Transport Canada Transports Canada

Advisory Circular

Subject:	**Compliance with Regulations and Standards for Engine-Inoperative Obstacle Avoidance**		
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1.0 INTRODUCTION

This Advisory Circular (AC) is provided for information and guidance purposes. It may describe an example of an acceptable means, but not the only means of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements nor does it establish minimum standards.

1.1 Purpose

Sections 704.47 and 705.57 of the *Canadian Aviation Regulations* (CARs) are the Part VII regulations applicable to Net Take-off Flight Path. These regulations require that the weight of an aeroplane be limited during take-off to ensure that obstacles are cleared by the prescribed margins and that engine out departures are planned in accordance with the criteria provided in these regulations. The Standard for Take-off Minima - Sections 723.30, 724.26 and 725.34 of the *Commercial Air Service Standard* (CASS) requires that the Company Operations Manual shall contain guidance on how to determine one engine inoperative climb gradient and obstacle clearance.

1.2 Applicability

This document is applicable to all Transport Canada Civil Aviation (TCCA) employees, to individuals and organizations when they are exercising privileges granted to them under an External Ministerial Delegation of Authority. This information is also available to the aviation industry for information purposes.

1.3 Description of Changes

Not Applicable.

2.0 REFERENCES AND REQUIREMENTS

2.1 Reference Documents

It is intended that the following reference materials be used in conjunction with this document:

(a) *Aeronautics Act*;

(b) Part VII, Subpart 04 of the *Canadian Aviation Regulations* (CARs)—*Net Take-off Flight Path;*

(c) Part VII, Subpart 05 of the CARS—*Net Take-off Flight Path;*

(d) Standard 723, Section 30 of the *Commercial Air Service Standard* (CASS*)—Take-off Minima;*

(e) Standard 724, Section 26 of the *Commercial Air Service Standard* CASS—*Take-off Minima;*

(f) Standard 724, Section 47 of the CASS—*Net Take-off Flight Path;*

(g) Standard 725, Section 34 of the CASS—*Take-off Minima;*

(h) Standard 725, Section 57 of the CASS—*Net Take-off Flight Path;*

(i) Transport Publication (TP) 308, Edition 1, 1996-07-01—*Criteria for the Development of Instrument Procedures;*

(j) Chapter 525 of the Airworthiness Manual (AWM)—*Transport Category Aeroplanes;*

(k) *Commercial and Business Aviation Advisory Circular* (CBAAC) No. 0141, 1998-05-13—*Notice to Pilots and Air Operators—Low-Energy Hazards / Balked Landing/Go-around*;

(l) TP 312, Edition 4, dated March 2003 (revised March 2005)—*Aerodromes Standards and Recommended Practices;*

(m) TP 12772, dated September 1996—Aeroplane Performance;

(n) TP 14371, effective 2008-04-10 to 2008-05-08—*Aeronautical Information Manual;*

(o) TP 14727, Edition 1, dated November 2007—*Pilot Proficiency Check and Aircraft Type Rating, Flight Test Guide (Aeroplane);*

(p) Federal Aviation Administration Advisory Circular (FAA AC) 25-7A, 1998-03-31—*Flight Test Guide for Certification of Transport Category Airplanes;*

(q) FAA AC 120-91, 2006-05-05—*Airport Obstacle Analysis;*

(r) FAA AC 120-29A, 2002-08-12—*Criteria for Approval of Category I and Category II Weather Minima for Approach;*

(s) FAA Regulation FAR Part 25—Airworthiness Standards: Transport Category Airplanes;

(t) FAA Regulation FAR Part 77—Objects Affecting Navigable Airspace;

(u) Australian Government, Civil Aviation Authority, Civil Aviation Advisory Publication, CAAP 235-4(0), dated November 2006. Acknowledgement: Copyright Commonwealth of Australia reproduced by permission;

(v) *International Civil Aviation Organization* (ICAO) Annex 6 – *Operation of Aircraft,* Attachment C to ICAO Annex 6, Part 1—*Aeroplane Performance Operating Limitations,*—Example 3, Section 3—*Take-Off Obstacle Clearance Limitations;*

(w) ICAO Annex 10, Aeronautical Communications, Volume 1, Radio Navigation Aids; and

(x) *Joint Aviation Authorities* (JAA) JAR-OPS 1, Amendment 10, 2006-03-01—*Commercial Air Transportation (Aeroplanes);*

2.2 Cancelled Documents

As of the effective date of this document, the following document is cancelled:

(a) Air Carrier Advisory Circular (ACAC) No. 0110R, 1998-03-06—*Notice to Air Operators—Net Take-Off Flight Path—Implementation Date for Cross-wind accountability*.

2.3 Definitions and Abbreviations

The following definitions and abbreviations are used in this document:

(a) **Actual Flight Path (Ref. Figure 2.3.1)**: The actual vertical flight path the aeroplane is expected to achieve when loaded at a weight to satisfy the required vertical clearances along the Net Take-off Flight Path. The Actual Flight Path is also referred to as the Gross Flight Path.

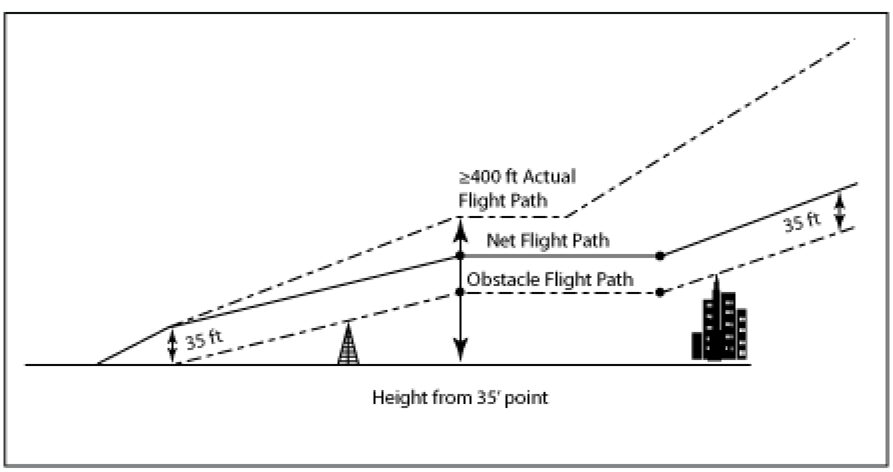

Figure 2.3.1 Net Take-off Flight Path (Ref. FAA AC 25-7A)

(b) **AEO**: All Engines Operating.

(c) **Aerodrome**: any area of land, water (including the frozen surface thereof) or other supporting surface used, designed, prepared, equipped or set apart for use either in whole or in part for the arrival, departure, movement or servicing of aircraft and includes any buildings, installations and equipment situated thereon or associated therewith;

(d) **Aeroplane**: means a power-driven heavier-than-air aircraft that derives its lift in flight from aerodynamic reactions on surfaces that remains fixed during flight.

(e) **AFM**: Aircraft Flight Manual.

(f) **Air Operator**: means holder of an air operator certificate.

(g) **Airport**: "airport" means an aerodrome in respect of which a Canadian aviation document is in force.

(h) **Area Analysis Method**: The Area Analysis Method defines an obstacle accountability area (OAA) within which all obstacles must be cleared vertically by the regulatory requirements.

(i) **ATC**: Air Traffic Control.

(j) **Balked Landing**: A discontinued landing attempt. The term is often used in conjunction with aircraft configuration or performance assessment, as in “Balked landing climb gradient; also see: “Rejected Landing.”

(k) **Cleanup**: The process of transitioning from a flaps extended to a clean configuration, and includes any changes in thrust or power settings.

(l) **Climb Gradient**: The ratio of change in height, during a portion of a climb, to the horizontal distance traversed in the same time period.

(m) **Close In Obstacle**: An obstacle located within the aerodrome (airport) boundaries.

(n) **Company Operations Manual (COM)**: A manual established by an air operator pursuant to Part VII (of the CARs).

(o) **Complex EODP**: EODPs that require immediate turns, multiple turns, or turns with variable bank angles. Complex EODPs may include shuttle climbs, speed restrictions, specific configurations, or any other unique operational requirements.

(p) **Controlling Obstacle**: The critical obstacle that establishes the required climb gradient.

(q) **Corpscon**: A publicly available US Army windows based software tool used to translate coordinates from NAD 27 to NAD 83 and HARN.

(r) **DEM**: Digital Elevation Model.

