilized approach profile is required especially past the FAF.

LANDING

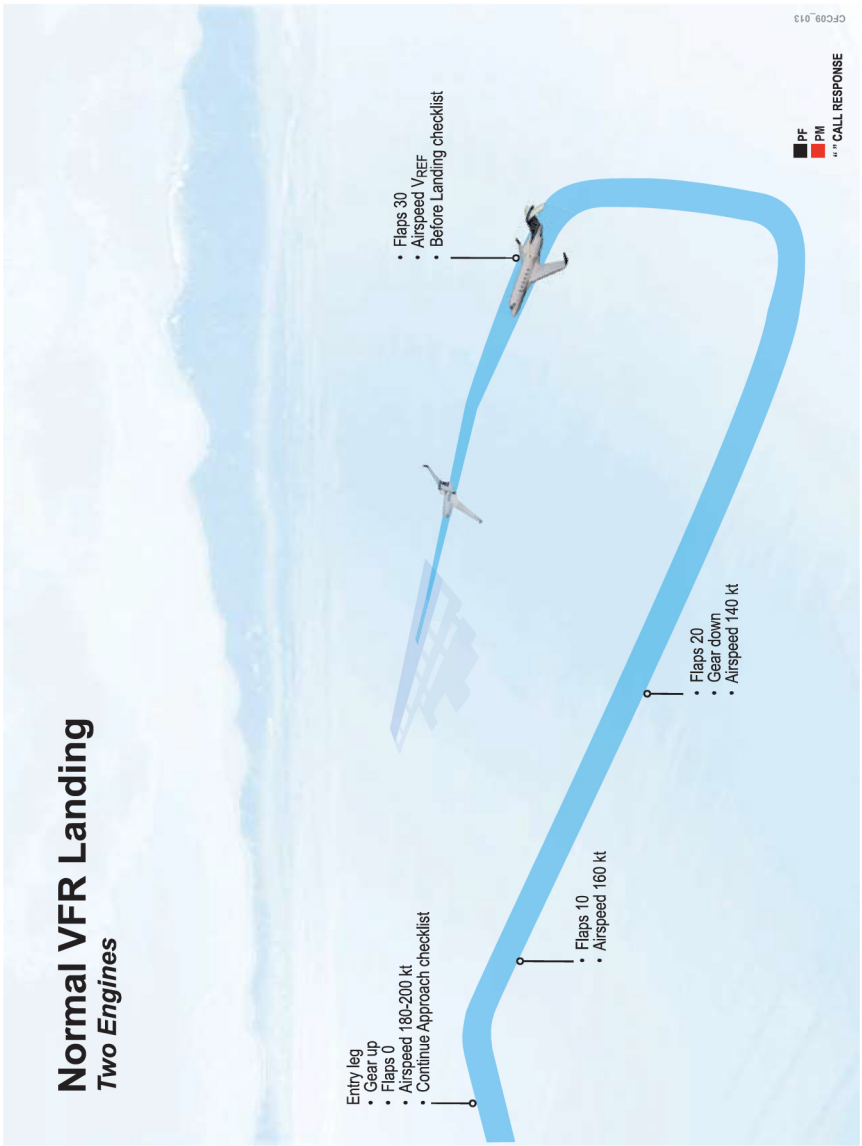
See Fig. 09–12–10. In a V_{REF} landing configuration, the aircraft is in a near landing attitude. V_{REF} should be achieved at 50 ft AAE for Landing performance numbers to be met. Refer to Normal Approach for Landing – Two Engines for Vref adjustment considerations. Constantly trim pitch to neutral and maintain V_{REF} until within a few feet of the runway. Then reduce thrust smoothly to idle and raise the nose very slightly from the attitude maintained on final approach. With aft mounted engines, the nose tends to rise as thrust is reduced and very little back pressure is required. Maintain attitude and allow the aircraft to fly onto the runway surface. During this slight flare, do not continue to raise the nose as the airspeed decreases (known as holding it off) or the aircraft will float and the calculated performance numbers will not be obtained.

If the aircraft is in a normal landing configuration and is equipped with autothrottle, the AT RETARD Mode will arm when reaching 200 Feet AGL (RETARD in white). Upon descending through 50 ft AAE, the RETARD mode will activate (RETARD in green) and both Thrust levers will be reduced to IDLE. This sequence is consistent with the AFM Performance considerations for landing distance assessment.

Short field approaches and landings should also be made at VREF as much as possible accounting for winds and increased distances as required. Do not attempt to grease it on or flare as much as normal landing. The wheel brakes are the primary means of stopping the aircraft and help achieve the calculated landing distance. Brakes efficiency is reduced if the tires are not firmly on the runway surface.

Upon touchdown, the spoilers will deploy automatically. The PM should verify and call, “Spoilers Deployed”. Lower the nosewheel smoothly to the runway, apply brakes as necessary and deploy the Thrust Reversers (TRs). To achieve maximum braking, do not pump the brakes. Use a smooth application, steadily increasing pressure on the brake pedals until the airplane decelerates at an appropriate rate. Use sufficient braking action early in the landing roll, while keeping passenger comfort in mind.

When the PM calls, “Two deployed”, smoothly pull the TR levers to the desired reverse thrust. If the TR levers remain in the maximum reverse thrust position, the engines begin to schedule down as the aircraft decelerates through 85 KIAS. During deceleration, when appropriate, smoothly and deliberately return the TR levers to the IDLE position in order to be at Reverse IDLE when reaching 40 KIAS. Use brakes and rudder as necessary for directional control. Move the thrust levers to the STOW position when desired. The PM should confirm the green and white REV EI indication has extinguished and the reversers are stowed. Refer to the AFM limitations for operation of the thrust reversers. After clearing the runway, proceed with normal after landing procedures.



Normal VFR Landing – Two Engines
Figure 09–12–10

CROSSWIND LANDING

Crosswind landings are similar to those in other aircraft. Adequate aircraft control in a crosswind velocity (measured at a 10 m height) of 28 kt during takeoff and 24 kt during landing was demonstrated during certification tests. Use the crab approach, then transition to a wing low, slipped drift correction prior to touchdown. Hold the upwind aileron into the wind through touchdown and track the centerline on the rollout. The spoilers will deploy automatically, reducing lift, and making the brakes more effective. In extreme crosswind conditions, an airspeed slightly higher than V_{REF} is warranted. As a general rule, an increase of one−half the gust factor up to a maximum of 10 kt over V_{REF} may be appropriate on final approach. Do not allow the aircraft to float with power off prior to touchdown. Fly the aircraft to touchdown with a mild flare. Upon touchdown, keep the aircraft on the surface. As the spoilers deploy automatically, follow through the landing rollout with roll control into the wind.

SLIPPERY SURFACES

Landing on a slippery surface requires careful consideration of many factors, such as type of runway surface, approach hazards, temperature, ice, water, snow, and other crosswind scenarios. Normally, thrust reverser operation helps achieve the computed stopping distance with a greater margin of safety. Wet and contaminated runway data is published in the AFM and AFM Supplements.

ONE ENGINE INOPERATIVE LANDING

With one engine inoperative, TRs may not be as effective on a contaminated runway as on a dry runway. Full single−engine reverse is fine on a dry runway, from a directional control standpoint. However, do not attempt high power single−engine reverse on slippery runways. Differential reversing on a slippery runway may not yield satisfactory performance. Be prepared to stow thrust reversers immediately if the airplane begins to slide sideways.The effects may be substantially different in crosswind scenarios depending if the acting thrust reverser is upwind or downwind.

HYDROPLANING

If there is a possibility of hydroplaning, use aerodynamic braking to slow below hydroplaning speed. Hydroplaning speed is approximately 112 kt for accelerating aircraft (nine times the square root of tire pressure) and 100 kt for a decelerating aircraft (eight times the square root of tire pressure). The main gear tire pressure should be serviced to 167−175 psi and the nosegear tire pressure should be serviced to 113−119 psi. If brakes are applied while the tires are hydroplaning, the hydroplaning can continue to a much lower speed.

GO–AROUND/MISSED APPROACH

A missed approach is accomplished when at DH/DA, the MDA when the time period is expired, the set distance is reached, sight of the intended landing runway is lost, or when in a position from which a normal visual landing approach cannot be accomplished. Other situations could also warrant the initiation of a missed approach.

If a go–around is necessary, either pilot can call for a go–around. The PF acknowledges by calling, “Going around”. At this point, selecting FD go–around mode (GA) through either TOGA switches (located on both thrust levers) repositions the command bars to 8° nose up, and disengages the autopilot and activates the GA thrust mode if autothrottle was engaged. While pitching up to the command bars, if autothrottle was not engaged set power to the takeoff detent “Set N_1“. The pitch attitude may have to be increased to more than 8° to attain V_{GA}.

The PF calls for flaps 10° when the speed trend is increasing and gear up (after a positive rate of climb is established). The PF climbs at V_{GA} and checks spoilers retracted. At relatively light gross weights, the aircraft quickly accelerates to V_{GA} with takeoff thrust. After climb and desired speed are established and when clear of all obstacles, reduce thrust as necessary to establish approximately 2000 fpm rate of climb. The trend vector is a helpful tool in accomplishing this.

The PM sets or confirms flaps 10°, calls out the direction of turn, if one is required, and the missed approach heading and altitude. The PM also notifies ATC of the missed approach, and retracts the flaps as per schedule. The Go–Around checklist is then accomplished.

The lateral mode is always GA at the start of the GA. If a ground–based approach (LOC, green needles) was being flown, the lateral command on the FD will be GA. To fly the missed approach sequenced in the FMS, this will require that the NAV source be selected to magenta and then engage NAV on the FGP. This is accomplished through the NAV SRC button located on the Display Control Panel (DCP). Once the magenta NAV source is selected (on–side FMS), NAV can be initiated to fly the published missed approach.

If an FMS–based approach (magenta needles) is flown, the lateral command bar is automatically selected to NAV and the only adjustment required in the missed approach would be for the vertical requirement (e.g.: FLC to GA speed).

NOTE: Prior to selecting a vertical navigation mode and engaging autothrottle, confirm MAA has been selected. If MDA remains, upon selection of FLC the AT will move the thrust levers to idle (THRUST MODE).

BALKED LANDING/LOW ENERGY GO–AROUND

According to Transport Canada AC 700–016, a Balked Landing is considered to be distinctly different from a “Low Energy Landing Regime”.

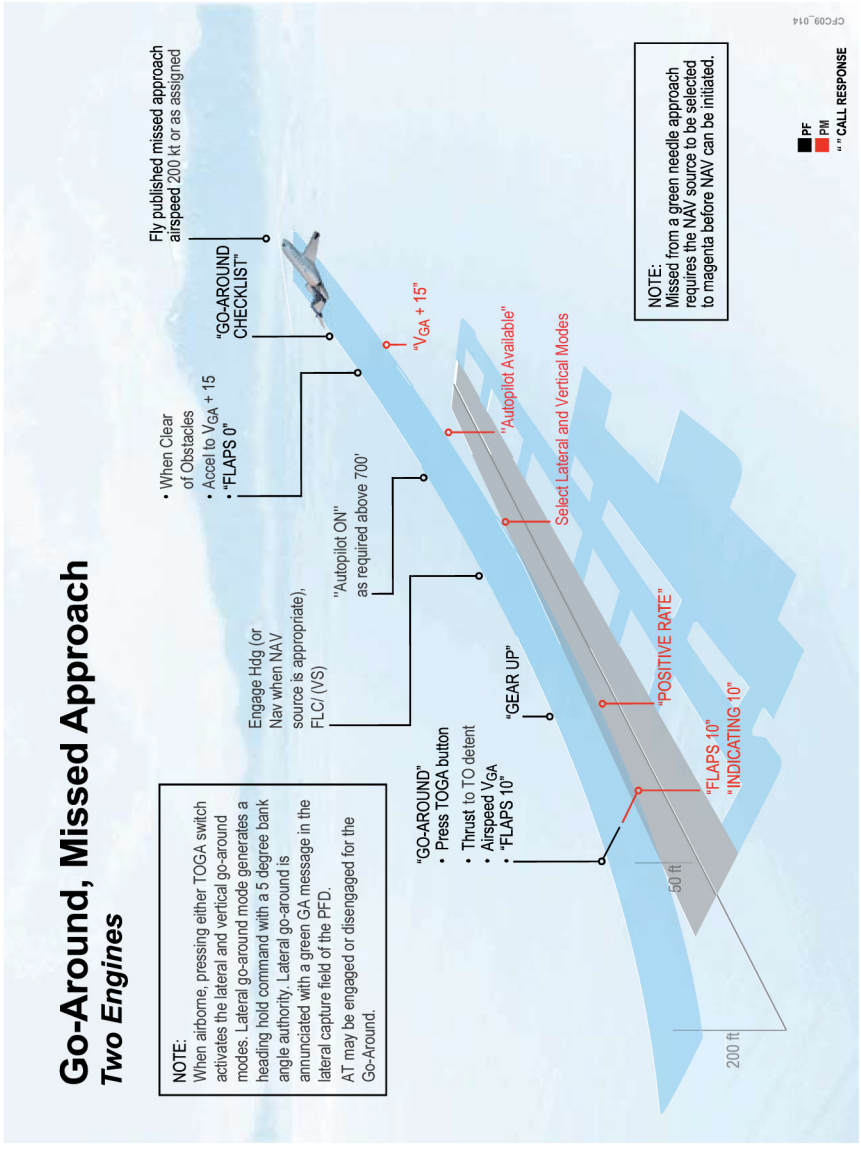
A **Low–Energy** landing regime is defined as a condition where a rejected or balked landing is commenced after a commitment to a landing has been made. In a low–energy landing regime, the aeroplane is in a descent at a height of 50 feet or less above the runway, in the landing configuration with thrust stabilized in the idle range, and airspeed decreasing (up to Vref–10). An attempt to conduct a rejected or balked landing from a low–energy landing regime may result in ground contact. Be prepared for a touchdown; airplane aligned with runway, bank angle minimized.

The engines are usually in, or close to, a low idle thrust setting and require several seconds to accelerate to MAX THRUST (TO). Missed approach obstacle clearance is often not considered from below the missed approach point. A mitigation strategy should be considered especially in obstacle rich environments. If there are any doubts regarding the probability of completing a safe landing, a Go–Around must be initiated.

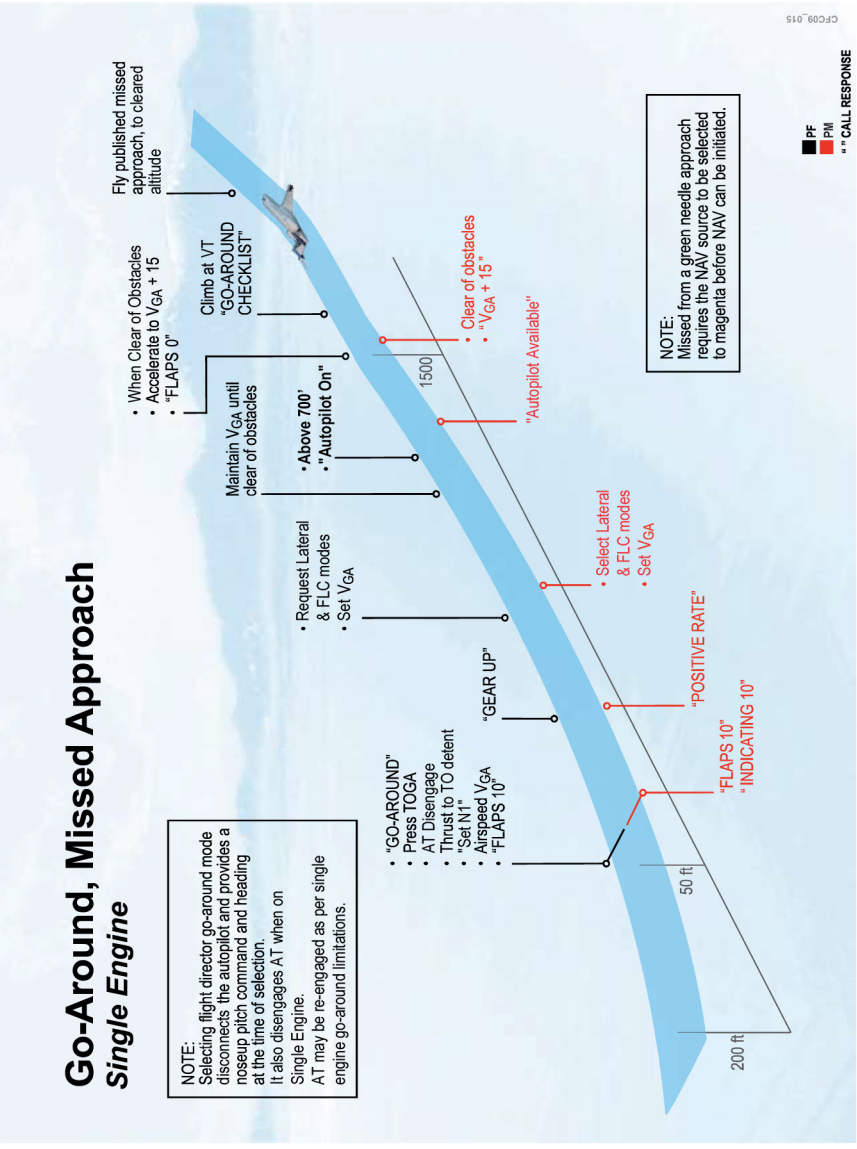
A low Energy Go–Around should be adressed as follows:

- Disengage AT
- Initiate a Go–around and simultaneously select TOGA and advance thrust levers to TO THRUST and confirm Spoilers retracted
- Maintain landing GEAR and FLAP configuration. (No configuration changes)
- Initially maintain or slightly increase pitch attitude (Similar to a flare)
- Be prepared for a touchdown; airplane aligned with runway, bank angle minimized

  NOTE: During touchdown, autothrottle may disengage. Ensure that thrust levers have advanced to TO THRUST.
- When safely established in the go–around with no further risk of touchdown (speed at or above VAC and airplane climbing), set FLAP 20, raise the gear
- Continue with the GA profile
- Re–engage automation as desired



Go–Around — Two Engines
Figure 09–12–11



Go–Around — Single Engine
Figure 09–12–12

TOUCH–AND–GO LANDINGS

Touch–and–go landings in conjunction with practicing non–normal procedures are not recommended. Full stop landings with a simulated inoperative engine are much safer. Simulated engine cuts during a touch–and–go landing can be hazardous in any aircraft. The PF may become confused concerning aborting or continuing the takeoff. These combinations are not recommended. Use of autothrottle during touch and go landings is prohibited.

All touch–and–go landings should be preplanned and cockpit procedures should be established Fig. 09–12–13. The PIC thoroughly briefs all aspects of the touch–and–go landing. Both crewmembers ensure the runway length is sufficient for touch–and–go maneuvers. Compute V_1, V_R, V_2, and required landing distance. These numbers do not vary much with succeeding touch–and–go landings. V_1 is difficult to positively call on every touch–and–go landing. Generally, V_R is reached at approximately the same time (or very shortly after) takeoff thrust is established.

Before commencing first Touch–and–Go ensure rudder trim is in the green band even if barely. This will avoid unnecessary EICAS messages during the maneuver on the ground.

After touchdown:

PF	PM
Lower the nosewheel to the surface	
Keep the airplane heading straight down the runway	Set wing flaps for takeoff while calling “Resetting Flaps” (flaps 20 is recommended for touch and go landings)
Keep the thrust levers just above idle to avoid spoiler deployment and do not rush the touch and go landing	Check elevator trim is within the green takeoff band Check rudder trim is within the green takeoff band
	Check EICAS (silent check)
	Call:"Go"
When the PM calls “Go”, advance the thrust levers smartly and deliberately to the T/O detent	
“Set N_1”	
	Check thrust levers in the T/O detent
	Call:"N_1 Set"
	Call:"V_1"
	Call:"Rotate" or "V_R"

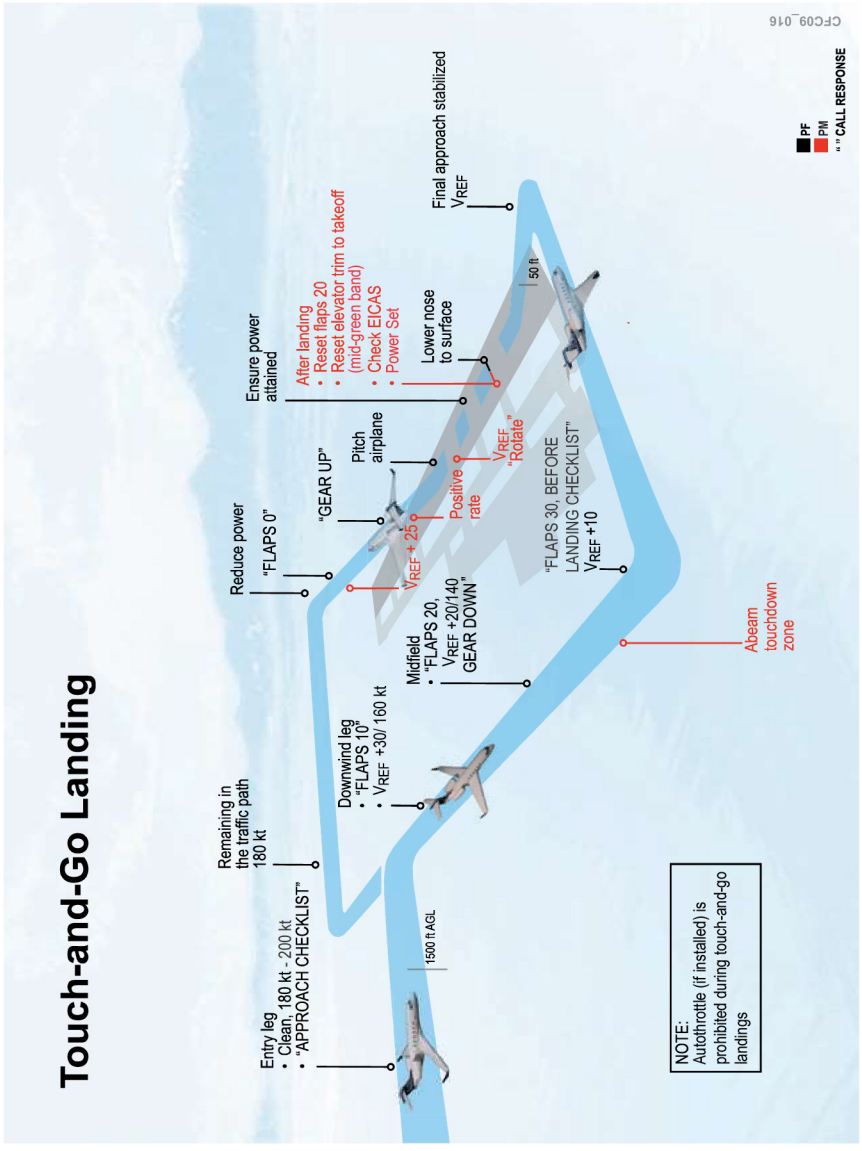
Follow normal Flap 20 Takeoff profile. It is acceptable to leave the flaps set at 10 for transition to downwind. Reduce thrust to avoid an extremely nose−high attitude and high rate of climb. Use the trend vector as a helpful tool. Enter the downwind leg at approximately 160 KIAS or at the recommended minimum maneuvering speed per configuration. Complete the After Takeoff and Approach, checklists followed by the normal approach profile.