(s) **DRG**: Digital Raster Graphic.

(t) **Engine Out Departure Procedure (EODP)**: An EODP for the purposes of this AC is the published engine-out departure procedure for flight crew use. EODPs are published as specific routes to be followed together with procedure design gradients and details of significant obstacles. EODPs have a number of names as adopted by industry, including Engine Out Contingency Procedures, Engine Out Escape Paths, Engine Out SIDs (EOSIDs) and Special Engine Out (Departure) Procedures.

(u) **Engine Out Missed Approach Procedure (EOMAP)**: An EOMAP for the purposes of this AC is the published engine-out missed approach procedure for flight crew use. EOMAPs are published as specific routes to be followed together with procedure design gradients and details of significant obstacles.

(v) **Engine Out Procedure**: For the purposes of this AC, a term to describe either an Engine Out Departure Procedure (EODP) or Engine Out Missed Approach Procedure (EOMAP).

(w) **FAA**: Federal Aviation Administration.

(x) **FAA "Still Air Corridor"**: A rectangular Obstacle Accountability Area based on the obstacle clearance requirements contained in FAR 121.189(d)(2) and without accountability for the effects of crosswind or other errors on the ground track of the aircraft.

(y) **FAR**: Federal Aviation Regulation.

(z) **Flight Track Analysis Method**: The Flight Track Analysis Method is an alternative means of defining an OAA based on the navigational capabilities of the aircraft.

(aa) **FMS**: Flight Management System.

(bb) **Geometric Altitude**: The true altitude of the aircraft referenced to mean sea level.

(cc) **Geometric Height**: The true height of the aircraft in relation to a specific datum.

(dd) **GIS**: Geographic Information System.

(ee) **GNSS**: Global Navigation Satellite System.

(ff) **Go-around**: A transition from an approach to a stabilized climb.

(gg) **GPS**: Global Positioning System, a U.S. spaced based GNSS.

(hh) **Gross Flight Path (Ref. Figure 2.3.1)**: The actual vertical flight path the aeroplane is expected to achieve when loaded at a weight to satisfy the required vertical clearances along the Net Take-off Flight Path. The Gross Flight Path is also referred to as the Actual Flight Path.

(ii) **Gross Gradient**: Climb gradient expressed as a percentage ratio, obtained using the following formula: Change in height divided by the horizontal distance travelled x100. The gross gradient is the actual gradient the aeroplane is expected to achieve for a given set of conditions.

(jj) **Gross Level-off Height**: Actual (Gross) geometric height above take-off surface for the flight acceleration segment.

(kk) **Gross Height**: The geometric height attained at any point in the take-off flight path using gross climb performance. Gross height is used for calculating actual pressure altitude at which obstacle clearance procedures and wing flap retraction are initiated, and level-off height scheduled.

(ll) **HARN**: High Accuracy Reference Network; A state-wide or regional upgrade of NAD 83 coordinates using GPS observations.

(mm) **Height**: The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

(nn) **Height Above Touchdown (HAT)**: The height in feet of the Decision Height (DH), Decision Altitude (DA) or the Minimum Descent Altitude (MDA) (for straight in approaches) above the Touchdown Zone Elevation.

(oo) **ICAO**: International Civil Aviation Organization.

(pp) **ICAO “Splay”**: An obstacle accountability area of prescribed dimensions as contained in ICAO Annex 6 – Operation of Aircraft, Attachment C, to ICAO Annex 6, Part 1 – Aeroplane Performance Operating Limitations.

(qq) **IFR**: Instrument Flight Rules.

(rr) **IFR Departure Procedure**: Published procedures which, if followed will ensure obstacle and terrain clearance of an IFR departure. IFR departure procedures are based on the premise that on departure an aircraft will:

(i) Cross at least 35 feet above the departure end of the runway;

(ii) Climb straight ahead to 400 feet above the aerodrome elevation before turning; and

(iii) Maintain a climb gradient of at least 200 feet per NM throughout the climb to the minimum altitude for enroute operations.

Note:

IFR departure procedures assume normal aircraft performance in all cases; i.e. All Engines Operating.

(ss) **IMC**: Instrument Meteorological Conditions.

(tt) **Improved Climb Performance/Overspeed Take-off**: An approved procedure for increasing take-off speeds to improve climb performance if runway conditions and dimensions allow.

(uu) **Low Energy Landing Regime**: For the purposes of this AC, 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. An attempt to conduct a rejected or balked landing from a low-energy landing regime may result in ground contact.

(vv) **Missed Approach (Procedure)**: The flight path followed by an aircraft after discontinuation of an approach procedure and initiation of a go-around. Typically a “missed approach” follows a published missed approach segment of an instrument approach procedure, or follows radar vectors to a missed approach point, return to landing, or diversion to an alternate.

(ww) **NAD27**: North American Datum of 1927. Replaced by NAD83 in 1986.

(xx) **NAD83**: North American Datum of 1983. The geodetic reference datum adopted in 1986 by the U.S., Canada and Central America for two-dimensional horizontal control.

(yy) **Net Gradient**: The gross gradient reduced by the required margins.

(zz) **Net Height**: The geometric height attained at any point in the take-off flight path using net climb performance.

(aaa) **Net Take-off Flight Path ((NTOFP) Ref. Fig 2.3.1)**: The net take-off flight path is the gross take-off flight path diminished by the required margins (0.8% for two-engine Transport Category aeroplanes) or the equivalent reduction in acceleration along that part of the take-off flight path at which the aeroplane is accelerated in level flight. The net take-off flight path must clear all obstacles within a prescribed area by at least 35 feet vertically.

(bbb) **NGS**: National Geodetic Survey.

(ccc) **NM**: Nautical Mile.

(ddd) **Non-Standard Climb Gradient**: A climb gradient associated with an instrument procedure that exceeds 200 feet per nautical mile.

(eee) **NOTAM**: Notice to Airmen.

(fff) **NTOFP**: Net Take-Off Flight Path.

(ggg) **OAA**: Obstacle Accountability Area.

(hhh) **Obstacle**: An existing object, object of natural growth, or terrain at a fixed geographical location or which may be expected at a fixed location within a prescribed area with reference to which vertical clearance is or must be provided during flight operations.

(iii) **Obstacle Flight Path (Ref. Figure 2.3.1)**: An artificial flight path as defined by the obstacles underneath the Take-off Flight Path.

(jjj) **OCS**: Obstacle Clearance Surface.

(kkk) **OEI**: One Engine Inoperative.

(lll) **Operations Manual**: A manual containing procedures, instructions and guidance for use by operational personnel in the execution of their duties.

(mmm) **PANS-OPS**: (ICAO) Procedures for Air Navigation Services – Aircraft Operations.

(nnn) **Reference Zero**: The point at which the aeroplane is 35 feet above the take-off surface at the end of the *Take-off Distance*. Reference Zero is the same point where the *Take-off Flight Path* begins.

(ooo) **Rejected Landing**: A discontinued landing attempt. A rejected landing typically is initiated at low altitude but prior to touchdown. If from or following an instrument approach it typically is considered to be initiated below DA(H) or MDA(H). A rejected landing may be initiated in either VMC or IMC. A rejected landing typically leads to or results in a “go around” and if following an instrument approach, a “Missed Approach”. If related to the consideration of aircraft configuration(s) or performance it is sometimes referred to as a “Balked Landing”.

(ppp) **Runway strip**: A defined area including the runway and stopway, if provided, intended to reduce the risk of damage to aircraft running off a runway; and to protect aircraft flying over it during take-off or landing operations.

(qqq) **RVR**: Runway Visual Range.

(rrr) **Screen Height**: The height of the aeroplane at the end of the Take-off Distance.

(sss) **Segments of the Take-off Flight Path**: The take-off Flight Path may be constructed from four or more segments depending on how the take-off flight path has been certified for a specific aeroplane type.

(i) **First Segment**: The first segment starts from the height of 35 feet above the take-off surface and extends to the point where the landing gear is fully retracted, at a constant V2 speed and flaps in the take-off position;

(ii) **Second Segment**: The second segment starts at the point at which the landing gear is fully retracted up to at least 400 feet above the runway, flown at V2 speed and flaps in take-off position;

(iii) **Third (Acceleration) Segment**: The acceleration segment is the part of the take-off flight path that begins at the end of the second segment and extends horizontally over the distance to completely retract the flaps and accelerate to the final take-off climb speed; and

(iv) **Fourth (Final) Segment**: The final segment starts from the end of the acceleration segment and extends to the end of the take-off flight path, flown at the final segment climb speed in the clean configuration;

(ttt) **SID**: Standard Instrument Departure.