SECTION 2
NORMAL PROCEDURES & TECHNIQUES

Be cognizant that these procedures are for touch and gos, not stop and goes. Any brake usage for stop and goes requires a thorough understanding and review of brake cooling AFM charts. Stop and goes without due diligence for brake cooling may result in adverse effects on brakes, tires, wheel assemblies and or structure.

NOTE:

1. A suggested minimum runway length is usually 10,000' at sea level.
2. You always want to use your nearest flap setting; if you use flaps 10, you use up a tremendous amount of runway simply waiting for the flaps to retract and the airplane is very ready to fly much earlier. Make sure that the rudder trim is in the T/O band; otherwise you will get a config warning. As much as the rudder trim is moved on this airplane, it is common to get a rudder trim config warning on a Touch & Go.
3. You should also be aware of the elevator trim being in the green band may not necessarily be the same as when setting a specific number per the Center of Gravity. The Pilot Flying should make judicious use of the control column when rotating for a touch and go.



Touch–and–Go Landing
Figure 09–12–13

AFTER LANDING AND CLEARING RUNWAY

After clearing the runway, the After Landing/Clearing Runway checklist is initiated. The engines should idle for at least one minute prior to shutdown. Upon shutting down an engine, the master caution lights flash, a single chime sounds and new CAS messages appear. Confirm all indications are appropriate for the configuration before canceling the flashing master caution lights. Monitor hydraulic pressure when taxiing to the ramp area.

Before shutting down an engine while taxiing to the parking area, some factors need to be considered. The runway and taxiway may be clear of ice, snow or slush, but the parking area might still be contaminated. Do not shutdown an engine until the condition of the parking area is known. With one engine operating on a slippery surface, the aircraft may turn in one direction easily and be difficult to taxi straight. If this situation is encountered, consider shutting down completely and towing the aircraft or restarting the other engine and resuming taxiing.

Chock the main gear when the aircraft is parked. If strong winds are expected, all wheels should be chocked. Install the gust lock, even for short periods. High winds may suddenly develop or jetblast/helicopter rotorwash may damage the controls. Before securing the aircraft, ensure all hot bus items are off, particularly the emergency, baggage, and entrance lights. Set all switches to off, remove all power from the airplane, and close the access doors.

SECTION 3
INSTRUMENT PROCEDURES

This section focuses on operations with the Challenger 350 in instrument conditions. More specifically, precision, non−precision, circling approach procedures and techniques are reviewed. Procedure turns, missed approach, and holding procedures are also discussed.

INSTRUMENT APPROACH CONSIDERATIONS

Several factors must be considered prior to commencing an approach. In addition to basic knowledge required for a flight (departure and destination weather, airport information, runway conditions, NOTAMS, etc.), the crew must also have a thorough understanding of the aircraft. More specifically, the crew should know what resources are available in the aircraft avionics package and how to effectively use them. The enroute and initial descent phases of flight are where flight crews should prepare, brief, and make decisions on what instrument approach procedures to execute. Study the respective approaches and procedures carefully.

Published approaches for Category C aircraft have a height above touchdown (HAT) in excess of 600 ft requiring only one mile of visibility. For example, in moderate or heavy rain there would be much less than a mile before the runway is seen if the aircraft is much higher than it should be (approximately 300 ft) to make a normal landing with normal maneuvers. Additionally, consider a normal straight−in approach with 500 ft HAT and 1 mi visibility required. If the approach speed is 115 KIAS the aircraft is moving along at 1.9 NM per minute. Optimally, the runway comes into sight 1 NM out, requiring an average descent rate of 1000 fpm to make the touchdown point. Any delay in establishing visual contact and/or starting a descent worsens the problem. If the aircraft is not in a position to make a normal descent to landing, execute a missed approach or visual pattern, if possible. Consider going to the filed alternate.

The visibility reporting system can sometimes work against the crew. If the visibility is reported as 1 mile, it is 1 statute mile which equates to 0.87 NM. This is enough of a difference to increase the descent required for the approach to more than 1100 fpm. If the ceiling and visibility is less than published minimums, the approach should not be attempted.

In different conditions, it may be advantageous to plan a circling approach. If so, ensure published circling approach minimums are being reported. Refer to the Airman's Information Manual (AIM) for visibility and radius distance minimums for Category C aircraft. If the airplane is to remain within this radius, precise airspeed and bank control are essential. Lower airspeeds result in a decreased turn radius. It is also easy to lose sight of the airport if circling approach speed is too high or bank is too shallow. Circling approaches are discussed later in this section.

After evaluating all the weather factors, flight crews may find the destination approach situation to be marginal. If so, seriously consider proceeding to a suitable alternate before descending out of the high altitude structure.

SECTION 3
INSTRUMENT PROCEDURES

When descending out of 18,000 ft or when within 50 NM of the terminal area for landing, call for and complete the Descent and Approach checklists. Compute V_{REF} and V_{GA} and set the airspeed bug to help anticipate approach speeds. Slow the aircraft early to avoid requiring rapid configuration changes and increasing the risk of falling behind the aircraft.

For perspective, if 10 NM is flown at 250 kt ground speed, it takes 2 minutes and 24 seconds to cover the distance. If 10 NM is flown at 200 kt ground speed, it takes 3 minutes to cover. If the ground speed is 150 kt, it takes 4 minutes.

Note how many miles are allowed for each published procedure turn. Two hundred knots keep the aircraft within 10 NM provided the wind is calm, the timing outbound is no more than 60 seconds, and a 30° bank is promptly initiated for 180° turns. In this case, the aircraft flies approximately 8 NM at the furthermost point in the procedure turn.

At major airports with busy terminal environments with a lot of airline traffic, flying a final approach at V_{REF} (unless minimum conditions exist or instructed to do so by ATC) would be unrealistic. The aircraft offers flexibility to change speeds and configurations easily. However, this manual makes recommendations on how to fly the aircraft in optimal speeds and configurations and/or instrument approach procedures for the lowest published instrument conditions combined with a short runway.

Fly the aircraft at minimum maneuvering speeds for each approach and landing configuration. Flying the recommended minimum maneuvering speeds allows more time to plan ahead. Course intercepts are smoother and cleaner. Crews also have more time on final approach, allowing slower descents and enabling the aircraft to remain within the confines of circling approach areas. Recommended maneuvering speeds are shown in Table 09–13–1:

FLAP SETTING	AIRSPEED
Flaps 0	V_{REF} + 40 kt (180 kt)
Flaps 10	V_{REF} + 30 kt (160 kt)
Flaps 20	V_{REF} + 20 kt (140 kt)
Flaps 30	V_{REF} + 10 kt

Recommended Maneuvering Speed
Table 09–13–1

NOTE: Maneuvering speeds based on max gross weight landing. V_{REF} varies with weight.

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INSTRUMENT PROCEDURES

ADDITIONAL INSTRUMENT SYSTEMS

Additional instrument systems, such as a radio altimeter and an altitude alerter function, are navigational safety devices installed on the aircraft. These systems contribute to a safe instrument approach if used properly. However, becoming so involved in setting and resetting these devices compromises safety. The following is a brief review of some of these aids:

- **Min Alert** – In addition to setting BARO and RA minimums, the MIN ALERT should be set as appropriate. This is usually BARO.
- **Altitude Select Knob**– Before takeoff, the initial leveloff altitude should be set. When climbing or descending, the altitude preselect should be set to the next leveloff altitude. Once established on the final approach fix (FAF) inbound, the missed approach altitude should be set in the altitude preselect, unless there are stepdown altitudes inside the FAF. Generally, since the PM accomplishes the radio communications, the PM also has responsibility for resetting the ASEL knob. Whether the ASEL knob is a function of the PF or the PM is up to the crew, as long as it is clear who is responsible so that an altitude assignment is not missed.
- **Navigation Radios**– Navigation and communication radios should be assigned to one crewmember. Ensure there is an understanding as to who changes and identifies frequencies, as well as who sets the approach headings. Neither pilot should change a navigation or communication frequency or bearing without informing the other pilot of their intentions.

HOLDING

Whether holding is accomplished enroute for ATC delays or as part of an approach procedure, the techniques are similar. If holding takes place in the enroute phase of the flight, holding speeds should be in compliance with the AIM (Table 09–13–2) below and the Computerized In–Flight Performance Software (CIFP) speeds.

When holding as part of an instrument approach, hold at speeds published in the pilots manual. In icing conditions, the crew should consider higher holding speeds and higher power settings. Slow the aircraft to holding speed within three minutes prior to reaching the holding fix. Do not hold in icing conditions with the flaps down. The initial outbound leg should be flown for 1 minute, or 1.5 minutes, whichever is appropriate for altitude. Timing of subsequent outbound legs should be adjusted as necessary to achieve proper inbound leg time (Table 09–13–3). Regulator authorities may be different on holding procedures such as EASA and FAA. Always adhere to your airspace's governing authorities regulations.

If the holding procedure is used as a procedure turn for an instrument approach, start slowing the aircraft 3 minutes prior to the IAF to arrive over the IAF at V_{REF} +30 and flaps 10°. When crossing the IAF, initiate the holding procedure, start timing when abeam the IAF, start descent to procedure turn altitude (if cleared), and maintain V_{REF} +30. At 60 seconds, turn back toward the inbound course and intercept the course inbound. When on course inbound, follow the same procedures as stated in the applicable precision or non–precision approach procedures.

CIVIL TURBOJET	MAXIMUM AIRSPEED
6,000 ft or below	200 KIAS
6,001 ft – 14,000 ft	230 KIAS
Above 14,000 ft	265 KIAS

Maximum Holding Airspeeds
Table 09–13–2

AT OR BELOW 14,000 FT MSL	ABOVE 14,000 FT MSL
1 minute	1.5 minutes

Holding – Inbound Leg Timing
Table 09–13–3

SECTION 3
INSTRUMENT PROCEDURES

NADP PROCEDURES

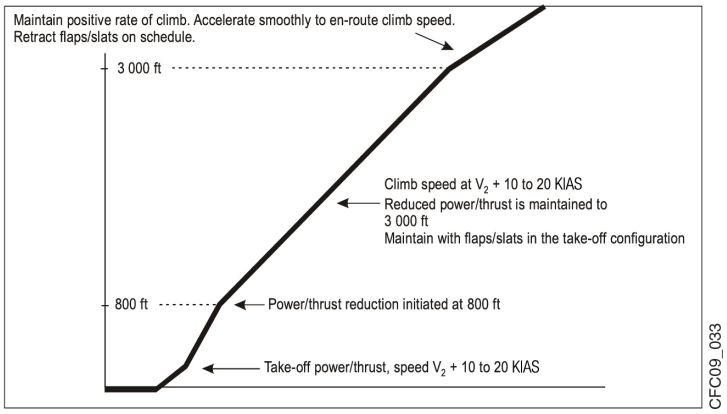
Noise abatement departure procedures are developed to reduce the noise signature of an aircraft in certain noise sensitive areas. Of the two Standard NADP 1 and 2 procedures, both require Takeoff thrust be maintained until a minimum of 800 AAE.

On Autothrottle equipped aircraft, any change to the FD mode selection after takeoff will change the active vertical FD out of TO, ie.: HDG, NAV or FLC. If the active FD vertical mode is not maintained in TO, when the autothrottle exits HOLD mode passing 400 AAE the Autothrottle will reduce the thrust to below Takeoff Rating. Both NADP profiles assume TO thrust until a minimum of 800 AAE.

For this reason, Autothrottle equipped aircraft should conduct a NON–Autothrottle takeoff when a noise abatement procedure is being flown and delay Autothrottle engagement until stabilized above 800 AAE and/ or takeoff power is no longer required.

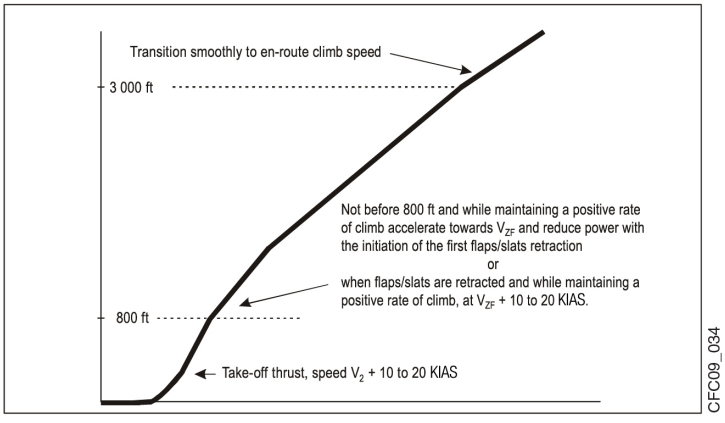
- Refer to Airplane Flight Manual, Chapter 6 – Certificated Noise Levels for Aircraft configuration guidance to achieve noise level compliance guidance.
- Additional guidance can be found in the Airplane Flight Manual, Chapter 8 – Restrictions on Performance Penalty (Takeoff and Landing) regarding noise abatement.

NOTE: The following tables are extracted from Transport Canada AIM guidance for NADP1 and 2 and are used as examples only.



Noise abatement take-off climb — Example of a procedure alleviating noise close to the aerodrome (NADP 1)

Figure 09–13–1



Noise abatement take-off climb — Example of a procedure alleviating noise distant from the aerodrome (NADP 2)

Figure 09–13–2

SECTION 3
INSTRUMENT PROCEDURES

COLD WEATHER TEMPERATURE CORRECTIONS

Temperature has an effect on altimeter accuracy as it relates to true altitude. When the air is warmer than standard, the airplane is higher than the altimeter indicates. Conversely, when the air is colder than standard, the airplane is lower than indicated. When flying into a colder air mass while maintaining a constant indicated altitude, true altitude is decreasing. The colder the temperature, the greater the difference between true altitude and indicated altitude. In extreme cold conditions, especially in mountainous areas, pilots should exercise caution in flight planning both in regard to route and altitude to ensure adequate enroute and terminal area clearance.

The table below, derived from ICAO formulas, indicates how much error can exist when the temperature is extremely cold. To use the table, find the reported temperature in the left column, and then read across the top row to locate the height above the airport/reporting station (subtract the airport/ reporting station elevation from the intended flight altitude). The intersection of the column and row indicates how much lower the airplane may actually be as a result of the possible cold temperature induced error:

ICAO COLD TEMPERATURE ERROR TABLE

°C	HEIGHT ABOVE AIRPORT IN FEET													
	200	300	400	500	600	700	800	900	1000	1500	2000	3000	4000	5000
+10	10	10	10	10	20	20	20	20	20	30	40	60	80	90
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
–10	20	30	40	50	60	70	90	90	100	150	200	290	390	490
–20	30	50	60	70	90	100	130	130	140	210	260	420	570	710
–30	40	60	80	100	120	140	170	170	190	280	380	570	760	950
–40	50	80	100	120	150	170	220	220	240	360	480	720	970	1210
–50	60	90	120	150	180	210	270	270	300	450	590	890	1190	1500

BFC01_008

Example

Temperature –30 °C (–22 °F), and the airplane altitude is 3,000 ft above the airport elevation during a procedure turn. The chart shows that the reported current altimeter setting may place the airplane as much as 570 ft below the altitude indicated on the altimeter. When operating in a non–controlled environment, the procedure turn should be flown at 3,600 ft to ensure obstacle clearance. ATC radar vectoring altitudes are normally compensated for temperature.

The altitude correction should be applied to the other published altitudes, specifically minimum altitude (DA / MDA). The FMS INDEX Menu has a TEMP COMP feature. It is basically a calculator that can be used to find the corrected barometric altitude.

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INSTRUMENT PROCEDURES

STABILIZED APPROACH PHILOSOPHY

Unstabilized approaches are a key contributor to CFIT events and RUNWAY OVERRUNS. This generic information is as per FAA and Flight Safety Foundation guidance. Please refer to your respective authorities for differences and additional guidance. Efforts should be made to use a continuous descent profile, more specifically during Non−Precision approaches (NPAs). Level−offs due to ATC, or procedural constraints may occur but they should not affect the technique significantly.

Approach slopes are normally intercepted at altitudes greater than 1,500 ft Above Airport Elevation (AAE) and guidelines are given for a standard 3° flight path angle.

The importance of a stabilized approach cannot be overemphasized. It ensures a safe approach and landing and reduces crew workload. Operators are encouraged to promote the use of the stabilized approach concepts to help mitigate CFIT.

The stabilized approach concept is characterized by maintaining a stable:

- Approach speed
- Vertical flight path
- Configuration to the landing touchdown point
- Descent rate: Typically characterized by a maximum of 1000'/min for a 3° glide slope.

Depart the FAF configured for landing and on the proper approach speed, power setting and flightpath before descending below the minimum stabilized approach height.

- 1,000 ft AAE (**IMC**), call “Stable”
- 500 ft AAE (**VMC**), call “Stable”
- Descent rate no greater than 1000 fpm unless specifically briefed.

STABILIZED CONSTANT DESCENT ANGLE (SCDA)// CONTINUOUS DESCENT FINAL APPROACH (CDFA)

SCDA/CDFA are techniques consistent with the stabilized approach concept for flying the final approach segment of a non−precision approach procedure (NPA) as a continuous descent profile, in opposition to the traditional Step down type approach. This is accomplished without level−off from an altitude at or above the final approach fix altitude to a point approximately 50 ft. above the landing runway threshold or the point when the flare maneuver should begin.

SCDA/CDFA approaches consider the minimum descent altitude (MDA) as a decision altitude (DA) and, if the runway is not in sight when the airplane reaches the MDA, a go−around must be initiated.

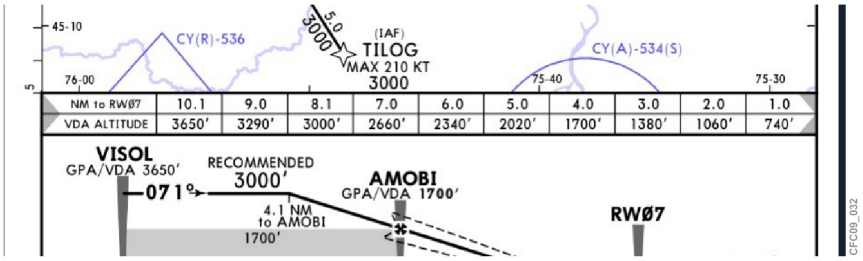
SECTION 3
INSTRUMENT PROCEDURES

Pilots must not descend below the MDA contrary to a DA when executing a missed approach from an SCDA/CDFA profile. This is why most operators require that a margin be added to the MDA to preclude MDA excursion during the Go–Around procedure. This revised MDA altitude (MDA + altitude additive/ margin) is called a Derived Decision Altitude (DDA). For the Challenger 350 an altitude additive of 50 ft is recommended for normal approaches.

Regulating authorities may also require Flight Crew to follow an accredited SCDA/CDFA training program with established operator SOPs.

Compliance with these instructions does not constitute operational approval for the use of SCDA/CDFA procedures. Refer to your state authority publications for any further guidance. Also be advised that certain authorities have given operators through OpSpec/MSpec/LOA's the privilege to treat an MDA as a DA, hence no additive is required. Again, consult your regulator for more information on that topic. A good reference document on the topic is FAA AC 120–108.

EASA and TC have developed their approach plates to support these kinds of approaches. They provide scalable guidance of distance versus altitude tables at every NM (Nautical Mile). Although not necessary to pursue this type of approach, it is a nice addition and facilitates the application that can be manually calculate with the 3 to 1 rule or 320 ft per NM for a 3 degree approach. Good communication via SOP call outs developed for this purpose will simplify greatly the resultant procedure. A key call should be done at every NM by the PM stating any deviations from calculated profile. Simply saying the PF is a little high/ low is insufficient. A specific number like 7 NM, 150 ft high, will provide the quantitative information necessary to the PF for an appropriate correction while maintaining a stabilized approach. Additionally, once acknowledged by the PF, another technique is for the PM to call the next distance and altitude constraint.



CDFA/SCDA
Figure 09–13–3

SECTION 3
INSTRUMENT PROCEDURES

CLIMB/DESCENT TABLE 10042

INSTRUMENT TAKEOFF OR APPROACH PROCEDURE CHARTS
RATE OF CLIMB/DESCENT TABLE
(ft. per min)

A rate of climb/descent table is provided for use in planning and executing climbs or descents under known or approximate ground speed conditions. It will be especially useful for approaches when the localizer only is used for course guidance. A best speed, power, altitude combination can be programmed which will result in a stable glide rate and altitude favorable for executing a landing if minimums exist upon breakout. Care should always be exercised so that minimum descent altitude and missed approach point are not exceeded.