(uuu) **SITA**: Specialists in Air Transport Communications and IT solutions.

(vvv) **Standard Cleanup Altitude**: A standard altitude selected by air operators for the third (acceleration) segment.

(www) **Standard Instrument Departure (SID)**: A pre-planned IFR air traffic control departure procedure published in graphic and textual form, for the use of pilots and controllers. Standard Instrument Departures (SIDs) provide transition from runways to the appropriate enroute structure.

(xxx) **Take-off Path**: The take-off path begins from a standing start and ends at 1500 feet above the take-off surface or at the point where the transition from take-off to the enroute configuration is completed, whichever is higher.

(yyy) **Take-off Flight Path (Ref. Figure 2.3.2)**: The take-off flight path begins at the end of the take-off distance and at a height of 35 feet above the take-off flight surface and ends at 1500 feet above the take-off surface or at the point where the transition from take-off to the enroute configuration is completed, whichever is higher. This is also known at the Gross Take-off Flight Path.

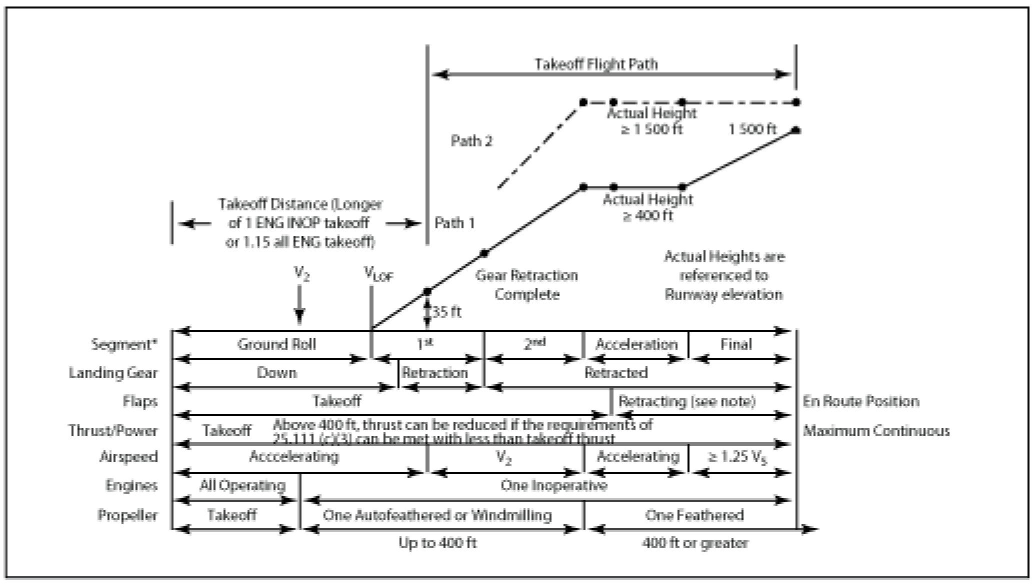

Figure 2.3.2 Take-off Segments and Nomenclature (Ref. FAA AC 25-7A)

(zzz) **TAWS**: Terrain Awareness and Warning System.

(aaaa) **TERPS**: United States Standard for Terminal Instrument Procedures.

(bbbb) **Touchdown Zone (TDZ)**: The first 3,000 feet of runway or the first third of the runway, whichever is less, measured from the threshold in the direction of landing.

(cccc) **Touchdown Zone Elevation (TDZE)**: The highest elevation in the touchdown zone.

(dddd) **TP**: Transport Canada Publication.

(eeee) **UTM**: Universal Transverse Mercator; A series of Transverse Mercator map projections used to represent the surface of the Earth.

(ffff) **V1**: Take-off Decision Speed (formerly denoted as critical engine failure speed).

(gggg) **VR**: Rotation Speed.

(hhhh) **V2**: Take-off Safety Speed.

(iiii) **VGA**: Go-Around Speed.

(jjjj) **VMC**: Visual Meteorological Conditions.

(kkkk) **VMCA**: Minimum Control Speed Air with the critical engine inoperative.

(llll) **VOR**: Very High Frequency Omni-directional Range.

(mmmm) **VREF**: Landing Reference Speed.

(nnnn) **WAAS**: Wide Area Augmentation System.

(oooo) **WGS-84**: World Geodetic System 1984 is a spatial reference system that was created to be used solely by Global Navigation Satellite Systems (GNSS). All GNSS receivers produce positions in WGS-84.

3.0 BACKGROUND

(1) Sections 704.47 and 705.57 of the CARs require that the weight of an aeroplane is limited to ensure vertical and horizontal clearance from obstacles along a net take-off flight path. The criteria within Sections 704.47 and 705.57 of the CARs are essentially identical. In addition, the Commercial Air Service Standards (CASS) for Runway Visual Range (RVR) 1200 and 600 take-offs, Sections 723.36, 724.26 and 725.34 require obstacle clearance criteria be met when conducting take-offs below standard minimum Instrument Flight Rules (IFR) visibilities.

(2) The vertical obstacle requirements of the obstacle clearance regulations are well defined in the aircraft certification (airworthiness) standards and are the basis for the obstacle clearance performance information published in the Aircraft Flight Manual (AFM). The horizontal obstacle clearance requirements are not defined in the aircraft certification standards, but are prescribed in the operating regulations.

(3) Under the Sections 704.47 and 705.57 of the CARs, an aeroplane must clear all obstacles along the net take-off flight path by at least 35 feet vertically or by at least 200 feet horizontally within the aerodrome boundaries and 300 feet horizontally outside those boundaries. The Federal Aviation Administration (FAA) regulations for take-off weight limitations have similar criteria for obstacle clearance. This AC provides for two basic methods of analysis to ensure clearance from obstacles: an Area Analysis Method and Flight Track Analysis Method.

(4) A review of various air operators' departure plans and practices has identified inconsistencies and misunderstandings in the analysis and criteria necessary for regulatory compliance.

(5) Guidance related to these regulations has been provided in *Commercial and Business Aviation Advisory Circulars (CBAACs)*, *Air Carrier Advisory Circulars (ACACs), Guidance material for Canadian Aviation Regulations*, Sections 744.47 and 745.57 of the CARs and Transport Canada Publication, TP 12772, *Aeroplane Performance*. The purpose of this AC is to provide a consolidated interpretation of the regulations and an acceptable means of compliance with Sections 704.47 and 705.57 of the CARs and Part VII standards for engine-out obstacle clearance related to low visibility take-offs.

(6) FAA AC 120-91, Airport Obstacle Analysis, provides for an acceptable method of obstacle analysis for compliance with FAA regulations, including 14CFR§ 121.180 and 135.379. TCCA has developed this AC on the basis of the FAA AC because of the similarity of the criteria for obstacle avoidance regulations between the associated Federal Aviation Regulations (FARs) and CARs. This AC provides the additional information and differences as necessary to comply with the applicable CARs. Additional guidance may be found in Australian Government, Civil Aviation

Authority, Civil Aviation Advisory Publication, CAAP 235-4(0); elements of which are incorporated in this AC.

(7) This AC provides information and acceptable criteria for determining safe clearance from obstacles along the engine inoperative take-off flight path, and for considering factors that may cause divergence of the actual flight path from the intended flight path. This AC also provides guidance to assist an air operator in developing engine inoperative missed approach procedures for obstacle clearance.

(8) This AC applies to aeroplanes that meet the performance certification requirements equivalent to the transport or commuter category. Aeroplanes meeting other performance requirements may use criteria and methods equivalent to those described in this AC, provided they properly account for the performance specified in the AFM.

(9) The methods and guidelines presented in this AC are neither mandatory nor the only acceptable methods for ensuring compliance with the regulatory requirements. Air operators may use other methods if those methods are shown to provide the necessary level of safety and are acceptable to TCCA.

(10) This AC need not serve as the sole basis for determining whether an obstacle analysis program meets the intent of the regulations. However, the methods and guidelines described in this AC have been derived from extensive TCCA, FAA and industry experience and are considered acceptable to TCCA when used appropriately.

(11) Mandatory words such as “shall” or “must” apply only to those who seek to demonstrate compliance to a specific rule by use of a method set out in this AC without deviation.