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CLIMB/ DESCENT ANGLE (degrees and tenths)		ft/NM	GROUND SPEED (knots)										
			60	90	120	150	180	210	240	270	300	330	360
	2.0	210	210	320	425	530	635	743	850	955	1060	1165	1275
	2.5	265	265	400	530	665	795	930	1060	1195	1325	1460	1590
VERTICAL PATH ANGLE	2.7	287	287	430	574	717	860	1003	1147	1290	1433	1576	1720
	2.8	297	297	446	595	743	892	1041	1189	1338	1486	1635	1783
	2.9	308	308	462	616	770	924	1078	1232	1386	1539	1693	1847
	3.0	318	318	478	637	797	956	1115	1274	1433	1593	1752	1911
	3.1	329	329	494	659	823	988	1152	1317	1481	1646	1810	1975
	3.2	340	340	510	680	850	1020	1189	1359	1529	1699	1869	2039
	3.3	350	350	526	701	876	1052	1227	1402	1577	1752	1927	2103
	3.4	361	361	542	722	903	1083	1264	1444	1625	1805	1986	2166
	3.5	370	370	555	745	930	1115	1300	1485	1670	1860	2045	2230
	4.0	425	425	640	850	1065	1275	1490	1700	1915	2125	2340	2550
	4.5	480	480	715	955	1195	1435	1675	1915	2150	2390	2630	2870
	5.0	530	530	795	1065	1330	1595	1860	2125	2390	2660	2925	3190
	5.5	585	585	880	1170	1465	1755	2050	2340	2635	2925	3220	3510
	6.0	640	640	960	1275	1595	1915	2235	2555	2875	3195	3510	3830
	6.5	690	690	1040	1385	1730	2075	2425	2770	3115	3460	3805	4155
	7.0	745	745	1120	1490	1865	2240	2610	2985	3355	3730	4105	4475
	7.5	800	800	1200	1600	2000	2400	2800	3200	3600	4000	4400	4800
	8.0	855	855	1280	1710	2135	2560	2990	3415	3845	4270	4695	5125
	8.5	910	910	1360	1815	2270	2725	3180	3630	4085	4540	4995	5450
	9.0	960	960	1445	1925	2405	2885	3370	3850	4330	4810	5295	5775
	9.5	1015	1015	1525	2035	2540	3050	3560	4065	4575	5085	5590	6100
	10.0	1070	1070	1605	2145	2680	3215	3750	4285	4820	5355	5890	6430

CFC09_031

CLIMB/DESCENT TABLE 10042

NOTE: For circling approaches, if the aircraft is not stabilized at the end of the circling maneuver for a stabilized descent to the landing runway or if the aircraft overshoots the landing runway, initiate a go–around and do not try to salvage the approach by excessive bank angle or excessive descent rates.

SECTION 3
INSTRUMENT PROCEDURES

VERTICAL NAVIGATION (VNAV): DESCENT AND APPROACH PROCEDURES

The use of the vertical navigation (VNAV) functionality of the Challenger 350 AFCS and FMS is an excellent tool for reducing pilot workload and increasing passenger comfort. Provided below are procedures that permit the safe and efficient operation of the Challenger 350 in VNAV from top of descent until touchdown and/or missed approach. For expanded information See Collins Manual (Challenger 300–350 Proline21 Advanced FMS, Chapter 19, Principals of VNAV).

ENROUTE VNAV CLIMB

The VNAV function could also be used for any climb profiles. This will assist the crew to comply with altitude and speed constraints at waypoints, and speed limits at altitudes. It will additionally help in following the vertical flight profile entered in the active flight plan. The VNAV climb target airspeed can be set using either the VNAV SETUP in the FMS (default value) or specific VNAV airspeeds from the LEGS page. Before initiating a VNAV climb, the crew must confirm that waypoints are programmed with VNAV altitudes (and airspeeds if non–default airspeeds are desired), altitude preselector is set to the ATC cleared altitude, which should be above the current altitude and VNAV is selected on the FGP.

If a higher altitude is selected prior initiating the climb, the aircraft remains level until the Bottom Of Climb (BOC). At the BOC, the aircraft captures the vertical track (VFLC displayed as the active vertical mode) and the autothrottle (if installed) activates the THRUST Mode to initiate the climb.

NOTE: The use of VFLC (FLC with VNAV) is prohibited during climb when the airspeed reference is displayed as Mach.

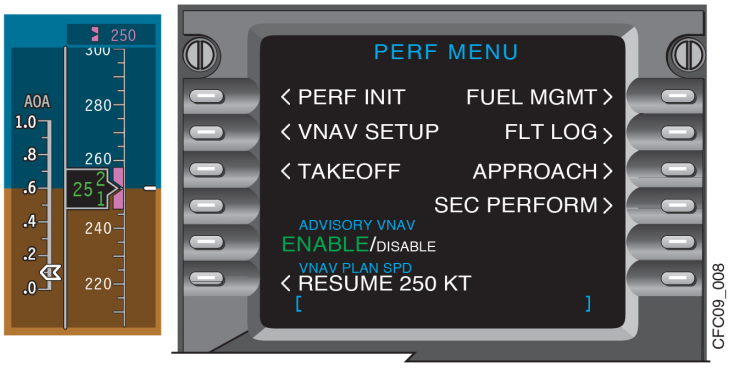


AT Modes – THRUST/SPD Mode
Figure 09–13–4

SECTION 3
INSTRUMENT PROCEDURES

VFLC VNAV CLIMB AND DESCENTS

For VFLC VNAV climb and descents profiles with speed constraints (where the speed bug is managed by the FMS), the crew must set and confirm the VNAV target speeds on either the FMS LEGS page or under the FMS – PERF MENU/VNAV SETUP pages. The crew can activate the VNAV planned speed through the FMS –PERF MENU – <RESUME xxx KT function>.



VNAV Climb Speed
Figure 09–13–5

NOTE: Under VNAV PLAN SPD, the speed bug and its analog value are controlled by the FMS and will be displayed in magenta color (FMS speeds) in lieu of cyan (SPEED bug input).

NOTE: The crew must also be aware that upon VFLC activation from VALT mode, the speed bug will switch from VNAV target speed (magenta) to the current aircraft speed (cyan). The crew should reactivate the VNAV planned speed through the FMS –PERF MENU – RESUME xxx KT function or manually reset the speed bug to the desired value (non–VNAV).

ENROUTE VNAV DESCENT

The VNAV descent airspeeds and angle can be set using VNAV SETUP in the FMS. The Challenger 350 has a high wing sweep and is considered to be of clean design. If descent angles of greater than 3° are required in the clean configuration, the use of flight spoilers may be required to maintain the required vertical path and/or airspeed.

In order to fly the descent profile, the STAR, TRANSITION, APPROACH, and RWY should have been programmed correctly and all crossing speeds and altitude limits verified. Before top of descent (TOD), VNAV is selected on the FGP. When cleared for descent, the PM sets the ATC cleared altitude on the altitude preselector.

If a lower altitude is selected prior to the TOD, the aircraft remains level until the TOD. At the TOD the aircraft captures the path (VPATH as the active vertical mode) and the autothrottle (if installed) retards/modulates (SPD as the active AT mode) to maintain the airspeed. If the lower altitude was selected after passing the TOD, the crew must initiate the descent using FLC, VS, or PTCH modes, and may intercept the descent path downrange of the TOD.

The FMS VERTICAL DIRECT function is useful when a low descent angle or a short descent is required. The FMS descent angle limits are 1° to 6°, however, if an angle greater than 3° is directed, crews will probably require flight spoilers for airspeed control. Another option is to use the VFLC, VVS or VPITCH modes to fly the aircraft back to the path, as mentioned previously, using flight spoilers if required.

VNAV APPROACH – GENERAL

VNAV is a viable option in numerous approach situations. It can add to situational awareness and allow a constant descent angle to landing. VNAV is available anytime FMS is the selected NAV source, although the crew may not always elect to use it. Once the approach has been selected in the FMS, a thorough approach chart study is the key to a successful VNAV approach. You must confirm that all the information contained in the FMS database is accurate — this includes waypoints, altitudes and descent path angles.

- The approach annunciation (RNP APPR/RNP AR APPR/LPV APPR on the PFD) must be displayed prior to the FAF indicating that the CDI sensitivity requirements have been met. Normally between IAF and FAF depending on approach type.
- The temperature restrictions in the notes section of the approach chart must be observed. Temperatures that are well below standard cause a reduction in true altitude, therefore, at very low temperatures this may infringe the obstacle clearance criteria. Crew should use the TEMP COMP function of the FMS to carry on approaches in cold weather (usually below 0°C).
- The altitudes and vertical path must not be changed from that contained within the FMS database. The descent path stored in the FMS ensures all altitude restrictions from the FAF to the missed approach point are met and must not be modified manually.
- An RNAV(GNSS) approach is classified as a non–precision approach therefore the autopilot must be disengaged by 200 ft AGL.
- An LPV approach is classified as a precision approach (FAA) therefore the autopilot must be disengaged by 80 ft AGL (If GP<3.5°).

SECTION 3
INSTRUMENT PROCEDURES

RWY VERSUS V–MDA APPROACHES

The FMS will code non–localizer approaches one of two ways. RWY (runway) or V–MDA (vertical navigation with no runway associated). The reason for this is some approaches do not allow for a constant descent angle to the runway or that there is no runway associated with the approach (circling only) (i.e. VOR–A, GPS–D).

RWY APPROACHES

A RWY approach will be indicated in the FMS by threshold altitude + 50 ft (green) abeam the RWY fix on the LEGS page. In this case the glidepath is calculated from 50 ft above the runway threshold to the FAF at the published approach angle (usually 3°). This angle will guarantee obstacle clearance from the FAF altitude to the MAP. A RWY approach may have minimums based on LNAV/VNAV (DA) or just LNAV (MDA). In either case a VNAV approach may be conducted to minimums.

V–MDA APPROACHES

A V–MDA approach will be indicated in the FMS by the letters V–MDA abeam the missed approach point and will not show a runway on the legs page. The reason V–MDA approaches exist is that there is not a runway associated with the procedure (circling only) because it is not straight in (>30° final course alignment to the runway) or the descent angle from the FAF to the MAP is more than 400 ft per NM. V–MDA APPROACHES MAY NOT BE CONDUCTED IN VNAV INSIDE THE FAF. The reason is that there is no guarantee of obstacle clearance to the runway.

A suggested technique is to deselect VNAV prior to the FAF crossing and engage VS for the rest of the approach.

USING VNAV FOR APPROACHES

When conducting an approach in VNAV, approach mode (APPR) and VNAV must be selected to ensure VNAV glide path (VGP) will be the active vertical mode on the FMA. VGP mode will not capture the altitude preselector (similar to an ILS glideslope), therefore, the altitude preselector should be set to the missed approach altitude after VGP capture.

Before conducting a VNAV approach, first ensure that the approach is a RWY approach. Then look at the minimums on the approach plate. There are two types of minimums associated with these approaches: MDA and DA.

VNAV WITH MDA MINIMUMS

With MDA minimums published, the aircraft must not descend below this altitude unless visual conditions are met as per regulation. Therefore if this approach is conducted in VNAV (VGP mode) then caution should be used to ensure the aircraft will not descend below the MDA.

Some countries require SCDA approaches. Under these circumstances some provide OpSpecs/MSpec/LOA to treat MDA as a DA. For those who do not, a suggested technique is to add 50' to the MDA and treat it like a DA. Most define this new altitude as a DDA (Derived Decision Altitude). Refer to the section on SCDA (Stabilized Constant Descent Approach) for details.

VNAV/LNAV WITH DA MINIMUMS

With DA minimums published, the aircraft may descend below this altitude during the transition to the missed approach. In this case when minimums are reached and the runway or approach lights are not in sight, the missed approach must be commenced and the aircraft will descend below minimums during the transition to the missed approach segment.

RNAV (GNSS) VS VOR, NDB APPROACHES

All approaches that are not localizer–based are treated the same way by the FMS. These approaches should normally be conducted in FMS (magenta) NAV source. In certain situations it may be necessary to conduct VOR approaches in green needles or NDB approaches with the bearing pointer. Lack of GPS RAIM, operations in a non–WGS–84 country, or the procedure not included in the FMS database are some reasons to conduct these approaches in “raw data”.

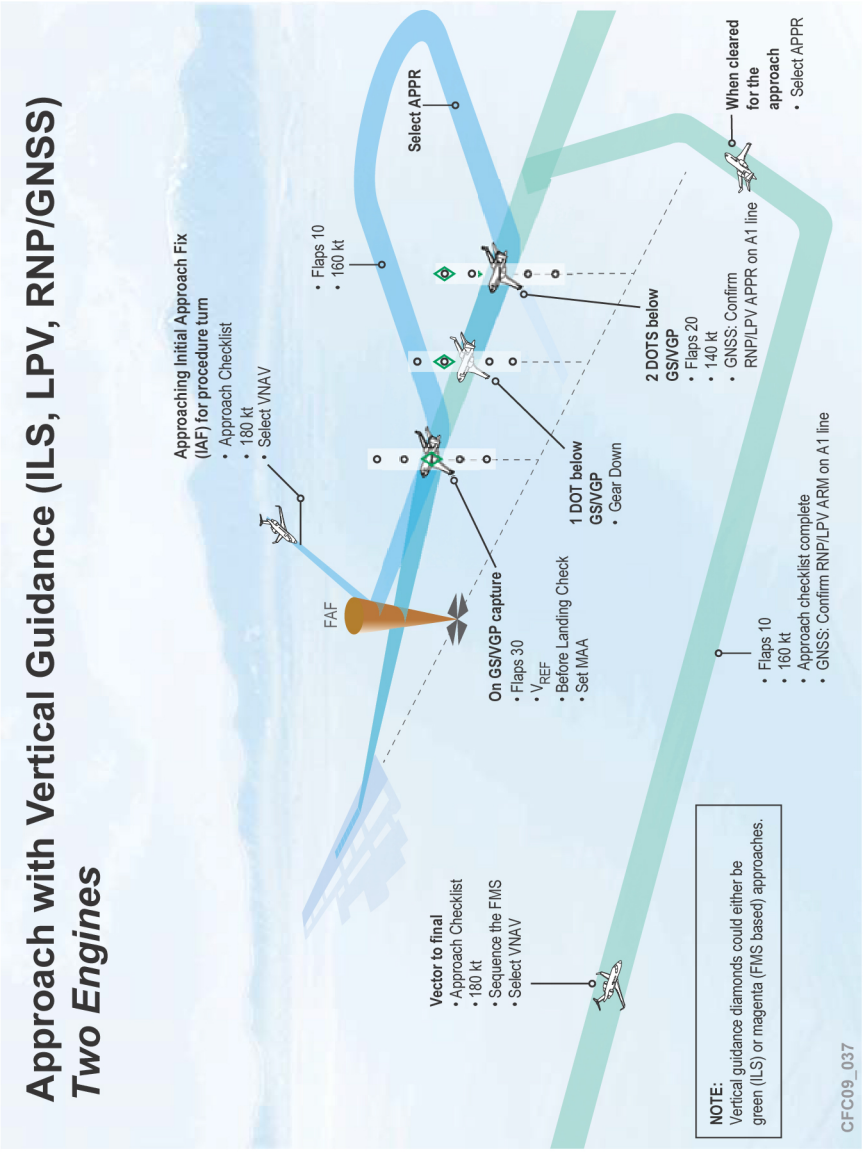
Another reason worth mention is that some Approaches may be listed as VOR or NDB stand alone approaches without GNSS/GPS indicated on the approach plate. These approaches can mostly be retrieved from the FMS and flown in Magenta (FMS) source but are recognized as a secondary source of information. Green needles and/of bearing pointers are the primary source of information and must be overlaid or single source at all times.

PRECISION APPROACH

The PM confirms the COM/NAV radios are set properly, checks the flight instruments, airspeed bugs, preselect altitude display, BARO (DH – displayed on the PFs and PMs PFD). If possible, the aircraft should be slowed to 160 KIAS within 10 NM of the outer marker (Fig. 3 – 6). Within 3 to 5 miles of the FAF or 2 DOTS below Glide SLope, the PF calls ”Flaps 20, gear down, Before Landing checklist” and slows the airplane to V_{REF} + 20(140 KIAS). The PM completes the Before Landing check– list to the flaps 30 item. Just prior to glideslope intercept (approximately one dot), for a two–engine approach, the PF calls for flaps 30 and slows the air– plane to V_{REF}, and begins a descent at the glideslope intercept. It is good practice to call for “Set missed approach altitude” when intercepting the glideslope. Upon confirmation that Flaps are 30, the PM then reports “Before Landing checklist complete”, and repeats the last ATC clearance. After passing the outer marker, the PM begins looking for visual references outside the airplane. The PM also monitors the instruments and calls out significant deviations such as one dot or more deflection on the localizer or glideslope and/or airspeed variations greater than ± 5 kt of V_{REF}.

SECTION 3
INSTRUMENT PROCEDURES

The PM makes altitude callouts at 1000, 500, and 100 ft above Minimums. The PM reports any visual contact with the ground or when the runway environment is in sight. Approaching minimums or missed approach point (DA), the PF continues cross−checking outside the aircraft for visual references. When satisfied visual references are adequate for landing, the PF announces “Visual”. At this point, the PM transfers attention inside the airplane, while cross−checking outside, and calls airspeeds, descent rates, and altitudes. The purpose is to verbally provide the PF, the same information as if still flying instruments. A missed approach should be initiated, if the aircraft becomes unstable along the approach or if a condition that could not warrant a safe landing occurs.



Approach with Vertical Guidance
Figure 09–13–6

SECTION 3
INSTRUMENT PROCEDURES

NON–PRECISION APPROACH

If the weather is close to or at published minimums, it is sometimes impractical or impossible to complete a non–precision approach successfully. This is due to the mathematical relationship of the minimum descent altitude (MDA) versus the minimum visibility combined with the approach speed.

These items occasionally combine to require an intolerable descent for landing. To continue the approach to landing after arrival at MDA, the runway environment must be in sight and the aircraft must be in a position from which a normal landing can be accomplished. A 3° approach calls for being at the following approximate altitudes:

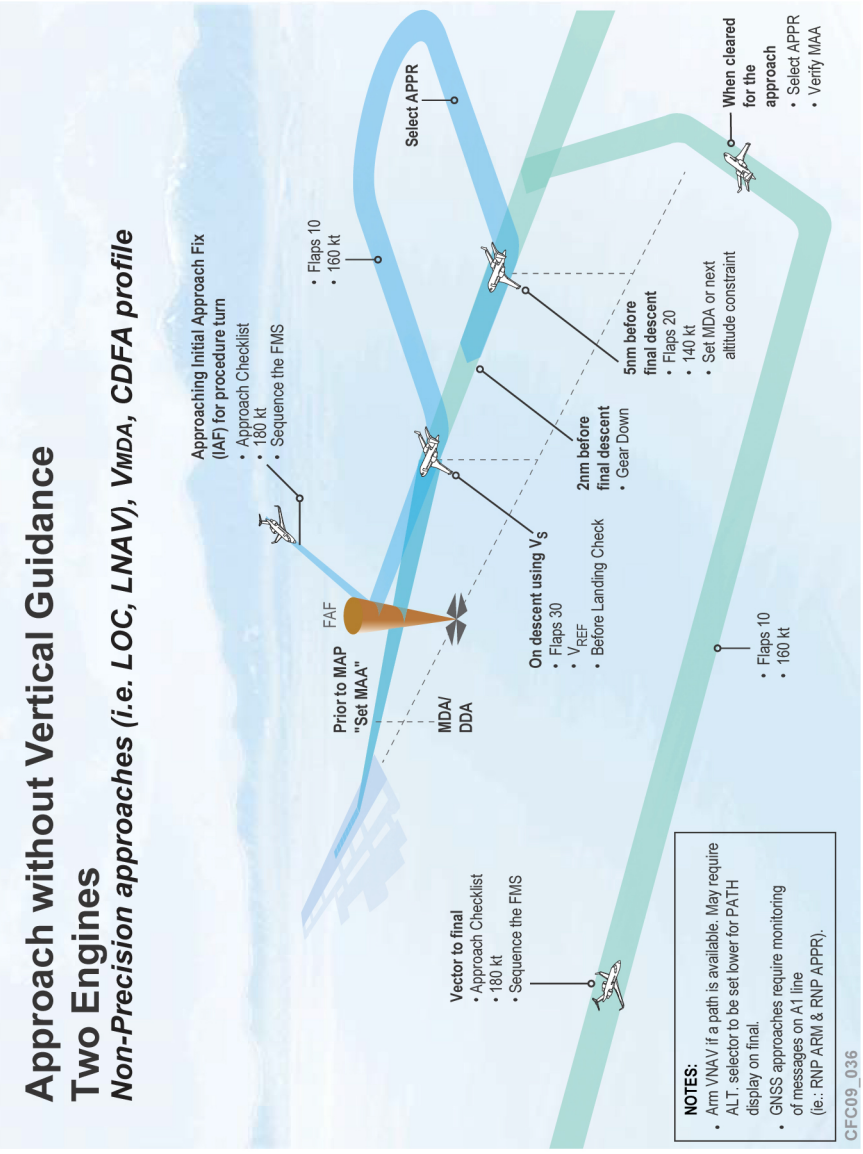
- 600 ft at 1.8 NM
- 500 ft at 1.5 NM
- 400 ft at 1.23 NM
- 300 ft at .9 NM.

For non–precision approaches with no published visual descent point (VDP), it is recommended that a time to see (the runway) point be calculated. Divide the HAT or HAA by 10. The result is the number of seconds the runway should be seen before arriving at the missed approach point (MAP). For example, if the HAT/HAA is 400 ft, divide by 10 (400/10 = 40). Forty seconds prior to the expiration of the time from FAF to MAP, the crew should be at MDA and have the runway environment in sight to accomplish a normal visual approach. Consequently, it is desirable to descend to the MDA before arriving over the VDP. A descent rate to accomplish this should be calculated accordingly.