4.0 IMPLEMENTATION

(1) The guidance contained within this AC is applicable to existing and new Engine Out Procedures. The guidance within this AC may contain criteria not considered in existing Engine Out Procedures. For this reason, TCCA recommends that air operators review existing Engine Out Procedures and develop a plan to implement the guidance in this AC with milestones to organize and schedule implementation.

(2) Service to a new aerodrome location or the development of new or revised airport/aerodrome obstacle data presents an opportunity for implementation. TCCA expects air operators to use the best available data for aerodrome obstacle analysis and to continually review and use improved data as it becomes available. Airports with critical terrain or obstacles should be given the highest priority. TCCA strongly urges air operators to review or re-analyze aerodromes with critical terrain or obstacles in accordance with the guidance in this AC within two years of the date this AC is issued.

5.0 SOURCES OF OBSTACLE DATA

(1) Air operators are expected to use the best, latest and most accurate available obstacle data for a particular aerodrome at the time of analysis. Data sources do not require specific TCCA approval.

(2) The most common sources of obstacle data are obstacle surveys and International Civil Aviation Organization (ICAO) Aerodrome Obstruction Charts -Type A. These charts usually account for close in obstacles within the airport boundary, however may include obstacles within 10 miles of the airport in mountainous areas. Air operators should be aware that an ICAO, Type A chart, or any other single source might not include all the pertinent information necessary for completing a take-off analysis. Other references and sources of obstacle data may be necessary for surrounding terrain.

(3) The following is a list of possible sources of obstacle data for air operator use:

(a) Aeronautical Information Publications (AIPs);

(b) Aeronautical Information Regulation and Control (AIRAC) Canada;

(c) Airport Characteristics Data Bank (ACDB)—Volumes 1-6;

(d) Area Navigation Approach Survey (ANA);

(e) Current Aerial or Satellite Imagery;

(f) Digital Elevation Model (DEM) or Digital Raster Graphic (DRG) information;

(g) FAA Form 5010-1—Airport Master Record;

(h) FAA Digital Obstacle File;

(i) FAA Obstruction Charts (US Airports);

(j) Geological Survey Maps;

(k) ICAO Airport Characteristics Database;

(l) ICAO Type A/B/C charts;

(m) International Air Transport Association (IATA) Airport and Obstacle Database (AODB);

(n) Jeppesen—Obstacle Database and Airway Manuals;

(o) Jeppesen/Lido Departure and Approach Charts;

(p) Nav Canada;

(q) National Geodetic Survey (NGS);

(r) NOTAMs;

(s) Obstacle Surveys;

(t) Published Instrument Approach Procedures;

(u) Published SIDs and Departure Procedures;

(v) SITA;

(w) Topographical Maps; and

(x) www.AIRNAV.com or www.gcr1.com/5010web;

(4) Existing obstacle data sources may not contain current or complete obstacle assessments for a particular airport. It is ultimately the responsibility of the air operator to ensure that the information used meets the requirements set forth by this AC. In order to ensure the accuracy and currency of the obstacle data TCCA encourages the use of periodic audits conducted by the air operator, vendor or a third party with clear results about any potentially unsafe findings. Refer to section 7.9 of this AC for more information about review cycles.

(5) Refer to section 7.0 of this AC for obstacle considerations.

6.0 ENGINE OUT DEPARTURE PROCEDURE REQUIREMENTS

6.1 All Engine Operating (AEO) versus One Engine Inoperative (OEI) Departure Criteria

(1) Standard Instrument Departures (SIDs) or Departure Procedures are based on TP 308—*Criteria for the Development of Instrument Procedures*. TP 308 is the basis for the departure procedures published in the *Canada Air Pilot* (CAP). Similar FAA AC criteria are contained in FAA Order 8260.3B, United States Standard for Terminal Instrument Procedures (TERPS) and the ICAO criteria are found in the ICAO *Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS).* The obstacle clearance requirements of these standards are based on normal operations with AEO.

Note:

One-Engine-Inoperative (OEI) obstacle clearance requirements and the all-engines-operating TP 308 requirements are independent.

(2) Engine Out Departure Procedures (EODPs) do not need to meet TP 308 or similar criteria or requirements. Compliance with TP 308 all-engines-operating climb gradient requirements does not necessarily assure that one-engine-inoperative obstacle clearance requirements are met. TP 308 typically uses specified all-engines-operating climb gradients to an altitude, rather than the certified one-engine inoperative airplane performance.

(3) The CAP departure procedures are designed with the expectation that an aircraft will maintain a minimum climb gradient of 200 feet per nautical mile (NM) throughout the climb until reaching a minimum IFR altitude for enroute operations. A higher gradient may be published as necessary, in which case the aircraft is expected to maintain this gradient to a specified altitude or fix, then continue climbing at a minimum gradient of 200 feet per NM, until reaching a minimum IFR altitude for enroute operations. For the purposes of analyzing performance on procedures developed under TP 308 (TERPS or PANS-OPS), it is understood that any gradient requirement, whether published or not, will be treated as a plane which must not be penetrated from above until reaching the stated height, rather than as a gradient which must be exceeded at all points in the path.

(4) Air operators must comply with the applicable Part VII of the CAR regulations and standards for the development of take-off performance data and procedures. There are differences between TP 308 and one-engine-inoperative criteria, including the lateral and vertical obstacle clearance requirements.

Note:

An engine failure during take-off is a non-normal condition, and therefore takes precedence over noise abatement, air traffic, SIDs, Departure Procedures, and other normal operating considerations.

(5) An air operator should ensure the pilot-in-command is aware of his/her command authority to declare an Emergency to deviate from Air Traffic Control (ATC) assigned clearances and instructions. Declaring an emergency may assist the flight crew in coping with the degraded performance and increased workload associated with an engine failure while navigating to remain clear of obstacles and/or terrain.

6.2 Engine Out Departure Procedures (EODPs)

(1) EODPs are published as specific routes to be followed together with procedure design gradients and details of significant obstacles.

(2) EODPs are normally established for each runway where instrument departures are expected or where SIDs are published and define a departure procedure for the various categories of aircraft used. EODPs should be designed to adhere to normal SIDs, to the maximum extent possible to minimize complexity and ensure predictability of the aircraft flight path for ATC.

(3) The fundamental difference between SIDs and EODPs is that SIDs provide the minimum performance considerations to meet the departure requirements assuming an all engine operation whereas EODPs are based upon engine out performance in relation to obstacle clearance.

(4) Other names for EODPs used by industry include Engine Out Contingency Procedures, Engine Out Escape Paths, Engine Out SIDS and Emergency Escape Manoeuvres. EODP will be the applicable term for engine inoperative take-off guidance to be used for the purposes of this AC.

6.3 Design Considerations for EODPs

(1) In order for an air operator to determine that a departure maintains the necessary obstacle clearance with an engine failure, the air operator should consider that an engine failure might occur at any point on the departure flight path.

(2) The most common procedure to maximize take-off weight when significant obstacles are present along the normal departure route is to use a special one-engine inoperative departure routing. If there is a separate one-engine-inoperative departure procedure, then the obstacles along this track are used to determine the maximum allowable take-off weight for that runway.

(3) Consideration should be given to the possibility of an engine failure occurring after passing the point at which the one-engine-inoperative track diverges from the normal departure track. Judicious selection of this point would simplify the procedure and minimize the difficulty of this analysis. This is generally achieved by keeping the two tracks identical for as far as is practical.

(4) In some cases, two or more special one-engine-inoperative tracks may be required to accommodate all the potential engine failure scenarios.

(5) When designing an EODP, it should be remembered that a crew may be occupied in dealing with an engine failure emergency, The EODP should be designed with simplicity in mind. The EODP should be as close to the published SID or Departure Procedure as possible while at the same time ensuring engine out obstacle / terrain clearance. Elaborate procedures involving numerous turns, conditional statements, speed restrictions, navigation radio selection and tuning, etc. should be avoided.

(6) In designing an EODP, a risk assessment should be performed to identify and focus on the high-risk portion(s) of the departure, which may include proximate terrain and obstacles, aircraft performance limitations, weather phenomena etc. Selecting a route away from significant terrain or providing a holding procedure to climb to a safe enroute altitude are methods to reduce the level of risk of a EODP to an acceptable level.

(7) Analysis of an engine failure after take-off may require the use of other suitable performance data in addition to that provided in the AFM. (Section 14.1 of this AC)

(8) The minimum weather requirements (Wind, OAT, QNH, Minimum Ceilings and Visibilities) should be published for the EODP.

(9) The EODP should identify, depict or provide information on significant obstacles and terrain.

(10) The EODP routing should be designed to avoid restricted or prohibited airspace.

(11) The EODP routing should be designed to avoid triggering any Terrain Awareness and Warning System (TAWS) alerts when the aircraft is flown along the EODP route within the specified tolerances. Should TAWS alerts be expected, the flight crew should be made aware of where in the EODP the TAWS alerts may occur and which specific TAWS alerts may be expected.

6.4 Flight Tolerances

Consideration should be given to flight tolerances in constructing an Engine Out Procedure to ensure that the required flight path can be flown without the need for excessive precision.

6.4.1 Flight Technical Error and Flight Guidance

Flight Technical Error (FTE) is the accuracy to which an aircraft is controlled as measured by the indicated aircraft position with respect to a defined flight path position. The FTE is related to the flight guidance provided to the pilot. In general the FTE improves as the levels of flight guidance and automation used become higher. The allowable FTE for Area Navigation (RNAV) or Global Positioning Systems (GPS) can be a function of the navigational phase of flight the aircraft is in (terminal, en-route or approach). The AFM may need to be consulted to obtain the particular FTE values.

6.4.2 Tolerances for Pilotage

(1) When designing an Engine Out Procedure the tolerance values provided in the following should be considered regardless of the flight guidance system the aircraft is equipped with. The values provided below are derived from TP 14727, *Pilot Proficiency Check and Aircraft Type Rating Flight Test Guide*.

(2) Heading: +/- 10 degrees;

Note:

An initial heading deviation of +/- 20 degrees should be considered during the engine failure event before stabilizing to a tolerance of +/- 10 degrees.

(3) Track Bar: +/- 10 degrees or +/- ½ scale indication;

Note:

When navigation is based on Aeroplane based navigation systems, it is necessary to consider track bar scaling as a function of phase of flight, such as approach, terminal or en-route.

(4) Bearing Pointer: +/- 5 degrees;

(5) Altitude: +/- 100 feet except +100 feet and minus zero feet at minimum altitudes;

(6) Airspeed: +/- 10 knots except:

(a) +10 and minus zero knots during minimum safe climb speed (V2);

(b) +10/-5 knots during approach, landing, rejected landing or go-around;

6.5 Development of EODPs at Specific Aerodromes

(1) Pilot and ATC workload can be minimized at a particular aerodrome if ATC is aware of published Engine-out Departure Procedures in advance. When developing EODPs or other procedures, air operators are encouraged to meet jointly with all interested parties and stakeholders to discuss all-engines-operating and one-engine inoperative requirements at a particular aerodrome. Interested parties may include, TCCA, NAV CANADA, the aerodrome operator, and other air operators.

(2) Air operators should be prepared to consider alternatives to their specific departure proposal that consider all-engines-operating and one-engine-inoperative requirements. Air operators should attempt to agree on a standard one-engine-inoperative ground track and should make every effort to develop the EODP and/or Instrument Flight Rules (IFR) departure procedure to match. The air operators should understand that changes to the current SID or IFR departure may require a modification in take-off weather minimums or variation in the length of the departure route. Because of the different performance characteristics of various airplanes and airline operational policy, this effort may not result in complete procedure standardization, but it is to the benefit of all parties that the number of unique procedures be minimized.

7.0 OBSTACLE CONSIDERATIONS

7.1 Frangible Structures

Single frangible structures fixed by function with an aeronautical purpose (such as antennas, approach lights, and signs) normally need not be considered in an obstacle analysis. Multiple frangible structures, or single frangible structures, which by the virtue of their size or mass can be reasonably expected to inflict significant damage to an aircraft in the event of a collision, should be considered.

7.2 Temporary or Transient Obstacles

Air operators shall take into account local temporary or transient obstacles such as ships, cranes, or trains. The clearance height allowances for vehicles above roads, railways, etc., contained ICAO Type A Obstruction Charts shall be used. Clearance height allowances contained in 14 CFR § 77.23 may be used. If the air operator does not have a means to determine the absence of a movable obstacle at the time of take-off, then the obstacle needs to be accounted for in the analysis.

7.3 Indeterminate Objects

(1) Air operators should use reasonable judgement to account for the height of indeterminate objects (objects without recorded height) displayed on topographic maps or aerial/satellite imagery. Indeterminate objects include such items as trees, buildings, flagpoles, chimneys, and transmission lines. Transmission lines and cables may be considered to be continuous obstacles.

(2) The air operator should use sound judgement in determining the best available data sources when conflicts occur between heights and locations of obstacles in the various sources. When considering forested areas, canopy heights for trees should be established.

7.4 Topographic Charts

The air operator should use topographic charts, DRGs or maps of an appropriate scale to ensure there is sufficient resolution to analyze terrain underlying the procedure. When contour lines cross the edge of a procedure, the contour line at the next higher interval should be used.

7.5 Digital Elevation Models (DEM)

The air operator may consider DEM data sources of an appropriate scale to ensure there is sufficient resolution to analyze terrain underlying the procedure. Due to the precise nature of a DEM the horizontal and vertical error associated with a DEM analysis should be taken into account when designing the procedure. The edge of a DEM cell closest to the departure end of the runway, or shortest cumulative procedure distance, should be considered as having the elevation value associated with the entire cell.

7.6 Survey Design

Obstacle surveys should be implemented to support the desired application. Surveys conducted to satisfy instrument approach design criteria might not necessarily account for obstacles that must be cleared during take-off. For example, the certification requirements for a two-engine Transport Category aeroplane provide for only a positive gradient capability during the first segment and a minimum net gradient capability of 2.4% reduced by 0.8% (1.6% in the second segment. This becomes more critical for departures from wet or contaminated runways, which have a 15 foot, rather than 35-foot screen height.

7.7 Coordinate Systems

(1) When considering obstacle data around an aerodrome, special attention should be paid to the coordinate system, or projected coordinate system, used in identifying the obstacle positions. Coordinates are usually shown in one of two ways: as geographical coordinates (i.e. latitude and longitude values in degrees) or grid coordinates, (as easting and northing values in metres) and based upon a reference system or datum. NAD83 is the official datum for North and Central America. For many aeronautical applications, NAD83 is equivalent to WGS-84. All Global Navigation Satellite System (GNSS) or GPS receivers produce geographical coordinates in WGS-84.

(2) Obstacle surveys, topographic maps or unprocessed aerial/satellite data may likely represent coordinates in a variety of different reference systems. Careful consideration of translating both horizontal and vertical positions into a coordinate system appropriate for the procedure must be taken into consideration when using sources with multiple coordinate systems. This can best be

handled by the use of a Geographic Information System (GIS), but may also be accomplished using publicly available coordinate conversion tools like Corpscon.

7.8 Obstacle Removal Programs and Zoning Regulations

(1) If the air operator cannot obtain adequate take-off weights through the methods of analyses recommended by this AC or other acceptable methods, an obstacle removal program should be considered.

(2) Aerodrome operators are required to take appropriate action to clear and protect terminal airspace required to protect instrument and visual operations to the aerodrome (including operations at established minimum flight altitudes) by mitigating existing, and preventing future, aerodrome hazards.

(3) One method of compliance is described in TP 312—*Aerodrome Standards and Recommended Practices* for obstacles within the aerodrome's control. In general, these criteria provide for removal of obstacles that are not fixed by function nor required for aerodrome operations safety, that are within the "Runway Strip" as defined in TP 312. Air operators should coordinate with the aerodrome air operator to determine whether it is feasible to have an obstacle removed.

(4) The Minister under the authority of Section 5.4(2) of the *Aeronautics Act* can make zoning regulations to prevent lands adjacent to or in the vicinity of an aerodrome from being used or developed in a manner that is incompatible with the safe operation of an aerodrome, or an aircraft. The zoning regulations can also apply to the use and development of land that can cause interference with signals or communication to and from aircraft and aeronautical facilities.