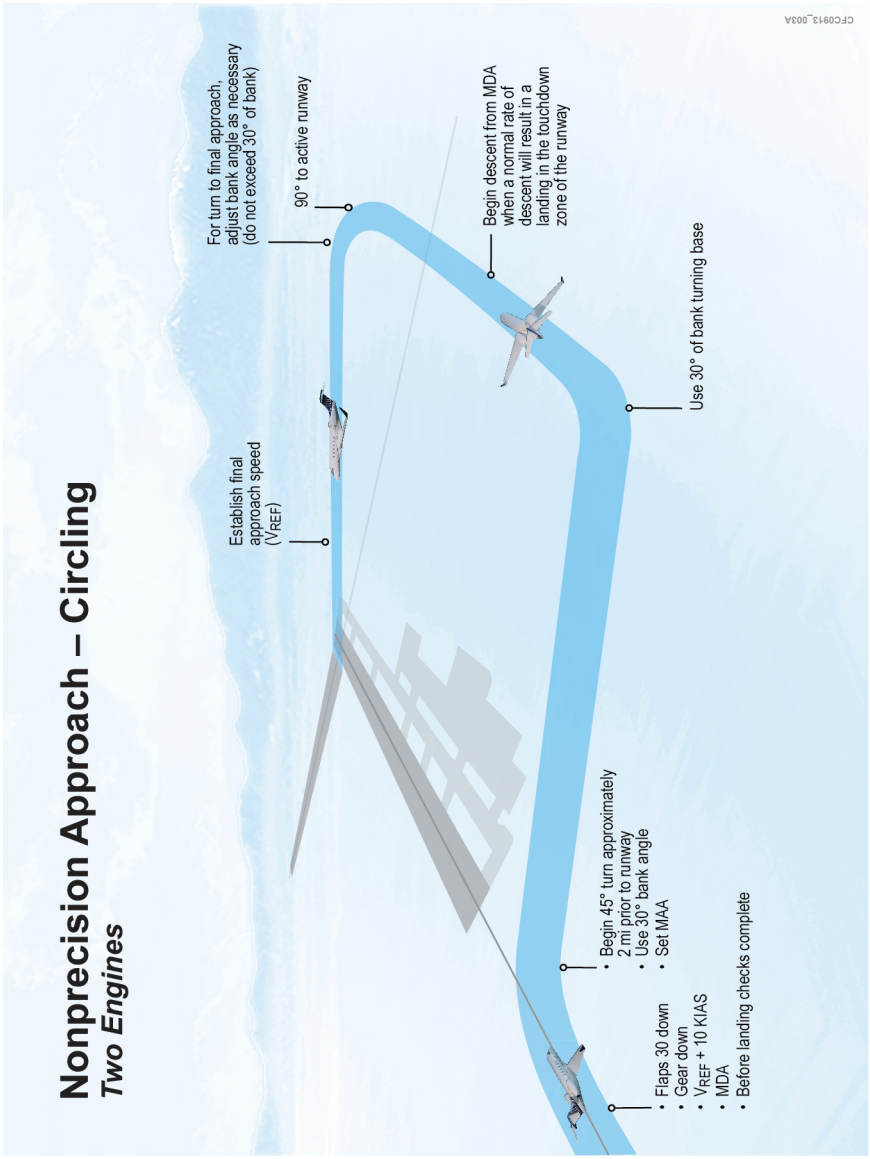
The PM also confirms the COM/NAV radios set properly, checks the flight instruments, airspeed bugs, preselect altitude display, and MDA displays on both PFDs. If possible, the aircraft should be slowed to 160 KIAS within 10 miles of the FAF (Fig. 09–13–7 and Fig. 09–13–8). Within 3 to 5 miles of the FAF, the PF slows the airplane to V_{REF} +20/140 KIAS and calls "Flaps 20, gear down, Before Landing checklist". The PM completes the Before Landing checklist down to the flaps 30 item. Just prior to the FAF, the PF slows the airplane to V_{REF} for straight–in approaches or V_{REF} +10 for circling approaches and calls for Flaps 30. Descent is started at the FAF (at 1,000 fpm) and the approach timing initiated. The PM then reports "Before Landing checklist complete," and repeats the last ATC clearance. After passing the FAF, the PM begins looking for visual references outside the airplane, while monitoring the instruments and calling out significant deviations such as one dot or more deflection on the CDI and airspeed variations greater than ± 5 kt of V_{REF}. A missed approach should be initiated at the missed approach point, if necessary.

Upon commencing the descent profile, set the altitude pre−selector to minimums in order to capture the MDA (like in a circling procedure). Once the MDA is captured the missed approach altitude should be set without delay.

The PM makes altitude callouts at 1000, 500, and 100 ft above MDA and also gives approach timing updates in reference to the VDP. The PM also reports any visual contact with the ground or when the runway environment is in sight. Approaching minimums or the missed approach point, the PF continues cross−checking outside the aircraft for visual references. When satisfied visual references are adequate for landing, the PF announces, “Visual”. At this point, the PM transfers attention inside the airplane, while cross−checking outside. The PM calls airspeeds, descent rates, and altitudes. The purpose is to verbally provide the PF the same information as if still on instruments.



Approach without Vertical Guidance
Figure 09–13–7



Nonprecision Approach
Figure 09–13–8

SECTION 3
INSTRUMENT PROCEDURES

PROCEDURE TURNS

When a procedure turn is required, the instrument approach procedure specifies the outbound and inbound courses, the distance within which the procedure turn shall be completed, and the side of the inbound course on which the turn should be made. Unless otherwise specified or restricted, the type, rate of turn, and the point at which the turn is begun is left to the discretion of the crew. When a holding pattern is depicted in lieu of a procedure turn, it must be executed within the one–minute limitation or published leg length.

A teardrop procedure/penetration turn may be specified. Its purpose is to permit an aircraft to reverse direction and lose considerable altitude within a reasonably limited airspace. This procedure works best when approaching the IAF from a direction requiring less than a 45° turn to the selected (or depicted) teardrop course. When depicted, this type turn must be executed. In some cases, the approach is made directly or via an Arc procedure from a specified intermediate fix to the final approach fix. If a procedure turn is desired when “No PT” is specified, special arrangements must be made with ATC. Other notes, symbols or ATC restrictions which limit a procedure turn, are listed on the approach charts.

For published instrument approaches with no procedure turn restrictions, most pilots elect the Jeppesen depicted 45°– type procedure turn. Other acceptable types of procedure turns are teardrop, 90°/270°, and racetrack (holding pattern type). Abiding by the following guidelines assures the aircraft stays within the procedure turn maneuvering airspace:

- **45° –Type Procedure Turn**— Within 3 minutes of the initial approach fix (IAF), slow the aircraft to arrive over the IAF at 160 KIAS and flaps 10. When crossing the IAF outbound, start timing and intercept the outbound course. Also, start descent to procedure turn altitude (if cleared) and maintain 160 KIAS. At 60 seconds (on course outbound), turn 45° as depicted and start timing for 45 seconds. If 160 KIAS is not maintained, the timing outbound should be adjusted accordingly. At expiration of 45 seconds or 20°–track change, turn 180° and level off at procedure turn altitude as required. Intercept the inbound course with FD and/or raw data as required. Lead the turn as necessary to roll out on the inbound course. When on course inbound, follow the same procedures as stated in the applicable precision or non–precision approach procedures addressed earlier in this chapter.

– **Teardrop –Type Procedure Turn**— Within 3 minutes of the initial approach fix, slow to arrive over the fix at flaps 10 and 160 KIAS. When crossing the initial approach fix outbound, start timing (one minute for a 30° teardrop), turn to a heading to intercept the course outbound, and start descent to procedure turn altitude (if cleared). At expiration of time, turn toward the inbound course and maintain procedure turn altitude (if applicable). Intercept the inbound course with the FD and/or raw data, as required. Lead the turn as necessary to roll out on the inbound course. Ideally, completion of the teardrop turn places the aircraft on course inbound. When on course inbound, follow the same procedures as in the applicable precision or non–precision approach procedures.

– **90°/270° –Type Procedure Turn**— Within 3 minutes of the initial approach fix, slow to arrive over the fix at flaps 10 and 160 KIAS. When crossing the initial approach fix outbound, start timing over or abeam the IAF, turn to a heading to intercept the outbound course within 60 seconds, maintain 160 KIAS, and start descent to procedure turn altitude (if cleared). At expiration of 60 seconds and on course outbound, turn 90° to the maneuvering side and immediately reverse the direction of turn for another 270° and maintain procedure turn altitude (if applicable). Inter–cept the inbound course with the FD and/or raw data, as required. Lead the turn as necessary to roll out on the inbound course. When on course inbound, follow the same procedures as stated in the applicable precision or non–precision approach procedures addressed earlier in this chapter.

CIRCLING APPROACH

A circling approach can be one of the most challenging of the instrument approach procedures (Fig. 09–13–9,). Turbulence, strong winds, poor visibility, and low maneuvering altitude can add to the challenge. Maintain proficiency and skills practice to minimize the high–risk maneuvering required for executing a circling approach. Advanced approach planning and briefing also add to the success of a circling maneuver. Airspeed control is extremely important and the handling characteristics and stability of the aircraft at slower speeds help flight crews reduce the high risks of these procedures even more. Anticipate the level–off at MDA and set sufficient thrust to maintain altitude and safe maneuvering speed throughout the procedure. During the circling, use available automation, including autopilot and autothrottle (if installed) to help reduce pilot workload.

A circling procedure itself is not difficult. The key is to stay within the prescribed distance from the airport. Under normal circumstances, the aircraft falls into Category C for circling approaches, thus having a circling radius of 1.7 NM from the runway end.

SECTION 3
INSTRUMENT PROCEDURES

TERPS 8260.3B Change 21 has recently modified the criteria for circling approaches. A black diamond with a white C in the circle–to–land minimums box of the approach plate indicates the revised criteria.



For category C aircraft, the new maneuvering radius has increased to 2.7 nm for an airport elevation of sea level to 1000 ft and increases 0.1 nm for every 1000 ft elevation change up to 9001 ft and above.

NOTE: Additional guidance for circling distances does not apply to PANS OPS.

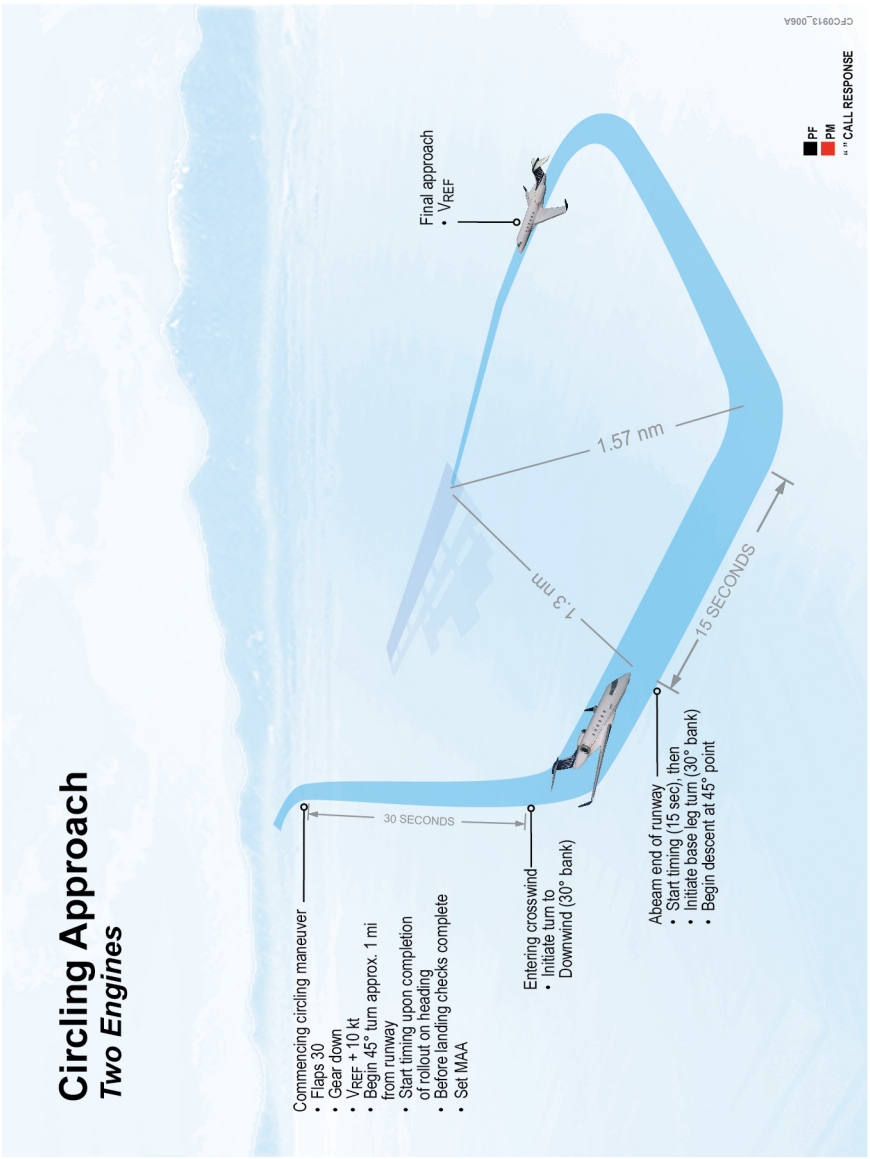
Whenever possible, the circling approach is made to the PF side to ease maintaining visual contact with the intended runway. The PM then monitors the flight instruments calling out excessive deviations in airspeed (+10/–5 kt), altitude (+100 ft, –0 ft), and bank angle (30° maximum). If the situation calls for executing the circle to the opposite side of the PF, the PM is better able to maintain visual contact with the intended runway. The PF should fly the airplane primarily on instruments and follow the timing and heading directions as the PM calls them out. It is imperative that a thorough briefing be completed prior to performing a circling approach, clearly defining who is inside watching the instruments and who is scanning outside.

An alternative is to have control of the aircraft transferred to the other pilot.

A consideration for when planning a descent from a circling altitude is the 3 to 1 profile. Calculate 320 ft per nm for a stabilized 3° path. So if you are at 640' circling MDA, your descent profile should commence 2 track miles (nm) from the runway for a 3° path.

Refer to your regulating authority from where it is appropriate to descend from a circling altitude. In the past, there has been disagreement on the topic among regulators. Some believe it is on final only, others within 10° of final and some written guidance only says “when landing is assured”. Which ever position is deemed to be the proper position to start from, a stabilized descent profile should be the goal.

NOTE: If the aircraft is not stabilized at the end of the circling maneuver for a stabilized descent to the landing runway or if the aircraft overshoots the landing runway, initiate a go–around and do not try to salvage the approach by excessive bank angle or excessive descent rates.



Circling Approach
Figure 09–13–9

SECTION 4
NON–NORMAL PROCEDURES

The key to handling non–normal/emergency procedures is to apply the basic principles of crew resource management (CRM). As always, the overriding consideration in any unusual situation must be to maintain aircraft control, analyze the situation, and take proper action.

CAS INHIBITING SYSTEM

The CAS is a tremendous asset for keeping the crew informed about the overall health of the aircraft. As mentioned in Section 2, there are phases of the flight where distraction needs to be minimized. The CAS inhibit mode prevents many CAS messages from being displayed until after takeoff and after landing. Once the inhibit mode is deactivated, a CAS message displays immediately if the condition is still valid.

The takeoff inhibit feature is automatically entered when the aircraft accelerates through 80 kt and ends when the aircraft climbs above 400 ft AGL or 60 seconds after the inhibit time started.

The landing inhibit feature is automatically entered when all the following conditions are met as the aircraft descends through 400 ft AGL and ends as the aircraft decelerates through 40 kt or 60 seconds after the inhibit time started.

TAKEOFF EMERGENCIES

The takeoff is a very critical phase of any flight. The crew takeoff briefing should leave no questions as to crew actions during the takeoff sequence (see section 2: Pretakeoff for the suggested crew takeoff briefing). Although there can be no clearly defined briefing to cover every contingency, there should be no question as to what each crewmember expects. The pilot monitoring (PM) should have full abort/reject/stop authority up to a given point, generally 80 kt. Takeoff aborts should normally not be attempted after the V_1 call. Balanced field length (BFL) versus runway available is a large part in the takeoff decision process. Takeoff abort scenarios basically fall into two different decision scenarios:

- Runway available > BFL
- Runway available = BFL.

Prior to takeoff, the flight crew should discuss go versus abort scenarios. For example, a go decision may be the better decision at V_1 minus 10 kt for a main gear blown tire. Remember the calculated BFL is based on four properly inflated main tires. If a tire is blown on takeoff, the calculated BFL lengthens considerably and is no longer valid. If takeoff is aborted due to a blown tire, most likely the other tire will blow and the brakes will be damaged by tire FOD, in addition to other areas of the aircraft that may receive FOD damage. Should the decision to go or stop be influenced by a critical BFL for a fire indication at V_1 minus 5 kt? These are questions the flight crews and flight department need to consider for crew takeoff briefings.

SECTION 4
NON–NORMAL PROCEDURES

Directional control is the primary goal. If directional control is lost, then there are no decisions to be made; the takeoff should be aborted. Nothing replaces good judgment and the final decision rests with the pilot in command (PIC). But knowing what to expect, what the parameters are, and the expected reaction makes everything much easier.

The toe brake system is the primary means of stopping the aircraft if a takeoff abort is initiated. The aircraft brakes are very effective. Upon initiating the takeoff abort, the procedure calls for maximum braking immediately. This brake application should be even and firm while simultaneously retarding the thrust levers to idle. If the aircraft starts to deviate from the centerline, apply rudder and differential braking to compensate. During training, flight crews should not execute consecutive multiple rejected takeoffs. The brakes should be allowed to cool between rejected takeoffs.

Typically, AFM brake cooling charts are based on the premise of ONE rejected take off or landing followed by ONE take off or rejected take off only. Allowances and procedures exist for multi–segment legs or crew training. Refer to AFM brake cooling performance section for additional guidance.

When experiencing any Flight control or AFCS related issues, AFM and QRH guidance must always be followed. Additionally, unless specifically mentioned in the AFM/QRH checklist, consider aircraft configuration / airspeed changes when dealing with abnormal situations.

i.e.: Should an AP STAB TRIM FAIL (C) message be posted during initial climb, keep in mind that changing aircraft configuration (retracting flaps for example) and/or increasing the airspeed could have adverse effects on the yoke residual forces. In those cases, consider delaying (if possible) the aircraft configuration and speed changes until the checklist is performed.

The Autopilot and the Stab Trim system work closely to achieve a smooth and efficient flight path. Proper stab trim positioning is very important for performance and passenger comfort. Although capable of handling out–of–trim situations, it is considered good airmanship to trim the aircraft properly before engaging the autopilot. This will prevent unnecessary trim clacker events, messages and will greatly facilitate aircraft handling should the autopilot inadvertently disconnect before reaching the required trim position. Much like you would not transfer control to another pilot without properly trimming the aircraft first, the autopilot should be given the same consideration.

REJECTED TAKEOFF/ENGINE FAILURE BELOW V1 SPEED

A rejected takeoff (RTO) is a profile initiated during a takeoff roll to expeditiously stop the airplane on the runway. As the airplane accelerates, energy increases rapidly. At low speeds, up to approximately 80 KIAS, the energy developed is not sufficient to cause difficulty in stopping the airplane. As the speed approaches V_1, on a balanced field, the effort to stop the airplane in the event of a reject takeoff approaches maximum. The decision to reject the takeoff must therefore be made so that the RTO can be initiated no later than V_1.

- During the takeoff run, making a decision to reject takeoff after V1 may result in the airplane not being able to stop safely on the remaining runway.
- Takeoff performance is based on a stopping distance that may or may not account for use of reverse thrust. On a dry runway reverse thrust is not factored. Use of maximum reverse thrust is factored on wet or contaminated runways.

Takeoff will be rejected prior to 80 kts for any abnormality. Between 80 kts and V1, reject only for the following:

- Master warnings
- Directional control problems
- safety of flight issues.

REJECTED TAKEOFF PROFILE

When triggered by circumstances (briefed or otherwise) warranting a discontinuance of the takeoff, a Rejected Takeoff (RTO) is to be initiated immediately and without reference to a checklist procedure. When the decision is made to reject a takeoff, either pilot may announce ”Stop, Stop, Stop”, ”Reject, Reject, Reject” or “Abort, Abort, Abort”.

NOTE: These are three widely used terms to call for an abort.

1. Abort, Abort, Abort
2. Reject, Reject, Reject
3. Stop, Stop, Stop

Any of these terms are acceptable as long as all crew members are clear on the call, its meaning and consistent with the SOPs. As a caveat the word STOP is becoming more widely used especially with ATC notifications for international procedures because it is more recognizable globally.

The PF must then immediately reduce thrust to idle and perform the rejected takeoff maneuver using maximum braking and thrust reversers as needed.