7.9 Review Cycles

(1) Air operators should establish an appropriate review cycle to periodically review the suitability of their performance data and procedures. In addition, air operators should evaluate the effect of changes that occur outside of normal information or charting cycles. These changes may occur as a result of issuance of an operationally significant Notice to Airmen (NOTAM), temporary obstacle information, new construction, Automatic Terminal Information System (ATIS), procedural constraints, navigational aid (NAVAID) outages, etc. For both periodic reviews and temporary changes, the air operator should consider at least the following:

- (a) The need for an immediate change versus a routine periodic update.
- (b) Use of the best available information.
- (c) Any significant vulnerability that may result from the continued use of data other than the most current data, until performance and/or procedures are updated through a routine revision cycle.
- (d) Continued suitability of estimates or assumptions used for winds, temperatures, climb gradients, NAVAID performance, or other such factors that may affect airplane performance or the airplane's flight path.
- (e) The review cycles and response times should be keyed to the needs and characteristics of the air operator's fleet, routes, aerodromes, and operating environments. No specific time frame is established for an air operator to conduct either periodic reviews or short-term temporary adjustments.

8.0 TERMINATION OF TAKE-OFF SEGMENT

8.1 End of the Take-off Flight Path

(1) The aircraft certification requirements define the end of the take-off flight path to be at 1500 feet above the take-off surface or at the point where the transition from the take-off to the enroute configuration is completed, whichever is higher (Section 2.3 of this AC). For the purpose of the

take-off obstacle clearance analysis, the end of the take-off flight path is considered to occur when:

(a) The aeroplane has reached the minimum altitude specified for a fix or the Minimum En-Route Altitude (MEA) for a route to the intended destination;

(b) The aeroplane is able to comply with en-route obstacle clearance requirements (Sections 704.48, 705.58, 705.59 of the CARs);

(c) The aeroplane has reached the minimum vectoring altitude, or a fix and altitude from which an approach may be initiated, if the air operator's emergency procedure calls for an immediate return to the departure aerodrome or a diversion to the departure alternate in the event of an engine failure during take-off.

8.2 Determination of Limiting Weight

When determining the limiting take-off weight, the obstacle analysis should be carried out to the end of the Take-off Flight Path as defined in Section 8.1 of this AC. Air operators should note that the end of the Take-off Flight Path is determined by the airplane's gross take-off flight path, but the obstacle analyses should use the net take-off flight path data.

8.3 Transition to Destination or other Suitable Aerodrome

In the event that the aeroplane cannot return to land at the departure aerodrome, the take-off flight path should join a suitable enroute path to the planned destination or to another suitable aerodrome. It may be necessary to address extended times and alternate fuel requirements when climbing in a holding pattern with reduced climb gradients associated with one-engine inoperative turns.

9.0 METHODS OF ANALYSIS

(1) Sections 704.47 and 705.57 of the CARs and Section 724.26 of the CASS require that the net take-off flight path clears all obstacles by either 35 feet vertically or 200 feet laterally inside the aerodrome boundary and 300 feet laterally outside the aerodrome boundary.

Note:

The regulations reference the obstacle clearance requirements in relation to the net take-off flight path. The operator should consider the physical dimensions of the aeroplane when considering the clearance margins. The vertical clearance requirements should be in relation to the lowest part of the aeroplane, considering the aeroplane's bank angle. The lateral clearance requirements should consider the wingspan of the aeroplane when the aeroplane is tracking along the net take-off flight path.

(2) To operate at the required lateral clearance, the air operator must account for factors that could cause a difference between the intended and actual flight paths and between their corresponding ground tracks. For example, it cannot be assumed that the ground track coincides with the extended runway centerline without considering such factors as wind and available course guidance. Additional factors include the effects of the initial disturbance incurred by the engine failure, pilot technique and the complexity of the departure routing and procedure.

This AC focuses on two methods that may be used to identify and ensure clearance of critical obstacles:

(a) Area Analysis Method (Section 10.0 of this AC); and

(b) Flight Track Analysis Method (Section 11.0 of this AC).

(3) The two methods may be used in conjunction with each other on successive portions of the analysis. For example, an air operator may choose to use an area analysis for the initial portion of the take-off analysis, followed by a flight track analysis, and then another area analysis.

9.1 Area Analysis Method

(1) The Area Analysis Method defines an obstacle accountability area (OAA) within which all obstacles must be cleared vertically by the regulatory requirements. The OAA is centered on the intended flight track and its dimensions are defined in Sections 10.2 and 10.3 of this AC. The effects of wind and available course guidance do not normally need to be accounted for in straight out departures with cumulative track change less than or equal to 15 degrees.

(2) ICAO provides criteria for an OAA which is commonly referred to as the *ICAO Splay.* The ICAO Splay has larger dimensions than the OAA provided in sections 10.2 and 10.3 of this AC. The ICAO OAA is therefore considered as an acceptable OAA for the purposes of this AC. The dimensions for the ICAO Splay are provided in Appendix B of this AC.

9.2 Flight Track Analysis Method

The Flight Track Analysis Method is an alternative means of defining an OAA based on the navigational capabilities of the aircraft. This methodology requires the air operator to evaluate the effect of wind and available course guidance on the actual ground track. While this method is more complicated, it can result in an area smaller than the OAA produces by the Area Analysis Method.

10.0 AREA ANALYSIS METHOD

10.1 General Considerations

(1) Sections 10.2 and 10.3 of this AC are the criteria for an OAA that may be used to show compliance with the Net Take-off Flight Path regulations (Sections 704.47 and 705.57 of the CARs). While the clearance values in the regulations are referenced in relation to the net take-off flight path of the aircraft, the clearance values do not account for the physical dimensions of the aircraft. Failure to account for the dimensions of the aircraft can result in a significant reduction of the obstacle clearance values required by the regulations.

(2) The wing tip clearance of any aeroplane will be reduced by one half of the wingspan if the aircraft were precisely flown on its intended ground track. In the case of a Boeing 777-300ER with a wingspan of 212.6 feet, the lateral clearance from an obstacle could be reduced by 106.3 feet. Therefore, the lateral clearance values of 200 feet inside the *aerodrome* boundaries and 300 feet outside would be reduced to 93.7 feet and 193.7 feet respectively.

(3) Similarly, banking this aircraft in a turn could reduce the vertical clearance margins by a significant amount, because of the large span of the wing. (Refer to Note at end of Section 13.1)

(4) For the purposes of this AC, the horizontal clearance values provided in Sections 10.2 and 10.3 of this AC are increased by one half of the wingspan where noted, to account for the physical dimensions of the aircraft.

10.2 Criteria—Straight Out Departures

(1) During straight-out departures or when the intended track or airplane heading is within 15 degrees of the extended runway centerline heading, the following criteria apply (Appendix A, Figure A.1):

- (a) The width of the OAA is 0.0625D feet on each side of the intended track (where D is the distance along the intended flight path from the end of the runway in feet), except when limited by the following and maximum widths.
- (b) The minimum width of the OAA is 200 feet plus one half of the wingspan on each side of the intended track within the aerodrome boundaries, and 300 feet plus one half of the wingspan on each side of the intended track outside the aerodrome boundaries.
- (c) The final width of the OAA is 2,000 feet on each side of the intended track.

Note:

The dimensions provided in this section are minimum values and may be increased to accommodate specific situations.

10.3 Criteria—Departure with Turns

(1) During departures involving turns of the intended track or when the airplane heading is more than 15 degrees from the extended runway centerline heading, the following criteria apply (Appendix A, Figure A.2):

(a) The initial straight segment, if any, has the same width as a straight-out departure;

(b) The width of the OAA at the beginning of the turning segment is the greater of:

(i) 300 feet plus one half of the wingspan on each side of the intended track;

(ii) The width of the OAA at the end of the initial straight segment, if there is one;

(iii) The width of the end of the immediately preceding segment, if there is one, analyzed by the Flight Track Analysis Method.

(c) Thereafter in straight or turning segments, the width of the OAA increases by 0.125D feet on each side of the intended track (where D is the distance along the intended flight path from the beginning of the first turning segment in feet), except when limited by the following maximum width;

(2) The final width of the OAA is 3,000 feet on each side of the intended track.

Note:

The dimensions provided in this section are minimum values and may be increased to accommodate specific situations.

10.4 ICAO Splay

(1) The OAA provided by ICAO, (commonly referred to as the ICAO splay) has larger dimensions than the OAA provided in this AC (Sections 10.2 and 10.3). As stated in section 9.1(2), the ICAO splay is considered to be acceptable as an OAA for compliance with the Net Take-Off Flight Path regulations.

(2) The minimum width of the ICAO splay will normally not have to be increased to account for aeroplane wingspan. In the case of a very large aeroplane with a wingspan of 200 feet or more, obstacles should be considered along the first 1000 feet of the track distance to ensure the clearance values required by the regulations are met.