The rejected takeoff profile is summarized as follows:

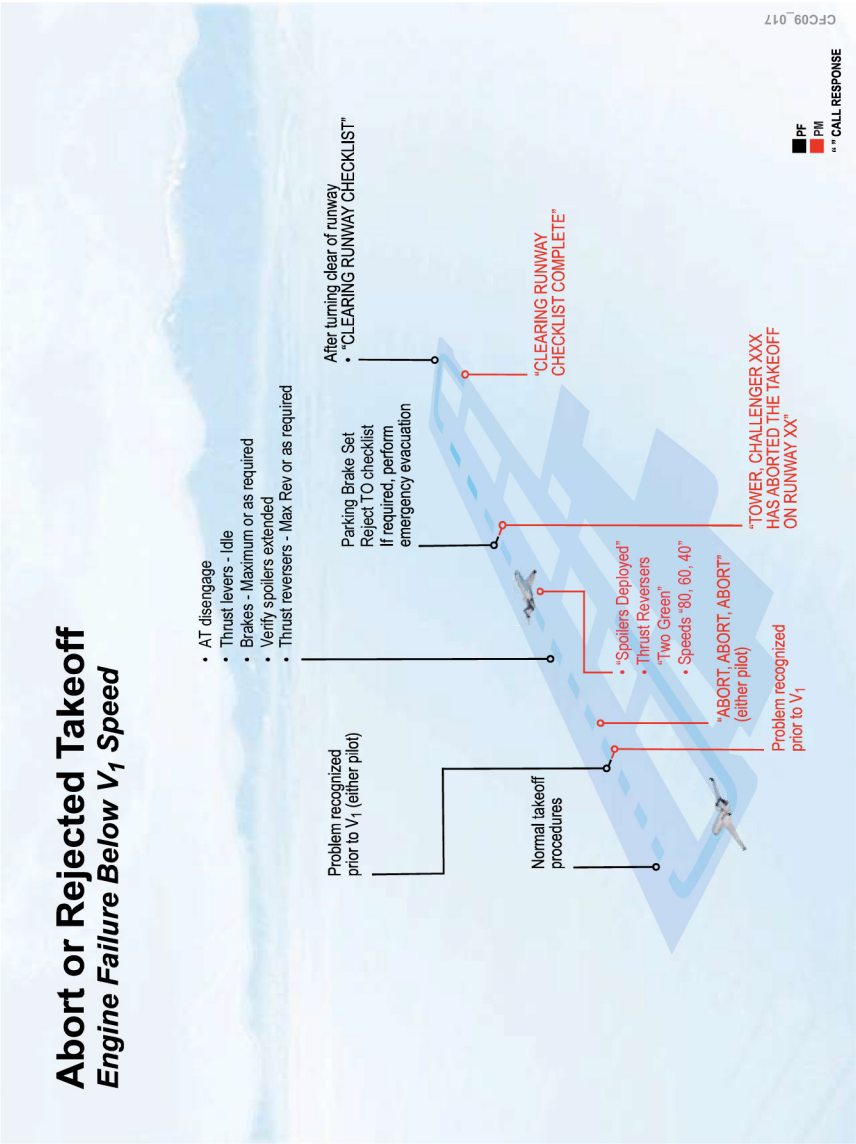
1. Autothrottle (if installed) ..... Disengage
2. Thrust levers ..... IDLE
3. Brakes ..... Maximum or as required
4. Thrust reverser(s) ..... Max rev or as required

END

NOTE: It may take a few seconds to deploy the thrust reversers. Do not delay braking while thrust reverser deployment takes place.

The PM should be monitoring TR deployment, Spoiler deployment and Speeds as per rejected take off guidance.

When the airplane has rolled to a full stop and the park brake is ON, the PM will commence the Rejected Takeoff/Engine Failure below V_1 or appropriate checklist, as commanded by the PF.



Engine Failure Below V1 Speed
Figure 09–14–1

SECTION 4
NON–NORMAL PROCEDURES

ENGINE FAILURE ABOVE V1 SPEED

If an engine fails at or above V_1 and the TLA is in the TO Detent, APR thrust will be commanded by the FADEC. Keep the nosewheel on the runway until V_R and track the centerline. At V_R, rotate the aircraft and continue to apply rudder to maintain track and bank into the good engine. The slip–skid indicator above each PFD should be centered. With a positive rate of climb, select the gear up, and pitch the aircraft to the command bar noseup attitude to establish V_2 . Once V_2 is established, the PF should maintain V_2 until obstacle clearance altitude or 1500 ft AGL, whichever is higher, and accelerate, to V_2 + 15 for flaps 10 or V_2 + 25 for flaps 20, and retract the flaps. Call for the checklist.

Use the following procedures to continue the takeoff (Fig. 09–14–2). When the airplane starts to yaw due to engine failure or other causes, apply a small amount of forward pressure on the control wheel. This keeps the nosewheel on the runway. Use rudder for directional control. Do not attempt to return to centerline; maintain parallel motion.

When the V_R or "Rotate" call is made, smoothly rotate to the command bars nose up pitch and maintain airplane control. When a positive rate of climb is established, call for "Gear up" and increase pitch to maintain V_2. Flight Level Change (FLC) selected to V_2 speed can be used for airspeed control. If turns are anticipated, it might be preferable to maintain up to a maximum of V_2 + 10 for stall margin considerations if half bank is unavailable or inappropriate. Once the airplane is stable and in trim, the autopilot may be engaged at 700 ft to relieve pilot workload. It is prohibited to re–engage the autothrottle following an engine failure on takeoff until the flaps are retracted and the aircraft has accelerated to enroute climb.

When airborne and stable, a good CRM technique is for the PF to ask the question “What happened?”. At this point, it allows the crew to come together, briefly discuss the issue to be sure that both are on the same page and action any appropriate immediate action items.

Both pilots ensure climb speed is attained and pitch attitude maintained so the airplane satisfies all obstacle clearance requirements. When the airplane is stable, the rudder trim may reduce rudder pedal pressure. When the airplane is clear of obstacles or 1500 ft AGL, whichever is higher, accelerate to V_2 + 15 for flaps 10 or V_2 + 25 for flaps 20, call for flaps up, and then call for the Engine Failure (Above V_1) checklist. Increase the airspeed to (V_{fto}) and continue the enroute climb if necessary. As airspeed increases, the need for rudder deflection decreases. APR thrust is limited to 10 minutes. Reduce the thrust levers to CLB within 10 minutes of takeoff as per AFM limitations.

SECTION 4
NON–NORMAL PROCEDURES

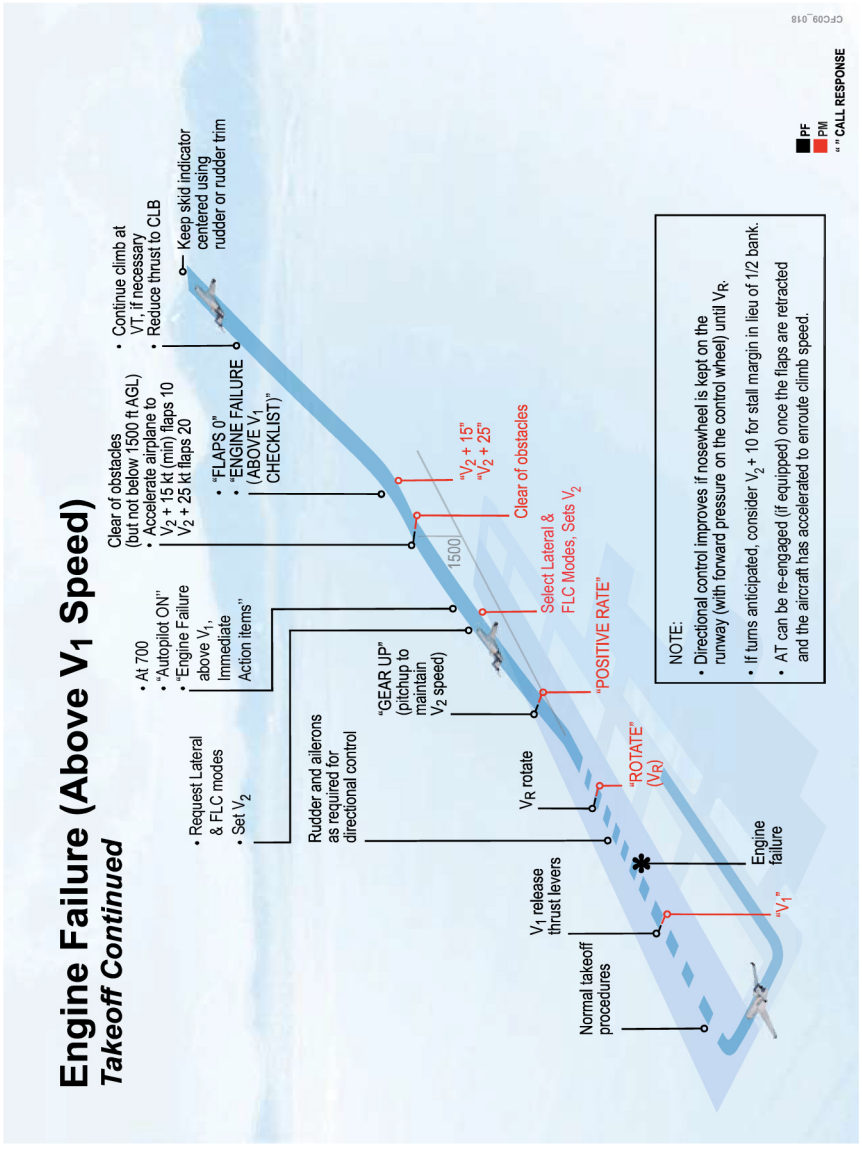
Both pilots positively identify which engine is not operating. The PF should guard the operating engine with one hand, while the PM confirms the proper throttle lever and then slowly retards the non–operating engine to IDLE. The PM then selects and confirms the non–operating engine run switch to OFF as per checklist instructions.

There are three critical items that need confirmation prior to selection to a different state at the same time:

1. Engine Run Switches
2. Generators
3. Engine Fire Switches

The person making the selection should have their hand over the Switch/Button/Lever when making the request for confirmation which not only addresses the system but confirms the L/R side. Any one of these wrongly selected could have dire consequences and must be done at the request and confirmation of the PF. Upon completing all checklist items, select a suitable airport for a single–engine landing. An engine restart may be attempted if conditions warrant.

During takeoff roll, the PM devotes his attention primarily to the engine instruments, EICAS, and airspeed indicator. This should allow any malfunction to be recognized and confirmed in the shortest amount of time. Callouts to the PF should be exactly as briefed. The PF should have primary focus on the aircraft, using peripheral vision to backup the PM inside. Late takeoff abort decisions after V_1 are notoriously unsuccessful for all turbojet aircraft. Know what is critical and stick with the decision made in the crew takeoff briefing. There should be no doubt by either crewmember as to what is expected during takeoff.



Engine Failure Above V1 Speed
Figure 09–14–2

SECTION 4
NON–NORMAL PROCEDURES

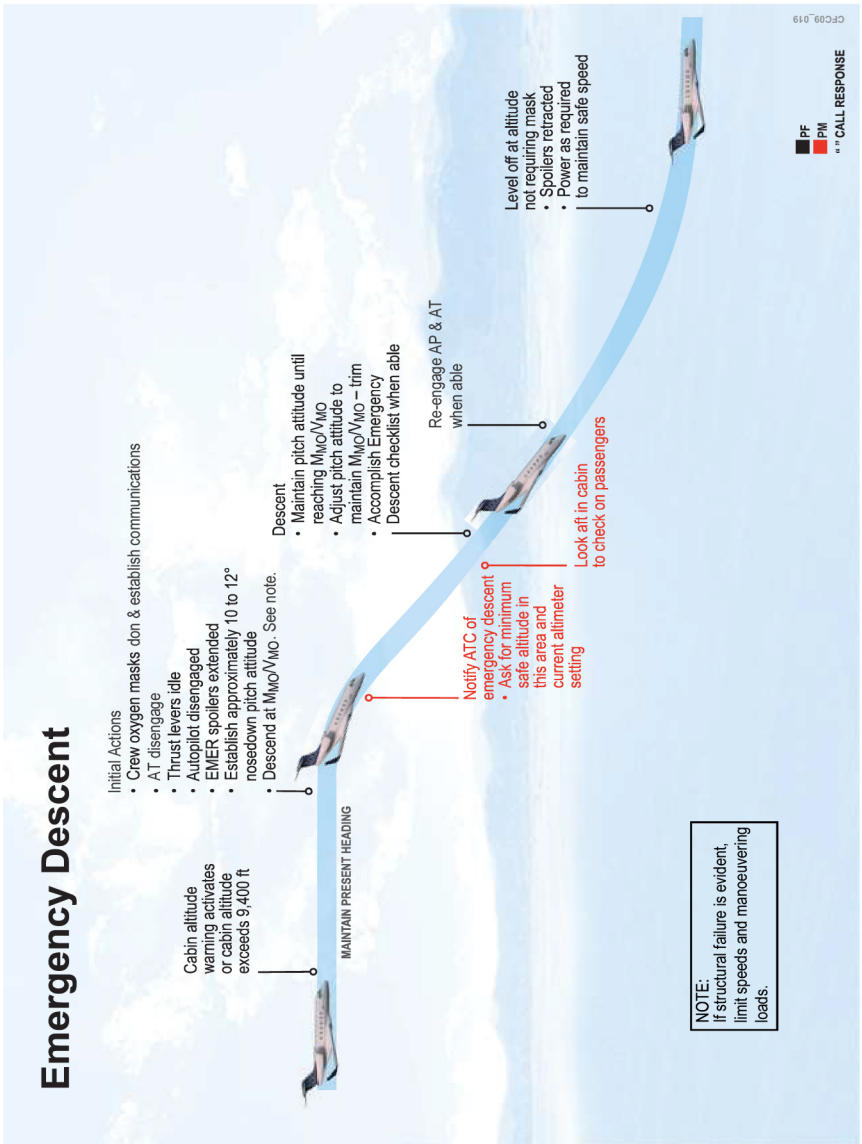
CRUISE EMERGENCIES

Malfunctions at altitude require the same thought process as those on takeoff. Maintaining aircraft control is the number one priority. Someone should always be flying the aircraft. For example, if an emergency descent is necessary due to rapid decompression, the primary crew concern should be to don the oxygen masks, and establish communications. At altitudes above FL 410, the time of useful consciousness (TUC) decreases significantly without supplemental oxygen.

Pilots always put on their oxygen masks first, before ensuring that the passengers' masks have dropped. The emergency descent Immediate Action Items on the checklist are necessary to learn and accomplish. See Fig. 09–14–3

Emergency Descent

Of special note to the profile, to get the spoilers out to the EMER detent requires pushing the button on top of the handle which you normally never do. Also, if you have aft pressure on the handle as you try to push the button, it may hang up. Relax the pressure on the handle momentarily to be able to engage it. Once established in the descent, it may be wise to re–establish the automation.



Emergency Descent
Figure 09–14–3

SECTION 4
NON–NORMAL PROCEDURES

APPROACH/LANDING EMERGENCIES

For a single–engine approach, the procedure is the same as with both engines running (Fig. 09–14–4). The single–engine landing distance need only be increased by the associated factors in the AFM over the distance required for normal landing.

Knowledge of the emergency checklists (especially the Immediate Action Items) and aircraft limitations is important in successfully navigating an emergency situation. Also, keep the passengers informed on the progress of the emergency. Overall, good CRM is one of the best tools in an emergency situation. The objective in any emergency is to protect the passengers and safely land the aircraft. Depending on the type of emergency, there are situations when it is better to enter a holding pattern, sort things out, and then proceed with the approach and landing (Fig. 09–14–5).

WINDSHEAR

If extreme windshear is encountered, recommendations are the FAA technique of flying the attitude indicator, using APR thrust, and climbing at just above stick shaker (Target low speed cue + 10kts initially) until a safe altitude is reached. Do not rely on pressure instruments until after exiting windshear conditions, reference the radio altimeter.

Be alert for windshear reports and conditions. Study approach weather and wind conditions carefully. Be prepared to use thrust if a sudden sustained airspeed loss on final approach is encountered. Conversely, if the aircraft suddenly picks up too much speed, deliberately and carefully decrease thrust. If the increase in airspeed was caused by a sudden increase in headwind component, the ground speed may not significantly change immediately.

During the approach, be cognizant of increased performance windshear and how likely it may be followed by decreased performance windshear. Under these conditions, it may be favorable to GA at the earliest possible moment of the onset of increased performance windshear.

WINDSHEAR ALERTS AND WARNINGS

Mode 7 of the TAWS of the Challenger 350 provides alerts and warnings if significant windshear is detected below 1500 ft AGL.

SECTION 4
NON–NORMAL PROCEDURES

WINDSHEAR RECOGNITION AND ESCAPE

Windshear escape should be performed whenever the TAWS has given a WINDSHEAR aural warning or whenever aircraft control becomes marginal below 1000 ft AGL. Marginal aircraft control may be recognized by uncommanded changes in the flight path in excess of (Refer to FAA AC 00–54, Appendix 1, Pilot Windshear Guide).

These values are guidelines only:

- 15 KIAS
- 500 ft/min vertical speed
- 5° pitch attitude
- Rapid one dot displacement from the glideslope
- Unusual throttle position for a significant period of time

At first indication of a windshear encounter the PF should simultaneously, disengage AT and AP and advance the thrust levers to the APR detent while ensuring spoilers are retracted and call WINDSHEAR RECOVERY, CHECK N_1. The PM responds with N_1 SET when APR N_1 is reached. The PF should roll wings–level and apply back pressure on the yoke at a normal rotation rate. The objective is to initiate a climb with 10–15 degrees initial pitch up. Increase pitch attitude smoothly and in small increments, trading airspeed for altitude as necessary to stop descent. The target airspeed (if possible) should be 10 kt above the low speed cue initially. Apart from retracting the flight spoilers (if extended), no other aircraft configuration changes should be made until safely clear of the ground and with a suitable climb rate. Maximum aircraft performance is achieved with maximum N_1 and a pitch attitude that tickles the stick shaker; however, care must be given to avoid overcontrolling and inducing stick pusher activation. Once clear of the windshear, the aircraft accelerates rapidly with APR set. Pitch attitude control and configuration changes should be conducted with close attention to the airspeed trend vector and the VSI/altimeter. The PM should closely monitor all indications on the VSI/altimeter and call out speeds to the PF. Advise ATC of the windshear and any excursions from cleared altitude or heading.

The following procedure should be employed for a windshear escape maneuver:

1. Autothrottle (if installed) ..... Disengage
2. Autopilot ..... Disconnect
3. Thrust Levers ..... APR
4. Flight Spoilers ..... Retract
5. Rotate smoothly to the takeoff/go around pitch attitude, allowing airspeed to decrease if necessary. Maintain wings level. Do not retract flaps or landing gear.

6. If the airplane continues to descend, increase pitch attitude smoothly and in small increments, bleeding airspeed as necessary to stop descent. Use stall warning onset (stick shaker) as the upper limit of pitch attitude. A good target would be Low Speed cue plus 10 KIAS initially.
7. Maintain escape attitude and thrust and delay retracting flaps or landing gear until safe climb out is assured and positive energy to the airplane has returned.

NOTE: Refer to AFM & QRH for official exact guidelines.

8. Once clear of obstacles or terrain and “WINDSHEAR” removed from PFD, resume normal flight.
9. Check airspeed and adjust thrust/configuration as required.

END

TAWS RECOVERY

The terrain awareness warning system (TAWS) of the Challenger 350 has seven modes. Modes 1 through 6 are basic TAWS functions while mode 7 includes windshear alerting. TAWS terrain alerting can be split into two areas — Caution and Warning. Refer to FCOM 2 for details of these modes.

CAUTION AREA

Penetration into a caution area generates a CAUTION TERRAIN aural warning and a GND PROX annunciation on the PFD. This occurs at approximately 60 seconds prior to predicted ground impact.

WARNING AREA

Penetration into a warning area generates a PULL UP aural warning and a PULL UP annunciation on the PFD. This occurs at approximately 30 seconds prior to predicted ground impact.

Should either area be penetrated, the PF should simultaneously disengage AT and AP, advance the thrust levers to the APR detent, ensure spoilers are retracted if used and call “TERRAIN RECOVERY, CHECK THRUST”. The PM responds with “APR SET” when APR is reached. The PF should roll wings level and apply back pressure to initiate a wings level climb at a normal rotation rate. The objective is to initiate a climb with 10–15 degrees initial pitch up. Increase pitch attitude smoothly and in small increments, trading airspeed for altitude as necessary towards the low speed cue (Target low speed cue +10 kts initially), back pressure must be reduced to maintain this speed. If altitude for recovery is critical, maximum aircraft performance can be achieved by applying enough back pressure on the yoke to maintain the edge of (tickle) stick shaker until clear of obstacles or terrain.

SECTION 4
NON–NORMAL PROCEDURES

TAWS – PULL UP – ESCAPE:

1. Autothrottle (if installed) ..... Disengage
2. Autopilot ..... Disconnect
3. Thrust Levers ..... APR
4. Flight Spoilers ..... Retract
5. Climb at maximum practical rate.
6. Landing Gear switch ..... UP
7. Maintain climb until the warning ceases.
8. Once clear of obstacles or terrain, resume normal flight.
9. Check airspeed and adjust thrust/configuration as required.

END

Your PFD terrain indications are a good source indicating peaks in the general area if not visual.

Approach Call outs

A TAWS alert is pre–programmed to sound at “1000 AGL and 500 AGL” it may be pre–programmed to advise other optional calls but it is important to understand that this is a RADALT call and not an indication above minimums. They are simply to advise of proximity to ground and relative position to the approach. The PF may acknowledge it by simply stating Check.

TCAS

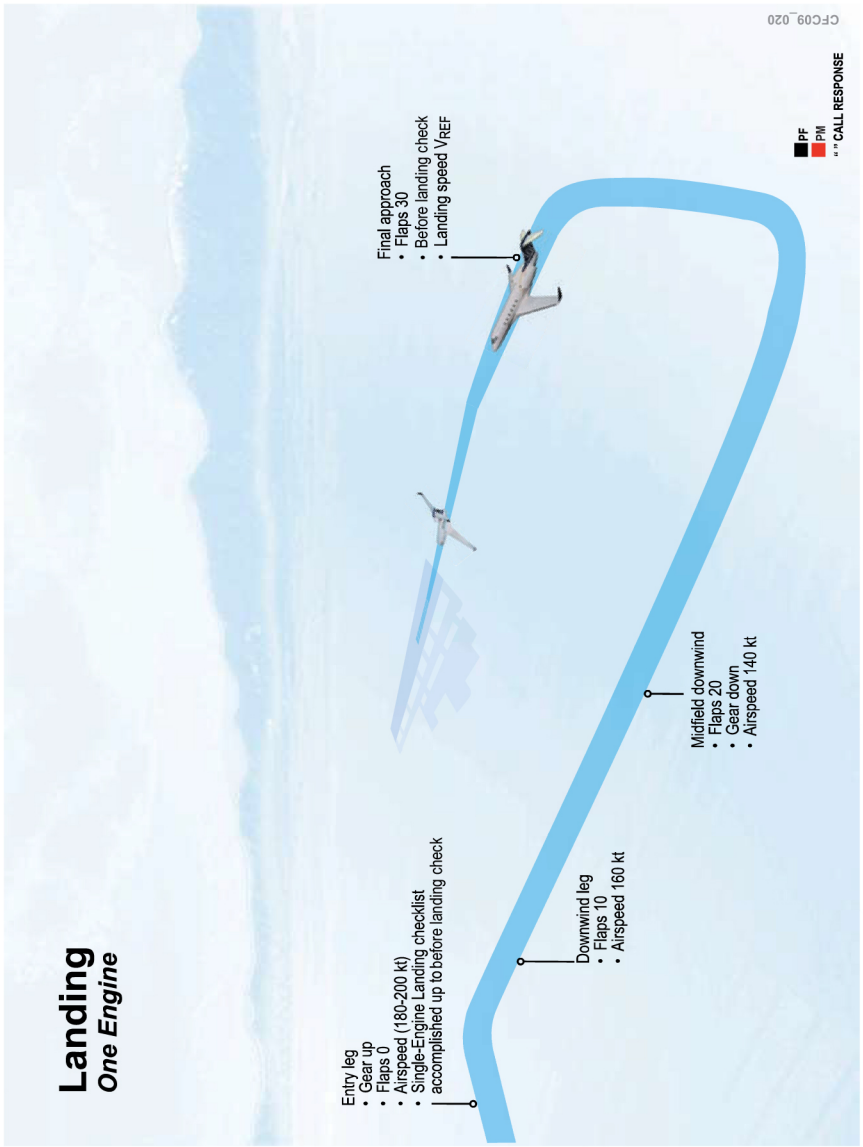
Either pilot can call TCAS traffic as it is noticed on the MFD. The PF should immediately optimize the scale of the MFD so that the traffic is on the outer edge of the display. The PF should then direct the PM to look outside for the traffic and turn on all exterior lights (See and be Seen). The PF continues to optimize the scale of the MFD, continues to direct the PM where to look for the traffic, and monitors the MFD for any changes in traffic flight path or new traffic. Should the PM become visual with the traffic, the PM should inform the PF and continue to monitor this traffic as well as look for others.

The PF should continue to monitor the MFD for any changes in traffic flight path or new traffic. The PM should also request/advise ATC of any flight path changes requested by the PF in order to avoid the traffic. The PF should take whatever Resolution Advisory (RA) attitude is directed by the TCAS. The PM should continue to look for the traffic and ensure the PF has met the Resolution Advisory (RA) directed by TCAS.

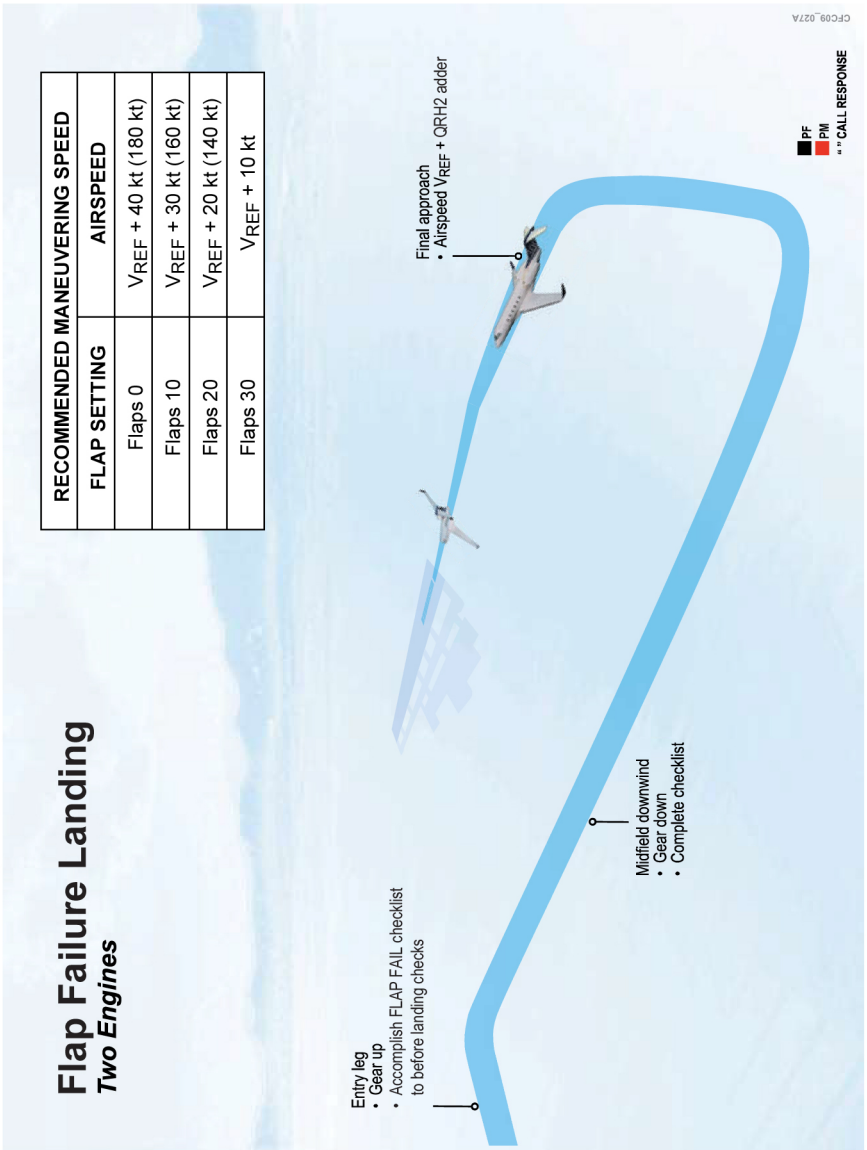
Resolution Advisory (RA) Actions:

1. Autothrottle (if installed) ..... Disengage
2. Autopilot ..... Disconnect
3. Follow VSI indications as indicated by green band
4. PM to advise ATC “TCAS RA”
5. After “CLEAR OF CONFLICT”, resume normal navigation
6. Advise ATC

END



Single–Engine Landing
Figure 09–14–4



No–Flap Landing
Figure 09–14–5

SECTION 4
NON–NORMAL PROCEDURES

RUNWAY OVERRUN AWARENESS AND ALERTING SYSTEM (ROAAS)

ROAAS is a feature of the TAWS unit that compliments flight crews' situational awareness to the possibility of exceeding the runway end during approach and landing. It is designed to be an added safety net for runway overrun hazards. ROAAS provides alerts to the flight crew when a real–time calculation of landing distance exceeds the remaining available distance to the end of the runway. It has two automatic modes of operations: In–Air and On–Ground Alerting.

ROAAS landing distance is representative of the Factored Operational Landing Distance (FOLD), not the AFM Actual Landing Distance (ALD).

IN–AIR MODE

During approach, should the ROAAS predicted landing distance exceed the available runway length, the system will generate a “RUNWAY LENGTH” aural alert and a RWY LENGTH annunciation on the PFD. There are two levels of In–Air alerts: Caution and Warning.

ROAAS In–Air CAUTION

RWY LENGTH (Amber annunciation on PFD)



“RUNWAY LENGTH” (Single Aural)

ROAAS In–Air CAUTION can occur during final approach between 450 and 200 feet above runway elevation:

1. Current predicted landing distance exceeds runway length available.
2. Consider a go–around.
3. If condition persists at 200 feet above runway elevation, a ROAAS warning will be issued.

NOTE: Small corrections can sometimes stop the ROAAS CAUTION message, but large corrections can lead to Unstabilized Approaches. Refer to: FCOM1, ROPAT Chapter 9, STABILIZED APPROACH PHILOSOPHY .

END

ROAAS In–Air Warning  **"RUNWAY LENGTH, RUNWAY LENGTH" (Continuous Aural)**

1. Execute a go–around.

NOTE: Contact with the ground may be unavoidable if go–around is initiated from a low altitude or high sink rate. If the airplane contacts the ground during the Go–Around, maintain the normal landing attitude or slightly higher. The airplane configuration (landing gear/flaps) should not be changed until the airplane is climbing if ground contact is made or not. Refer to FCOM 1 ROPAT, Balked Landing / Low Energy Go–Around procedure.

END

ON–GROUND MODE

After landing/touchdown, should the ROAAS predicted landing distance exceed the remaining runway length, the system will generate a "DECELERATE" or "DECELERATE NOW" aural alert and a DECELERATE annunciation on the PFD. There are two levels of On–Ground alerts: Caution and Warning.

ROAAS On–Ground Caution

ROAAS On–Ground Caution can occur during the landing rollout:

DECELERATE (Amber annunciation on PFD)  **"DECELERATE" (Single Aural)**

1. Current predicted stopping point is approaching the end of the runway.
2. Increase deceleration to avoid a ROAAS Warning.

END

ROAAS On–Ground Warning

DECELERATE (Red annunciation on PFD)  **"DECELERATE NOW" (Continuous Aural)**

1. Brakes ..... Maximum
2. Thrust reversers ..... MAX REV

END

SECTION 4
NON–NORMAL PROCEDURES

OPERATIONAL CONSIDERATIONS

ROAAS is only available for landing.

If landing on wet or contaminated runways, select RCC5. ROAAS (if installed) may not provide timely alerts to reduce the risk of overrun on contaminated runways with braking reports less than RCC 5.

The ROAAS Model Distance (RMD) can be conservatively approximated by FOLD. As a result, ROAAS must be selected OFF for operations on runways shorter than FOLD or divert to a longer runway. With ROAAS on, to avoid ROAAS alerts, the landing distance available must be equal to or greater than FOLD. (See Flight Crew Operating Manual, Volume 1, Chapter 6 – PERFORMANCE for FOLD information or QRH 1 P–43).

NON–NORMAL AND EMERGENCY PROCEDURES

There are three possible impacts to ROAAS operation due to system malfunctions:

1. ROAAS alerting becomes unreliable due to signal failure (e.g. **WOW FAIL**). In this case, the crew will be directed to select ROAAS OFF, as alerting and landing distance calculations may be unreliable or inaccurate.
2. RMD under–predicts the landing distance due to reduced deceleration capability (e.g. **INBD BRAKES FAIL**). In this case, ROAAS alerts will assume full system functionality and may not be timely enough to completely prevent an overrun. Crews are not directed to select ROAAS OFF, because any alerts will still be valid and can reduce the severity of an overrun.
3. The AFM non–normal/emergency landing distance could be shorter than the calculated ROAAS landing distance. ROAAS calculations are closely approximated by FOLD, and AFM non–normal/emergency landing distance factors are based on ALD. As a result, for non–normal/emergency procedures with a relatively low ALD factor and/or increased approach speed, the resulting minimum runway distance will fall below the ROAAS calculated landing distance. These non–normal/emergency procedures are identified with the following note:

   NOTE:
   - For aircraft with ROAAS installed, ROAAS should be selected OFF when landing on an RCC 6 runway with a length shorter than the increased ALD plus 2,000 feet (600 m).
   - ROAAS should be selected OFF when landing on a runway with RCC less than 6.
   - If the above note(s) do not apply, ROAAS should be kept on.

SECTION 5
TRAINING MANEUVERS

Bombardier has collaborated with other Manufacturers and ICAO to create Revision 03 of the Airplane Upset Prevention and Recovery Training Aid (AUPRTA). This is free courseware available online and in the APP store that targets in depth knowledge for upset recovery.

Refer to Advisory Wire: AW000–02–0003 for more detailed information.

NOTE: If there is any disagreements between AUPRTA or ROPAT guidance with the AFM, the AFM guidance prevails.

In addition to evaluating normal operational skills and procedures, certain training and testing maneuvers are required to pass ATP, Type Rating, and Part 135 practical tests. The following section focuses on a few of the maneuvers required by the FAA ACS (Airman Certification Standards).

When conducting maneuvers, altitudes are at the discretion of the instructor/examiner. They should be chosen based on aircraft performance and safe clearance from terrain, obstacles, and other traffic. At the same time, entry altitudes for approach to stall maneuvers (Stall to Shaker) should be realistic and consistent with the maneuver configuration. Typically, from relatively flat terrain at approximately sea level, training is conducted at 14000 ft but can vary.

Training maneuvers are intended to be done in a simulator. Most but not all could be done in the airplane. Stalls to pusher in the actual airplane are not authorized, and are in fact prohibited by AFM limitation (min speed authorized being shaker).

All in–aircraft training maneuvers should be conducted in VMC with appropriate cloud clearance to ensure the aircraft is clear of all traffic for the full duration of the maneuver. When conducting training maneuvers in a flight simulator or training device, minimum altitude and cloud clearance do not apply and are based on the training objective. For example, landing configuration stall demonstrations and recoveries may be conducted at the MDA, departure configuration stalls may be conducted immediately after takeoff, etc.

SECTION 5
TRAINING MANEUVERS

The use of the flight director and/or autopilot and autothrottle remains at the discretion of the instructor/examiner. The decision to use aircraft automation is based on the objective of the maneuver and skills of the customer trainee. For example, a steep turn exercise is an instrument–skills maneuver, so the flight director, autopilot and autothrottle should be off. A stall–recovery maneuver used to demonstrate aircraft low–speed handling characteristics should be flown without the use of the flight director, autopilot or autothrottle. However, when demonstrating a stall recovery, allowing the autopilot trim to the stall warning is beneficial. In the course of training, a pilot should see stall recovery maneuvers both with and without the use of the aircraft automation.

- Steep bank turns
- Approach to stall – clean configuration
- Approach to stall – takeoff/approach configuration
- Approach to stall – landing configuration
- Unusual attitude recovery.

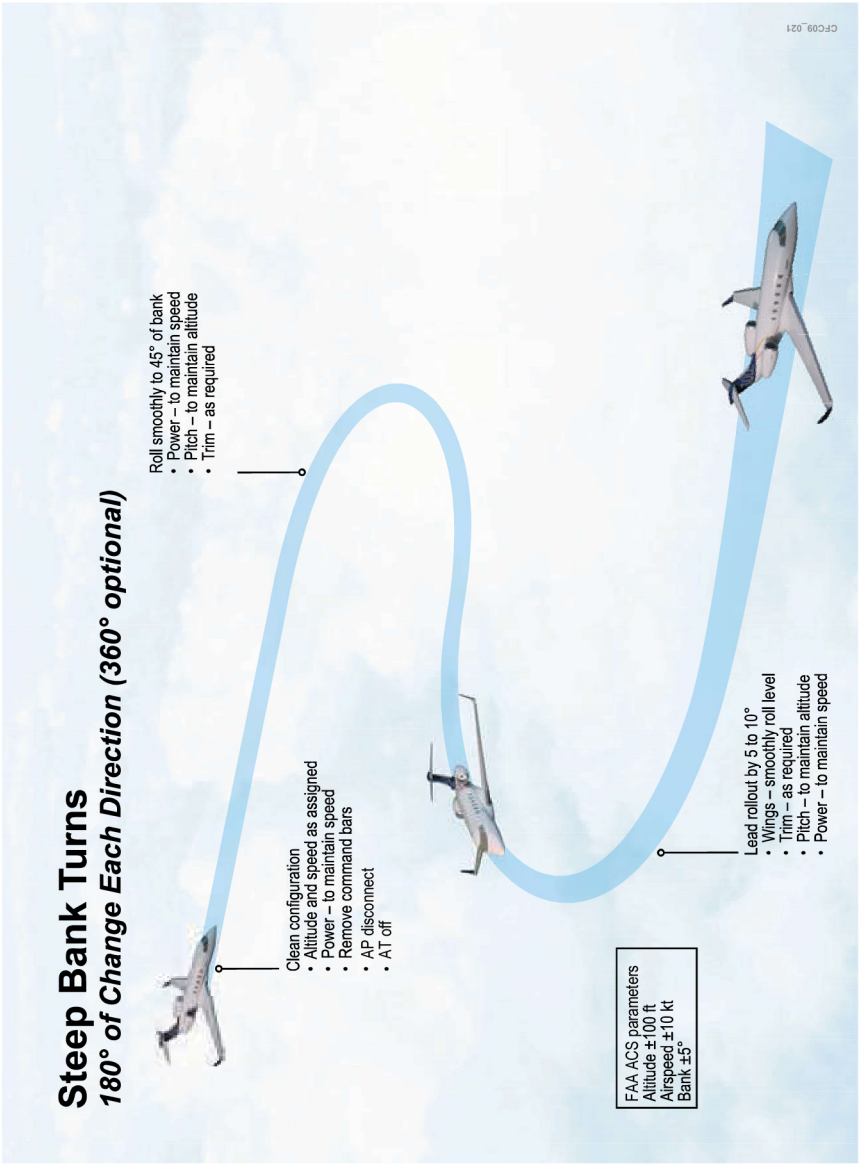
STEEP BANK TURNS

The flight director will be off for this maneuver. Altitude and speed selection is at the discretion of the instructor/examiner. The normal maneuvering speed for this exercise is 250 KIAS and 14000 ft. This maneuver is usually accomplished at 45° of bank, turning in both directions with heading changes of 180°. A constant speed and altitude is maintained throughout the maneuver (Fig. 09–15–1).

Stabilize the airplane at the assigned speed and altitude. While rolling into the turn, increase power (Approx. increase 2%–4% N_1) to maintain the assigned airspeed at 45° of bank. While rolling into the turn, adjust pitch to maintain altitude. Trim, if desired, to reduce yoke pressure.

Start the rollout approximately 10° prior to the desired heading. The actual lead time is dependent on the pilot's roll rate. No pause is necessary or desired when changing the direction of turn. Continue the turn, rolling into the opposite direction 45° of bank. Very little trim correction is required when transitioning quickly from one direction to the other.

During the maneuver, the PM can be used, as briefed by the PF, to monitor and announce deviations from altitude, bank, airspeed, and heading. For coordination, PM heading calls of 30, 20, and 10 can be used to increase the accuracy of the rollout heading. The PM can adjust power as directed by the PF (Approx. increase 2% N_1). In recent times, some authorities no longer allow that practice for check rides hoping to sharpen your skills so it may be good practice to do on your own. In the real world however it would be considered good CRM.



Steep Bank Turns
Figure 09–15–1

SECTION 5
TRAINING MANEUVERS

APPROACH TO STALL AND RECOVERY PROCEDURES

With smooth technique, the pilot can easily control the aircraft flight path and rate of change in speed during the maneuver entry and recovery from stall warning regime. Recovery is normally initiated at the first indication of low speed / Stall. The warning system indications include but not limited to Nose high attitude, slow speed, rapidly decreasing speed trend vector, sloppiness of flight controls, **stick shaker**, pusher, or aural warnings. When training in a flight simulator or training device, recovery may be delayed to demonstrate additional stall warning indications and aircraft flight characteristics at lower than normal flight speeds. If autothrottle equipped, typically the system not used until recovered.

The AFM recovery procedures must be used. The AFM recovery should be maintained until the aircraft is above the minimum safe speed for the current condition. Normally, the aircraft is recovered to 180 KIAS at the same altitude the maneuver began.

While altitude loss is a consideration, it is not the primary point of focus. Reducing the angle of attack by reducing the pitch attitude should be the pilot's main goal, not maintaining an arbitrary cleared altitude. The emphasis must be on recovering the airplane from the stall, regardless of the altitude loss; maintaining your cleared altitude is irrelevant in stall recovery. That is not a license to lose an unreasonable amount of altitude however and principles of good airmanship apply.

At low altitude (past the FAF on approach), terrain proximity is definitely a factor which must be considered. Proper balance between altitude loss and stall recovery technique should be exercised with proper judgement. A trade off must occur from what is required versus what is acceptable but you may wish to use all you can.

The autopilot and/or flight director may be used on any of the three approach–to–stall maneuvers. If the autopilot is used, a distraction may be used, making the stall warning activation and aircraft recovery more realistic.

Appropriate horizontal cloud clearance must be maintained to ensure the maneuver will be completed in VMC and so clearance from other traffic is maintained. Stall warning activation speeds V_S should be calculated for specific altitude, weight, and configuration before the maneuver begins. V_{REF}/ V_2 will be calculated for the specific weight and manually set on the speed tape. If the stall warning system does not activate at the determined speed, an immediate recovery to normal flight speeds will be made and no further low–speed training may be conducted until the sources of the error is corrected.

SECTION 5
TRAINING MANEUVERS

When training is conducted in a flight simulator or training device, altitude and cloud clearance requirements do not apply. The instructor will determine the maneuver conditions based on the training needs at the time. Stall warning speeds do not need to be calculated. If a stall recovery maneuver based on a departure is conducted, a V_2 and flap retract speed should be posted on the airspeed tape. If a stall recovery maneuver based on an approach situation is conducted, V_{REF} and V_{ga} should be posted on the airspeed tape.

The following approach−to−stall profiles are examples and strict adherence to their choreography is not required as long as all three profiles (clean, approach/takeoff, and landing) are performed. Proper recoveries per AFM procedures **must** be followed.

APPROACH TO STALL — CLEAN (FLAPS 0)

The approach to stall − clean configuration is accomplished with flaps and landing gear retracted. Normally, there would not be V−speeds selected for this phase of flight, therefore it is not appropriate to select anything other than what would be available for normal cruise flight.

Maintain heading and altitude entering the maneuver. Initially, stabilize the airplane at 180 kt using about 65% N_1. Retard the thrust levers to IDLE. As airspeed decreases, the pitch attitude will increase in order to maintain altitude. At the first indication of an impending stall, perform the AFM stall recovery procedure. Some altitude loss will result.