(3) The dimensions of the ICAO Splay are provided in Appendix B of this AC and are defined in Attachment C, to ICAO Annex 6- Part 1—*Aeroplane Performance Operating Limitations*, - Example 3, Section 3—*Take-off Obstacle Clearance Limitations*.

10.5 Considerations for the Area Analysis Method

The following apply to all departures analyzed with the Area Analysis Method:

(a) A single intended track may be used for analysis if it is representative of operational procedures. For turning departures, this implies the bank angle is varied to keep a constant turning radius with varying speeds.

(b) Multiple intended tracks may be accommodated in one area analysis by increasing OAA width accordingly. In a turn, the specified OAA half-widths (i.e., one-half of the OAA maximum width) should be applied to the inside of the minimum turn radius and the outside of the maximum turn radius. An average turn radius may be used to calculate distances along the track.

(c) The distance to an obstacle within the OAA should be measured along the intended track to a point abeam the obstacle.

(d) When an air operator uses the Area Analysis Method for straight out departures, the air operator does not normally need to separately account for crosswind, instrument error, or flight technical error within the OAA.

(e) The effects of wind, and flight technical error should be accounted for in turning departures to ensure the aircraft remains within the OAA (Section 13.0 ANALYSIS OF TURNS). Flight technical error is related to the flight guidance available to the pilot and may be a consideration where a specific bank angle needs to be maintained during a turn or varied to maintain a track. The effects of wind may be minimized when intended track is followed using a Flight Director Track Mode (rather than a Heading Mode) or a Flight Director Lateral Navigation (LNAV) mode.

(f) Obstacles prior to the end of the runway need not be accounted for, unless a turn is made prior to the end of the runway.

(g) One or more turns of less than 15 degrees each, with an algebraic sum of not more than a 15-degree change in heading or track, may be analyzed as a straight out departure.

(h) No accountability is needed for the radius of the turn or gradient loss in the turn for a turn with 15 degree or less change in heading or track.

10.6 Use of Canada Air Pilot (CAP) IFR Departure criteria as an Area Analysis Method

Appendix C of this AC, discusses a graphical method developed by TCCA to determine engine out required climb gradients through the use of CAP Departure Procedure climb gradients as an alternate to an obstacle analysis based on an OAA. This method provides for compliance with obstacle clearance requirements without the need to conduct an obstacle analysis or develop an EODP. Because this method is based upon climb gradients to satisfy All Engines Operating criteria, it may result in a higher required climb gradient, and therefore a lower allowable max take-off weight compared to an analysis based upon an OAA for engine-out departures.

10.7 FAA Still-Air Corridor

(1) An industry practice exists, that uses an OAA based on the lateral obstacle clearance values derived from the FAA Net Take-off Flight Path regulations, which is commonly referred to as the *FAA Still-Air Corridor*. The FAA Still-Air Corridor is an OAA of rectangular shape with width of 400 feet inside the aerodrome boundaries, stepping up (without a splay) to a width 600 feet outside the boundaries.

(2) The dimensions of the FAA Still-Air Corridor are insufficient for use as an OAA without accounting for crosswind error, instrument error, or flight technical error. The FAA Corridor is also narrower than the allowances for ground-based course guidance (Section 13.0 of this AC) and there is currently no aircraft navigation system certified capable of tracking precisely on the centre of the FAA corridor, to ensure the required horizontal obstacle clearance.

(3) TP 12772 requires that the effects of crosswind be considered upon the track of the aircraft if using the FAA Still-Air Corridor. When wind is accounted for, the net result may be an OAA with a splay having similar dimensions to that provided in this AC or the ICAO splay.

Note:

The use of the FAA Still-Air Corridor as an OAA, without accountability for crosswind, instrument error, or flight technical error is not considered to be an acceptable OAA for the purpose of the CARs.

11.0 FLIGHT TRACK ANALYSIS METHOD

The Flight Track Analysis Method involves analyzing the ground track of the flight path. This section discusses factors that the air operator should consider in performing a Flight Track Analysis.

11.1 Pilotage in Turns

The air operator should consider the ability of a pilot to initiate and maintain a desired speed and bank angle in a turn. This ability will be related to the flight guidance, automatic flight control and auto throttle capability available to the pilot. Use of a Flight Director track guidance based on LNAV may reduce the pilot effort in following a ground track. Assumptions used here should be consistent with pilot training and qualification programs. Refer to Section 13.0 of this AC, Analysis of Turns for more detailed criteria with respect to turning Engine Out Procedures.

11.2 Winds

(1) Refer to Section 13.2 of this AC for specific considerations related to wind during turns.

(2) When using the Flight Track Analysis Method while course guidance is not available, air operators should take into account winds, including crosswind, components that may cause the aeroplane to drift off the intended track.

(3) The air operator should take into account the effect of wind on the take-off flight path, in addition to making the headwind and tailwind component corrections to the take-off gross weight used in a straight-out departure. (The regulations require that no more than 50 per cent of the reported headwind component and not less than 150 per cent of the tailwind component be considered in the analysis.)

(4) When assessing the effect of wind on a turn, the wind may be held constant in velocity and direction throughout the analysis unless known local weather phenomena indicate otherwise.

(5) If wind gradient information is available near the aerodrome and flight path (e.g., wind reports in mountainous areas adjacent to the flight path), the air operator should take that information into account in the development of a procedure. This should include the effects of significant winds, large gusts or turbulence that may be reasonably expected.

12.0 COURSE GUIDANCE

Air operators may take credit for available course guidance when calculating the lateral location of the actual flight track relative to the intended track as part of a Flight Track Analysis.

12.1 Allowance for Ground-Based Course Guidance

(1) When ground-based course guidance is available for Flight Track Analysis, the following nominal allowances may be used, unless the air operator can substantiate tighter allowances for specific navigational aids at a particular aerodrome:

- (a) Localizer (LOC) - +/- 1.25 degree splay with minimum half-width of 300 feet. (Minimum width governs up to 2.25 nm from LOC.)
- (b) Very High Frequency Omni-directional Range (VOR) - +/- 3.5 degree splay with minimum half-width of 600 feet. (Minimum width governs up to 1.6 nm from VOR.)
- (c) Automatic Direction Finder (ADF) - +/- 5 degree splay with minimum half-width of 1,000 feet. (Minimum width governs up to 1.9 nm from ADF.)
- (d) Distance Measuring Equipment (DME) Fix - +/- 1 minimum instrument display increment but not less than +/- 0.25 nm.
- (e) DME Arc - +/- 2 minimum instrument display increments but not less than +/- 1 nm.

Note:

The above splays originate from the navigation facility.

(2) These allowances account for crosswind, instrument error, flight technical error and normal NAVAID signal inaccuracies. Further allowances should be made for known signal anomalies. Refer to ICAO Annex 10, Aeronautical Communications, Volume 1, *Radio Navigation Aids, for more detailed criteria.*

(3) Ground-based course guidance may be used in combination with other forms of course guidance to construct a departure procedure.

12.2 Allowance for Aeroplane Based Area Navigation Capabilities

(1) Aeroplane-based area navigation refers to a system (e.g., Flight Management System (FMS), GNSS, RNAV, Required Navigation Performance (RNP), Internal Reference System (IRS)).

(2) Aeroplane-based area navigation permits aeroplane operations on any desired course including a turn expansion for flyby or flyover waypoints. Aeroplane based area navigation is within the coverage of ground or space-based station reference navigation signals or is without direct course guidance from a ground-based NAVAID (within the limits of self-contained system capabilities).

(3) The credit and consideration given to each system depends on its accuracy, redundancy, and usability under one-engine-inoperative conditions. The system should have an aircraft type certification approval to the applicable requirements and should meet the required operational criteria.

(4) The minimum allowance is the demonstrated accuracy of the airplane-based navigation equipment.

Note:

Under no circumstances can the OAA half-width be reduced to less than the regulatory minimums of 200 feet within the aerodrome boundaries and 300 feet after passing the boundaries. The minimum half-width values should also account for aircraft dimensions such as wing span.

Note:

The demonstrated accuracy provided in the AFM may not be accurate for determining the OAA without further substantiation. For example, the AFM demonstrated accuracy has not considered “site specific” dependencies such as accuracy and availability of ground based NAVAIDs.

(5) Airplane-based course guidance may be used in combination with other navigational course guidance to construct a departure procedure.

12.3 Aeroplane Based Navigation System Considerations

The inputs, alerts, and annunciations and the availability and suitability of particular sensors to a particular navigation system should be considered. The Engine Out Procedure should publish any radio navigation aids required for the procedure.