1. **Autopilot ..... Off**
2. **Lower the pitch attitude to reduce angle−of−attack.**
3. **Autothrottle (if installed) ..... Off**
4. **Thrust Levers ..... APR**
5. **Flight Spoiler lever ..... Retract**
6. **Level the wings.**

After airspeed increases and stall warning is extinguished:

7. Pitch attitude ..... Adjust to minimize loss of altitude.
8. Advise ATC and proceed as cleared.

END

SECTION 5
TRAINING MANEUVERS

For training purposes, stall recognition can be considered as stick shaker but as mentioned above there are many indications prior to stick shaker activation that should prompt the Stall recovery technique. Good airmanship requires us to keep an active watch on aircraft performance, which should keep the aircraft outside of an impending stall regime. It is also important to note that a stick shaker event is not yet a stall but it should still prompt an immediate stall recovery procedure

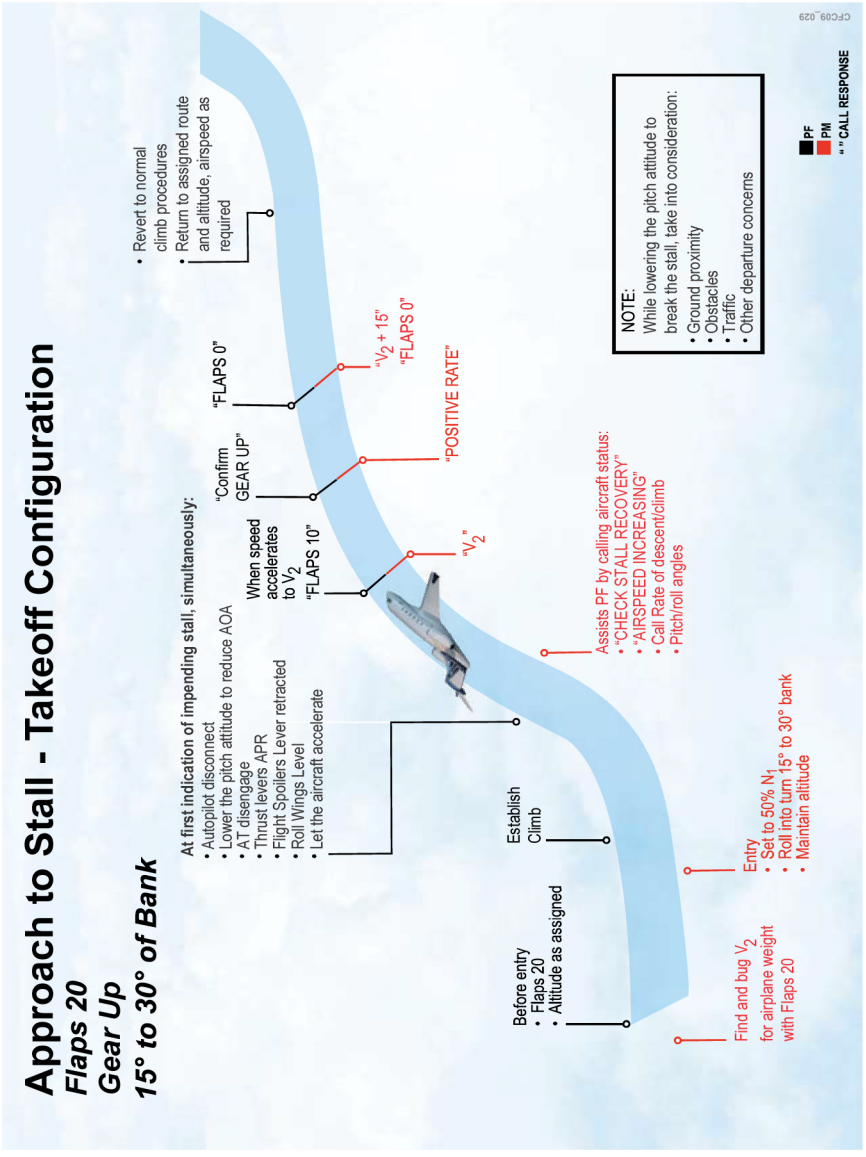
APPROACH TO STALL — TAKEOFF OR APPROACH CONFIGURATION FLAPS 20

The approach to stall–takeoff configuration is accomplished with flaps at 20° (Fig. 09–15–2). Prior to approaches to stalls, compute and set the airspeed bug to V_2 for the applicable weight. While slowing the aircraft, use the pitch trim to reduce control forces; however discontinue trim when reaching the computed V_2. This may be accomplished by displaying the FMS takeoff speeds.

Initially, stabilize the airplane at 180 kt. Configure the airplane with flaps 20°. Fly at 15° – 30° of bank. Power should be set to approximately 50% N1 to cause a slow deceleration to low–speed warning.

At the first indication of the low–speed warning or impending stall, perform the AFM stall recovery procedure. Altitude loss will occur and is expected. Emphasis must be on reducing the AOA to recover from the stalled condition. Do not change configuration when airspeed is below V_2. Once the airplane accelerates above V_2, flaps may be retracted to 10°. When a positive rate of climb is indicated, and when selected airspeed increases above V_2+15, then flaps 0 selected. Return to the original altitude and maintain present heading. Reduce thrust to recover to 180 kt or previously assigned speed. Once stabilized and recovery is underway, advise ATC and proceed as cleared.

As this profile addresses flaps 20 be certain to select proper V_2 if attempting an approach to stall Flaps 10. The V_2 speed is a factor of V_{SR} which changes with flap settings.



Approach to Stall – Takeoff or Approach Configuration
Figure 09–15–2

SECTION 5
TRAINING MANEUVERS

APPROACH TO STALL — LANDING CONFIGURATION

The approach to stall – landing configuration is accomplished fully configured and preferably in association with a published procedure (Fig. 09–15–3). Prior to accomplishing this approach–to–stall maneuver, compute and set the landing airspeed bugs for weight. This should be accomplished by displaying the FMS–based approach speeds (V_{REF} and V_{ga}).

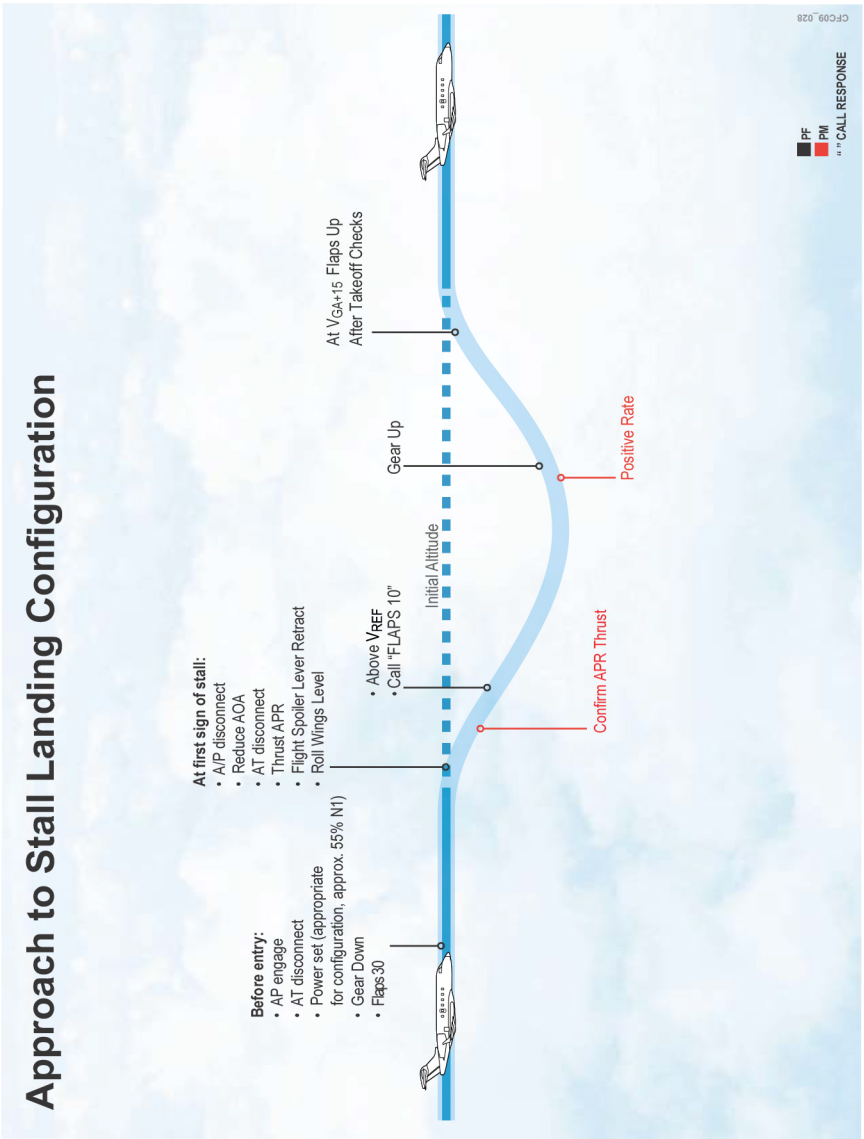
Configure the aircraft for landing in level flight. Set power to 55% N1. Slow to V_{REF}.

At the first indication of the low–speed warning or impending stall, perform the AFM stall recovery procedure. Altitude loss will occur and is expected. Emphasis must be on reducing the AOA to recover from the stalled condition.

Once the aircraft accelerates to a least V_{REF}, the flaps may be retracted to 10°. After a positive rate is attained, the gear may be retracted. When clear of obstacles, accelerate to V_{GA} +15 and retract flaps to 0. Once stabilized and recovered advise ATC and return to previously assigned altitude and heading or newly issued clearance.

When established on the appropriate heading and altitude, reduce the thrust to maintain 180 kt.

If accomplishing this maneuver in a flight simulator or training device, it is beneficial to conduct this maneuver in conjunction with a non–precision approach. The aircraft should be fully configured at the FAF. Allow the aircraft to descend at a rate sufficient to level off at the MDA prior to the VDP. Maintain V_{REF} during the descent. At level off, do not increase power. Allow the aircraft to activate the low–speed warning.



Approach to Stall – Landing Configuration
Figure 09–15–3

SECTION 5
TRAINING MANEUVERS

DEMONSTRATION OF THE STICK PUSHER

This maneuver is conducted in a **flight simulator or training device only**, not in the aircraft. This maneuver will be briefed in advance. It must be made clear to the customer trainee that this maneuver is to demonstrate the operation of the stick pusher.

This maneuver may be conducted in conjunction with any of the low–speed recovery maneuvers described previously. As the aircraft slows through the low–speed warning cue, the stick shaker will activate and the autopilot will disconnect. The customer trainee must hand fly the (simulator) while continuing to reduce speed. The stick pusher will activate. Allow the customer trainee to experience a full pusher recovery to normal flight.

Once pusher is activated allow the pusher to take the yoke out of your hands, at a normal AOA it shall release and you must be prepared to maintain a forward pressure. It must be clear to the pilot that a forward pressure must be maintained during initial “STALL RECOVERY” as it will tend to nose up and may cause secondary shaker and or pusher activation. Then the AFM stall recovery procedure can be completed as normal.

The low energy regime must be exited completely before resuming normal flight, much like any other stall.

SECTION 5
TRAINING MANEUVERS

HIGH ALTITUDE STALLS

This maneuver is conducted in a **flight simulator or training device only**, not in the aircraft, as it is a training requirement for certain authorities.

At higher altitudes, less power is available from the engines and an exchange of altitude for speed is required because the spool up time of the engines and speed/energy increase can be very slow from idle. Typically, a high altitude stall recovery is handled in what may seem as a counter intuitive method. Should the aircraft stall in cruise at 38000 ft, in addition to the normal stall recovery technique, you may be required to maintain a lower pitch attitude of minus 5 degrees below the horizon until the aircraft can recover a minimum energy of .72 Mach. Any recovery to level flight before these parameters are attained can leave you struggling on the wrong side of the power curve and may lead to secondary stalls. This may lead to a large altitude loss which can be as much as 5000 ft. ATC and crew communications can not be over emphasized.

Stall Recovery Procedure:

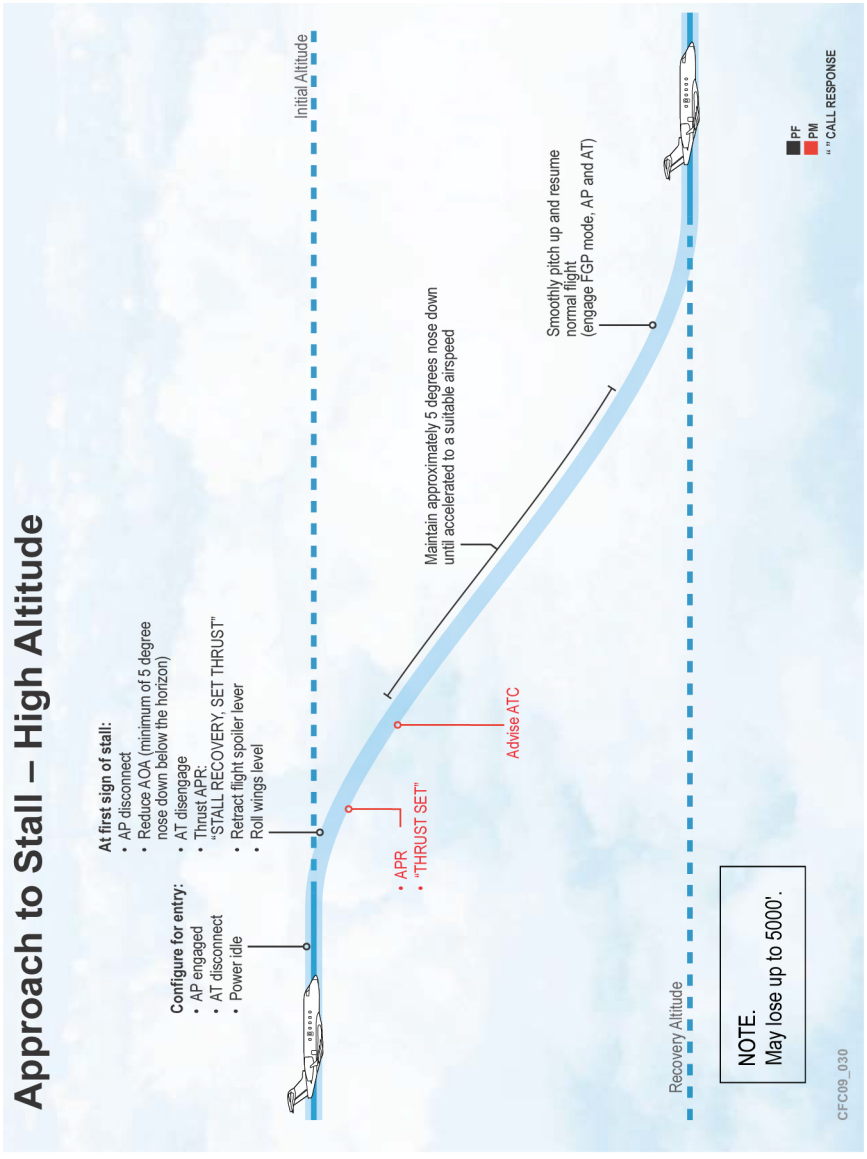
1. Autothrottle (if installed) ..... Disengage
2. Autopilot ..... Disconnect
3. Lower Pitch Attitude (target – 5 degrees below horizon)
4. Thrust Levers ..... APR
5. Spoilers ..... Retract
6. Roll Wings Level

END

Calls:

PF	PM
"Stall Recovery, Set N_1"	
	"N_1 Set"

The PM should advise ATC, monitor performance and voice energy (speed) returning and altitudes losses progressively until recovered.



Approach to Stall – High Altitude Stall
Figure 09–15–4

SECTION 5
TRAINING MANEUVERS

UNUSUAL ATTITUDE RECOVERY

It is important to maintain positive control of the aircraft by recognizing the airplane flight condition.

During a sudden or unknown change to an unusual attitude, verify the aircraft attitude using all available indicators. Use these references to make the proper recovery.

Aircraft upsets and unusual attitudes (UAs) can be caused by a number of factors including failure of attitude information, clear air turbulence, windshear, wake turbulence, engine failure, flight control problems, aircraft mishandling, or pilot inattention.

The first step in any upset recovery is to centralize the controls to avoid exacerbating the situation. Then an expeditious analysis of the aircraft pitch attitude, angle of bank, current airspeed, airspeed trend, rate of descent, and altitude. Make use of primary flight and performance instruments (PFD) when analyzing the situation; however, should their reliability be in doubt immediate reference must be made to the standby instruments. Except for the most minor upsets, it is generally advisable to disconnect both the autopilot and the autothrottle until the aircraft is recovered to normal conditions.

SECTION 5
TRAINING MANEUVERS

Immediate Actions

1. Centralize controls.
2. Analyze the situation: cross–check both primary and secondary attitude instruments.
3. Disengage the autopilot and autothrottle.
4. The pilot with the reliable attitude information assumes control and flies the recovery.
5. Check Airspeed:
   - Airspeed decreasing PF announces “NOSE HIGH RECOVERY”.
   - Airspeed increasing PF announces “NOSE LOW RECOVERY”.

END

NOSE HIGH — AIRSPEED SLOWING

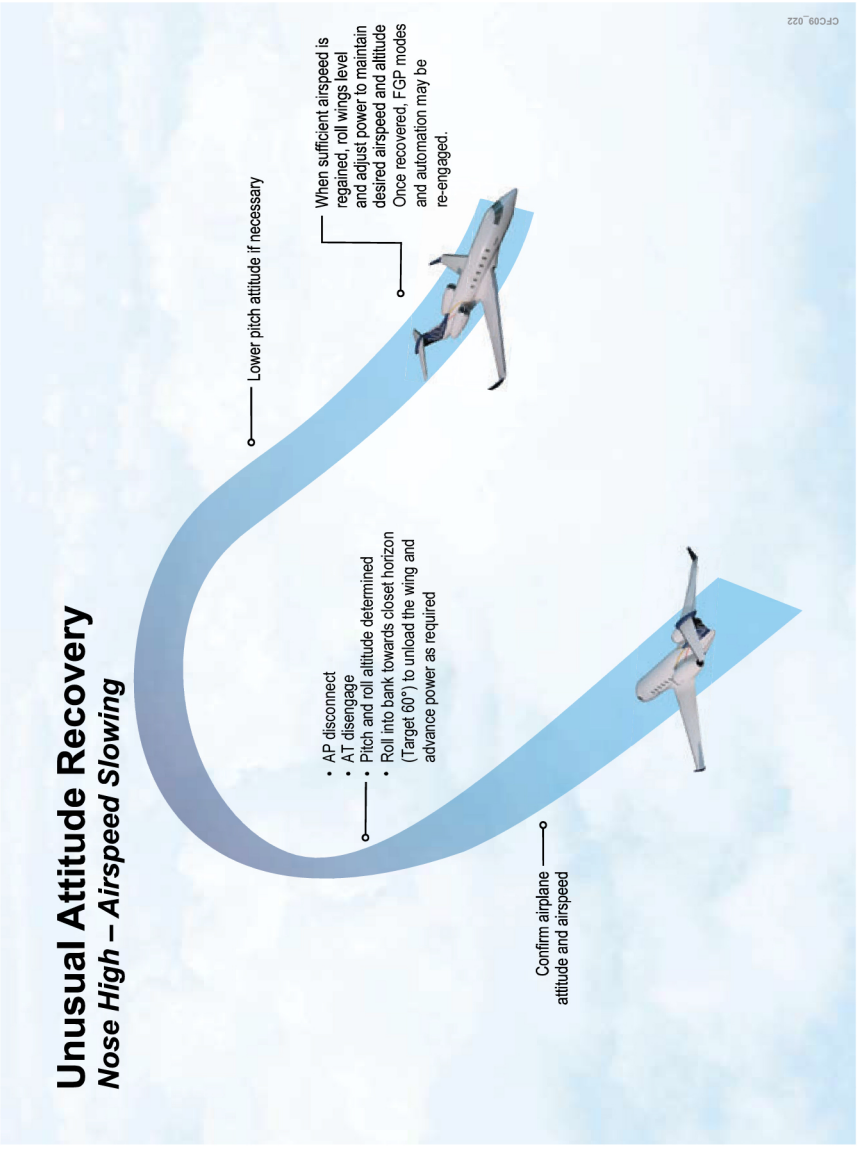
Once the nose high, airspeed slowing, increasing altitude indications are confirmed (cross check instruments), Disengage AT and AP. Roll the wings toward the nearest horizon to unload the wing (Target 60 degrees bank), while simultaneously applying full power and retract flight spoilers if used to counter the decreasing airspeed (Fig. 09–15–5). Allow the nose of the airplane to fall to the horizon. Roll wings level and return the airplane to level flight. Then adjust power to maintain the desired airspeed.

By targeting 60 degrees and releasing the back pressure on the yoke, the nose will have a natural tendency to drop rapidly, therefore achieving the primary objective – bring the nose down – without applying or exceeding any negative g loading. Once stable, re–engage automation and advise ATC. Resume normal flight and clearance if appropriate.

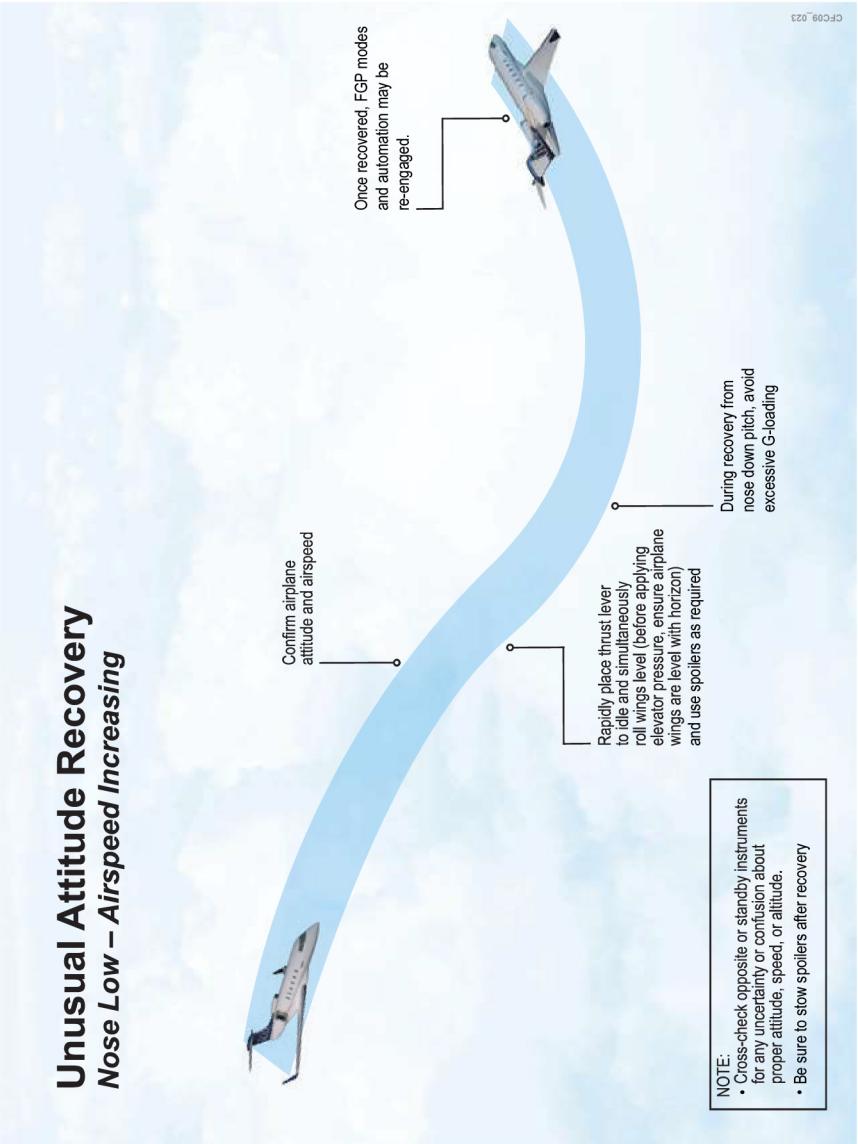
NOSE LOW — AIRSPEED INCREASING

Once the nose low, airspeed rapidly increasing and altitude decreasing condition is confirmed (cross check instruments), Disengage AT and AP. Rapidly place the thrust levers to idle and roll wings level to the horizon (Fig. 09–15–6). Spoilers usage may be necessary to prevent overspeed. Before adding elevator pressure, make sure the wings are level. Use elevator pressure to return the airplane to level flight, adjust the power and retract flight spoilers (if used) to maintain the desired indicated airspeed. Be careful not to over stress the aircraft while applying back pressure from nose down attitude (wing loading).

Once stable, re–engage automation and advise ATC. Resume normal flight and clearance if appropriate



Nose High – Airspeed Slowing
Figure 09–15–5



Nose Low – Airspeed Increasing
Figure 09–15–6

SECTION 6
SUPPLEMENTAL GUIDANCE

NOSEWHEEL STEERING (NWS) INOPERATIVE (INOP)

DISPATCH WITH NWS INOP/ NWS FAIL

Dispatch with NWS INOP, if authorized, must be in accordance with the approved MEL.

NOTE:
1. Takeoff with nosewheel steering (NWS) inoperative (INOP) must be performed in accordance with DDG/MMEL specific variant guidance. Included with the guidance is AFM Supplement 2 (Supplemental information for the MMEL) performance guidance.
2. For FAA–registered Challenger 350 airplanes, takeoff with NWS INOP is not authorized.
3. From a stopped position on the centerline of the runway, the Rolling Takeoff technique is recommended as described in the Flight Crew Operating Manual (FCOM) Chapter 9 (ROPAT) section 2 (NORMAL PROCEDURES & TECHNIQUES) with the takeoff distance impact per Airplane Flight Manual (AFM) Chapter 6 (Standard Performance Procedures).

When takeoff with NWS INOP is planned, the runway should be chosen to minimize crosswinds if possible. Maximum crosswind component for takeoff and landing is 15 knots.

Takeoff distance available should be greater than the calculated takeoff distance. As per the AFM Supplement 2 and MMEL/DDG guidance, the Dry and Wet Takeoff Field Length obtained from the applicable basic CAFM data must be increased by 1.0% (1.01 factor) when dispatching with NWS INOP.

In addition to this MMEL correction, the recommended rolling takeoff technique adds an extra 100 feet to the Takeoff Distance. Both corrections are cumulative. The CAFM calculator allows selection for the Nosewheel Steering Inoperative and Rolling Takeoff considerations.

The nosewheel steering system must be selected OFF. The nosewheel will be free castering.

Dispatch with NWS INOP is prohibited for the following conditions:

- Contaminated Runways
- Operations with Steep Approaches up to 5.5 degrees (AFM Supplement 10)

SECTION 6
SUPPLEMENTAL GUIDANCE

NWS INOP TAXI TECHNIQUE

When nosewheel steering (NWS) is inoperative (INOP), the nosewheel is free castering and taxi can be accomplished using differential braking. Application of differential braking will turn the airplane while it is moving. Differential thrust can be used in moderation to facilitate turns and to prevent slowing down excessively as a result of braking.

Anticipate turns and turn reversals or termination of turns because smooth opposite direction differential braking must be anticipated to facilitate tracking the desired route and to avoid jerky braking and associated discomfort for passengers. Above all, brake temperature management can be largely controlled by anticipating long in advance taxi needs through rudder and differential thrust. Sharp turns should be avoided as they require more braking action either to enter, exit or both.

Minimize prolonged use of sustained brake applications to not cause excessive increase of brake temperatures. This is especially important for NWS INOP taxi following a landing or RTO with aggressive braking.

Care must be exercised when making tight turns. Avoid castering the nosewheel to high angles approaching 90 degrees. Larger angles beyond 55 degrees up to 90 should be avoided. At extreme nosewheel angles, forward progress may no longer be possible and excessive lateral forces could be placed on nosewheel tires, potentially causing tire damage, tire coming off the wheel, deflation or damage to the nose gear. A tow bar may be required to straighten the nosewheel. If there is any doubt, the airplane should be stopped until a tow can be arranged.

NWS INOP TAKEOFF TECHNIQUE

NOTE: NWS failure could occur during the takeoff roll. The **NWS FAIL** CAS message is Takeoff Inhibited above 80 KIAS, thus the TO below 80 KIAS should be aborted and care needs to be taken. After the decision to reject the takeoff, use the NWS Landing Technique to safely stop on the runway. The nosewheel will be free castering after the NWS failure. Once at safe taxi speed, use the NWS INOP taxi technique. After 80 KIAS you should not notice the steering inoperative and once airborne (and above 400 feet), the CAS message should appear, which you will need for landing.

Minimize sharp turns entering the runway. Confirm that the airplane is lined up with the runway, ensure the nosewheel is also tracking in line with the runway before application of takeoff thrust.

As the airplane accelerates, maximize use of rudder via pedal input to maintain centerline control. If additional directional control is required at slower speed, modulate differential brake input (enough input to prevent or correct an undesired drift, but not enough to grossly impact normal acceleration) until aerodynamic forces on the rudder provide control. AFM Supplement 2 performance correction provides for differential braking during acceleration.

Additional takeoff distance must be considered when using this technique.

NOTE:

1. Higher crosswinds will adversely impact centerline control.
2. Do not ride the brakes.
3. When runway length available is approaching runway length required, operators should consider not dispatching with NWS INOP.
4. In the event of rejected takeoff, the crew should apply maximum braking as much as practicable and, if required, slightly reduce pedal pressure on applicable brake to maintain directional control, **i.e. reduce the brake on the pedal opposite of the desired direction**.

LANDING WITH NOSEWHEEL STEERING INOP

When a landing with NWS INOP is planned, the following apply:

- Choose the longest, widest available runway with minimum crosswind and turbulence to provide maximum deviation space and reduce pilot workload.
- Landing distances may be greater than for a normal landing because of the requirement to use differential or asymmetric braking for directional control as aerodynamic rudder control diminishes. The calculated landing distances are based upon a maximum symmetric brake application to a stop. Deviations from this technique, including asymmetric braking and less than maximum brake application, will increase the required stopping distance. Crews must properly account for this increase when selecting a landing runway.
- Select NWS to the OFF position.

If NWS fails during landing rollout, despite possible associated CAS message(s)/aural tone, crew awareness may be delayed until the airplane path deviates directionally even with significant pedal input to counter drift. Once aware, the pilot requires prompt transition to appropriate technique. Do not attempt to troubleshoot during the rollout.

SECTION 6
SUPPLEMENTAL GUIDANCE

NWS INOP AFTER LANDING TECHNIQUE

The nosewheel will be free castering. As speed decreases, directional control will gradually transition from primarily aerodynamic control via rudder input, to differential braking. This will become apparent with ever–increasing rudder input to deflection limit. Approaching pedal travel limit, start applying appropriate differential brake input to control centerline.

During aggressive braking (large brake pedal application), precise differential braking may be more difficult to modulate. With large rudder pedal deflections, precise differential brake application on either pedal may require more conscious effort. In all cases, strict attention should be paid to prevent inadvertent brake application on the aft–moving brake pedal. Elevated crosswinds will adversely impact centerline control, making the task more difficult and may result in high asymmetric brake temperature.

At taxi speed, use differential braking and differential thrust to clear the runway. Use of high–speed turnoffs should be considered only when directional control is well in hand and conditions permit.

If directional control becomes difficult, the airplane should be stopped until a tow can be arranged.

SECTION 7
RNP AR PROCEDURES

GENERAL

Operator must receive approval from authorities before performing RNP AR approaches. Approved training must be accomplished and SOPs implemented. The following covers RNP AR specific supplemental items that require attention. General operating preflight and flight procedures, technical requirements, and failures cases are not specifically addressed. AFM supplement 7 shall be used for limitations and compliance.

Effective 2021, the FAA has required that the operators supply the vendors with written approval prior to releasing RNP AR databases. Companies such as Collins have since removed RNP AR approaches from their database. A separate database including RNP AR approaches remains available upon request when accompanied by authority approval.

NOTE: The following procedures assume a fully functional aircraft. Impact of failures or MEL items shall be validated through **AFM Supplement 7**. In all cases, the required equipment list supersedes MEL relief, unless RNP AR is specifically addressed in the operator's MEL. For additional information, also refer to Equipment Failures in the FCOM 1.

PREFLIGHT

1. Verify validity of the navigation database for ETA and confirm RNP AR NAV database is loaded
2. On GNSS CONTROL page, confirm GNSS 1 and 2 ENABLED
3. If no SBAS is available and/or enabled, check RAIM at ETA (confirm SBAS status on GNSS STATUS pages 1 and 2)

SECTION 7
RNP AR PROCEDURES

BEFORE COMMENCING APPROACH

1. Load desired approach from FMS database (compare approach title with approach chart title):
   (a) Do not modify the lateral path, with the exception of going Direct to Fix (DF), as long as that fix is prior to the final approach fix (FAF) and does not immediately precede an RF leg.
   (b) ARRIVAL DATA – confirm APPR MODE is RNP AR, RNP FAF–MAP value is 0.30, GP mode is BARO, WGS–84 is YES
   (c) LEGS page – Crosscheck route (waypoints, RF legs courses, descent angles, GP angles) and constraints with approach chart; Map PLAN view should be displayed for best RF Legs confirmation
   (d) LEG INFO – verify RNP values associated with different segments (0.30 or greater for final segment, 1.00 for missed approach segment)
   (e) Do not modify the lateral track on the LEGS page. Altitude/Airspeed waypoints may not be changed on the final leg
2. TEMP COMP as required
3. Altimeters set to local QNH (RNP AR not authorized for remote altimeter setting)
4. Verify both altimeters within 75 feet
5. The autopilot must be engaged between the final approach point FAP/ FAF and the missed approach point on RNP AR approaches. Both flight directors must be operational and independently displayed.
6. EPU value within limits (see note below)
   (a) Verify EPU value on PFD or FMS PROGRESS page 2/2
   (b) Check no LOW POSITION ACCURACY message

NOTE: If EPU is greater than RNP or EPU is invalid for 8 seconds during approach phase of flight or 28 seconds at any other time, it will generate a **LOW POSITION ACCURACY** message on FMS CDU. The EPU is a total system error calculation by the FMS based on sensors available for position updates. Use this for Situational Awareness (SA).

CAUTION: RNP AR Approach operations are approved for RNP AR Approaches greater than or equal to RNP 0.3 in the approach segment and RNP 1.0 in the missed approach segment.

SECTION 7
RNP AR PROCEDURES

APPROACH BRIEFING

Standard approach briefing as per FCOM 1 should be performed with the addition of RNP AR segment speed restrictions and supplemental standard calls (see tables below). Contingency plans specific to the approach to be flown must be briefed, including but not limited to:

1. Equipment failure (Refer to Equipment failures subsection)
   (a) Before commencing approach
   (b) After approach is commenced
2. Loss of VNAV
3. Initiating a missed approach on a RF Leg
4. Missed Approach Considerations
5. Any potential hazard due to terrain, wind variation or a combination of both. If information and/or terrain is conducive to windshear, flight crew should emphasize the planned recovery maneuver during an RF leg.

MAXIMUM SPEEDS IN RNP AR RF LEGS

MAXIMUM SPEEDS IN RF LEGS – TERPS REQUIREMENTS					
SEGMENT	INDICATED AIRSPEED BY AIRCRAFT CATEGORY				
	CAT A	CAT B	CAT C	CAT D	CAT E
Initial and Intermediate (IAF to FAF)	150	150	250	250	250
FINAL (FAF to DA)	90	120	140	165	As Spec
Missed Approach (DA to MAHP)	110	150	250	265	As Spec
MAXIMUM SPEEDS IN RF LEGS – PANS OPS REQUIREMENTS					
SEGMENT	INDICATED AIRSPEED BY AIRCRAFT CATEGORY				
	CAT A	CAT B	CAT C	CAT D	CAT E
Initial and Intermediate (IAF to FAF)	150	180	240	250	250
FINAL (FAF to DA)	100	130	160	185	As Spec
Missed Approach (DA to MAHP)	110	150	240	265	As Spec

SECTION 7
RNP AR PROCEDURES

SUPPLEMENTAL STANDARD CALLS DURING RNP AR APPROACH

PHASE OF FLIGHT	CONDITION	PF	PM
RNP AR APPROACH	31 NM from the 1st way point on the RNP AR approach	CHECK	RNP AR ARM
	At IAF	CHECK	RNP AR APPR
	1/2 Dot Deviation from Glidepath	CORRECTING	GLIDEPATH
	1 Dot Deviation from Lateral Track	CORRECTING	TRACK
	Passing MAP on missed approach	CHECK	RNP AR MA

WHEN CLEARED FOR THE RNP AR APPROACH

1. Verify two independent FMS as the active NAV SRC
2. Arm APPR and Engage VNAV (or confirm active)
3. Confirm ADC and IRS independent sources on each PFD
4. TAWS should be operational and displayed
5. It will show RNP AR ARM when within 31 NM of a waypoint on the approach. Other RNP approaches use the destination airport, RNP ARs are different.
6. Altitude Preselector:
   (a) Select FAF/ FAP altitude until VGP is the active vertical mode on FMA
   (b) Select Missed Approach Altitude when VGP is captured
7. Adhere to published speed limits and segment speed limits
8. Confirm RNP AR APPR displayed on PFD at the IAF or Transition Waypoint
9. Confirm Lateral Deviation Scale RNP value indicates 0.30 prior to 2 NM from FAF/ FAP
10. Monitor EPU value throughout approach

EXCESSIVE LATERAL OR VERTICAL DEVIATION

Discontinue Approach when:

- Excessive Lateral deviation (2 dots/1×RNP), or
- Excessive Vertical deviation (1 dot below path/–75'), or
- Either lateral or vertical scale shows an amber flashing display

MISSED APPROACH

The lateral track must be followed to the MAP and the MAHP, unless clear of obstacles or otherwise instructed by ATC. Pressing TOGA will sequence the lateral mode from APPR to NAV (LNV on FMA), and the vertical mode to GA. When conducting a go–around at any point during the approach, continue to follow the RNP AR approach lateral track and speed constraints until established at or above the min safe altitude.

Depending on ATC instructions or other requirements, initiating a GA early on the approach may require modification of the GA profile. Selecting GA and the ensuing GA thrust and GA pitch guidance may not be required or appropriate (for example maintaining altitude and speed constraints associated with portion(s) of RNP AR approach). In all cases, the PF will determine the appropriate thrust and aircraft configuration to meet the required profile and transition. It is essential to precisely follow the published approach track up to minimum safe altitude while maintaining any speed constraints. Altitude preselect may need to be reset to meet the changed requirement(s). For autothrottle installed aircraft, pressing TOGA will cause AT to activate thrust mode and subsequently go–around power. Depending on the situation and aircraft position along the RNP AR approach, GA power might be inappropriate for speed constraints. V_S vertical mode could be used with AT in speed mode for proper vertical tracking and speed constraint adherence.

Altitude preselect may need to be reset to meet the changed requirement(s). If TOGA is not used to trigger the GA, then the crew must ensure the FMS is sequenced appropriately. Ensure the SPEED bug is set appropriately.

Upon reaching the FAF/ FAP, the FMS transitions to SEQ INHB (sequence inhibit). When TOGA is selected, GA will re–enable auto–sequencing (AUTO).

NOTE: When responding to a TAWS alert, see Call out box, avoid deviating from lateral track due to protected airspace constraints.

SECTION 7
RNP AR PROCEDURES

EQUIPMENT FAILURES

NAVIGATION EQUIPMENT

An RNP AR approach must not be commenced or continued unless the required navigation equipment, as specified in the RNP AR Approach Required Equipment List found in AFM Supplement 7, replicated below, are operating satisfactorily.

RNP AR APPROACH – REQUIRED EQUIPMENT LIST	
Equipment	**Prior to Approach**
Yaw damper and autopilot	Both must be operational
PFD 1 and 2	One (1) PFD available and operational for each side
ADC 1 and 2	Two (2) ADCs must be operational
GNSS 1 and 2	Two (2) GNSS sensors must be available to commence the approach; one (1) GNSS sensor is required to continue the approach
FMS 1 and 2	Two (2) FMSs must be available and operational for each side
IRS 1 and 2 (ATT and HDG)	Two (2) IRSs must be operational
TAWS	TAWS must be operational and displayed
FD 1 and 2	Two (2) FDs must be operational and independently displayed

RNP AR Approach operations are approved with Autothrottle engaged or disengaged (if installed).

NOTE: An approach is considered to be commenced once past the IAF.

SECTION 7
RNP AR PROCEDURES

APPROVED FLAPS SETTINGS

RNP AR Approach operations are approved for any FLAP configuration up to the FAF and FLAP 30 from FAF to MAP.

ENGINE FAILURE

RNP AR Approach operations are approved following failure of one engine.

NOTE: As a contingency plan briefing, one could decide that an engine failure while flying an RF Leg would trigger an immediate go–around. If a go–around is conducted, continue to follow the RNP AR approach lateral track and speed constraints until established at or above the min safe altitude.

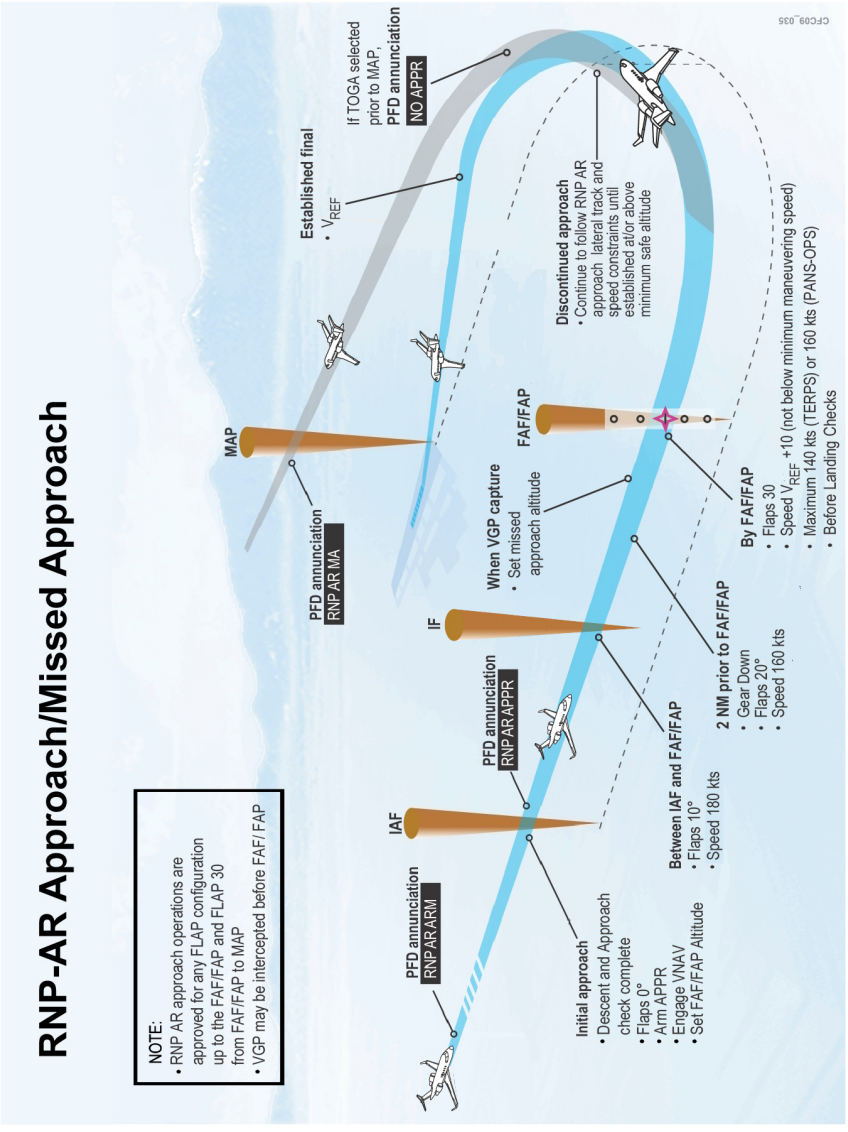
NO APPR CAUTION MESSAGE ON PFD

A NO APPR caution message on PFD can be triggered by numerous causes. In all cases, the approach shall be discontinued.

EFIS PARAMETER MISCOMPARE

The approach shall be discontinued when **EFIS MISCOMP** caution message is displayed and is accompanied by amber **ALT** annunciation on PFD.

NOTE: When conducting a go–around, at any point during the approach, continue to follow the RNP AR approach lateral track and speed constraints until established at or above the min safe altitude.



RNP AR Approach/Missed Approach
Figure 09–17–1

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FOR AVIATORS, BY AVIATORS.

LOFT.AERO