12.3.1 Global Navigation Satellite System (GNSS/GPS)

Air Operators using GNSS (GPS or Wide Area Augmentation System (WAAS)) should ensure that the system provides the necessary integrity monitoring, accuracy, availability and Course Deviation Indicator (CDI) sensitivity for the conduct of the Engine Out Procedure. Air operators should also ensure that Engine Out Procedures are accurately coded into the Navigation Data Base (NDB), and are consistent with the published procedures provided to the flight crew. The air operator should establish a process for the routine updates of the Engine Out Procedures into the NDB.

12.3.2 DME/DME

DME/DME position updating is dependent on FMS logic and DME facility proximity, availability, and signal masking. DME/DME performance is subject to the available number and geometry of facilities.

12.3.3 VOR/DME

Unique VOR characteristics may result in less accurate values from VOR/DME position updating than from GPS or DME/DME position updating.

12.3.4 Inertial Navigation

Inertial reference units and inertial navigation systems are often coupled with other types of navigation inputs, e.g., DME/DME or GPS, to improve overall navigation system performance.

12.4 Allowance for Visual Course Guidance

(1) Visual ground reference navigation is another form or course guidance. However, to take advantage of visual course guidance, a Flight Track Analysis should be performed.

(2) The ability to laterally avoid obstacles by visual reference can be very precise, if the obstacles can be seen and are apparent. It is the air operator's responsibility to operate in weather conditions, including ceiling and visibility at the time of the operation, that are consistent with the use of the visual ground reference points for the navigation upon which the obstacle analysis is based.

(3) The air operator will normally require authorization to conduct EODPs based on visual course guidance in the form of an Operations Specification (OPS SPEC).

Note:

The standards for visual course guidance currently apply to propeller driven aeroplanes and reside in Subsection 724.47(3) of the CASS for Propeller-Driven Large Aeroplanes and Subsection 725.54(3) of the CASS for Reciprocating Engined Aeroplanes.

(4) To take advantage of visual course guidance, the flight crew should be able to continuously determine and maintain the correct flight path with respect to ground reference points so as to provide a safe clearance with respect to obstructions and terrain.

(a) The EODP should be well defined with respect to ground reference points so that the track to be flown can be analysed for obstacle clearance requirements;

(b) An unambiguous written and/or pictorial description of the EODP procedure should be provided for crew use;

(c) The limiting environmental conditions (wind, ceiling, visibility, day/night, ambient lighting, obstruction lighting, etc.) should be specified for the use of the procedure so that the flight crew is able to visually acquire ground reference navigation points and navigate with respect to those points; and

(d) The EODP must be within the one-engine-inoperative capabilities of the airplane with respect to turn radius, bank angles, climb gradients, effects of winds, cockpit visibility, etc.

(5) When visual course guidance is used for Flight Track Analysis, the following minimum allowances (in addition to turn radius) apply:

(a) If the obstacle itself is the reference point being used for visual course guidance, the minimum allowance is 300 feet plus one half of the wing span for lateral clearance from that obstacle.

(b) When following a road, railway, river, valley, etc., for course guidance, the minimum allowance is 1,000 feet on each side of the width of the navigation feature. This width should include the meandering and/or curves of the navigation feature being used or the definable centre of the valley or river.

(c) When using a lateral visual reference point to initiate a turn, the minimum tolerance is +/– 0.25 NM along the track at the turn point.

(d) When initiating a turn directly over a visual reference point, the minimum tolerance is +/– 0.50 NM along the track at the turn point.

(e) When initiating a turn to avoid overflight of a visual reference point, the minimum tolerance is +/– 1 NM along the track at the turn point.

(6) Visual course guidance may be used as part of an IFR procedure (e.g. SID) or in conjunction with IFR flight during that portion of the operation, which is in visual meteorological conditions (VMC). The visual course guidance may be used in combination with other forms of course guidance to construct a one-engine-inoperative departure procedure.

(a) All relevant parts of an obstacle must be clearly discernible. At night, obstacles and any relevant supporting structure (guy wires, etc.) must be sufficiently lit;

(b) Weather minimums should be established to allow for the visual acquisition of an obstacle and for maintaining continuous visual contact with an obstacle until it is no longer a factor;

(c) The pilot must be able to maintain visual contact with the obstacle at all anticipated deck angles with the consideration that an engine failure may occur after V1;

(d) The flight crew must be able to maintain visual contact at anticipated bank angles during departures (this permits assessment of the effectiveness of the turn with respect to the obstacle and winds); and

(e) Where a group of obstacles exist, visual turns to avoid one obstacle may not lead toward another (any turn must be away from all obstacles).

13.0 ANALYSIS OF TURNS

(1) The Net Take-off Flight Path regulations provide criteria for allowable bank angles when necessary to turn to avoid an obstacle. A turn can be used to avoid a limiting obstacle along a straight out departure path and allow an increase in the maximum allowable take-off weight. A turn will introduce other considerations such as new obstacles, reduced stall margins and reduced gradients of climb.

(2) For turning departures, the bank angle, speed, and turn radius may be fixed and/or varied to achieve the required result. The determination whether to fix the bank angle or turn radius will depend on the available course guidance during the turn, and whether an area analysis or flight track analysis method is used. (Refer to Section 10.5 of this AC for considerations for the Area Analysis Method with regard to available course guidance.)

13.1 Bank Angle

(1) Under Sections 704.47 and 705.57 of the CARs, the aeroplane shall not be banked before reaching a height of 50 feet, and the maximum bank shall not be more than 15 degrees at or below 400 feet and not more than 25 degrees above 400 feet, aircraft speed and configuration permitting. Increasing the bank angle results in reduced vertical clearance between obstacles and the wing tip of the aeroplane and has adverse effects on the performance of the aeroplane.

(2) Obstacle clearance at certain aerodromes may be enhanced by the use of bank angles greater than 15 degrees. A bank angle greater than 15 degrees at or below 400 feet requires authorization in the form of an Operations Specification (OPS SPEC). Bank angles between a height of 100 and 400 feet should be planned to not exceed 20 degrees. Any bank angles greater

than 25 degrees when above 400 feet require specific evaluation and may require additional authorization from the Minister.

Maximum Bank Angles

Height(h) (Above Departure End Of Runway – feet)	Maximum Bank Angle (Degrees)
100>h>50*	15
400>h>100*	20
h>400	25

* = or ½ of wingspan, whichever is higher (Refer to Section 13.4)

(3) The AFM generally provides a climb gradient decrement for a 15-degree bank. For bank angles less than 15 degrees, a proportionate amount of the 15-degree value may be applied, unless the manufacturer or AFM has provided other data. Bank angles over 15 degrees require additional gradient decrements.

(4) If bank angles of more than 15 degrees are used, V2 speeds should be increased to provide an equivalent level of stall margin protection and adequate controllability (i.e., VMCA (minimum control speed, air)). Unless otherwise specified in the AFM or other performance or operations manuals from the manufacturer, acceptable adjustments to ensure adequate stall margins and gradient decrements are provided by the following table:

Bank Angle Adjustments

Bank Angle	Speed	'G' Load	Gradient Loss
15°	V2	1.035	AFM 15° Gradient Loss
20°	V2+XX/2	1.064	2 x AFM 15° Gradient Loss
25°	V2+XX	1.103	3 x AFM 15° Gradient Loss

Where 'XX" = the all-engines-operating operating speed increment (usually 10 or 15 knots)

Note:

For some aeroplanes, the AFM standard V-speeds may already provide sufficient stall margin protection without additional adjustments.

(5) Bank angles over 25 degrees may be appropriate in certain circumstances but require specific evaluation and may require TCCA authorization.

(6) Accountability for speed increase for bank angle protection may be accomplished by increasing V-speeds by the required increment shown above by accelerating to the increment above V2 after lift off. The following are examples of acceptable methods:

(a) if available, AFM data for "improved climb" or "overspeed" performance may be used to determine weight decrements for the desired increase to V1, VR, and V2;

(b) a weight decrement from the Weight/V-speed relationship in the AFM for the desired increase in V1, VR, and V2 may be calculated; and

(c) the acceleration above V2 can be accounted for, by trading the climb gradient for speed increase. The climb gradient loss is integrated over the distance required to accelerate to determine an equivalent height increment to be added to all subsequent obstacles.

(7) Gradient loss in turns maybe accounted for by increasing the obstacle height by the gradient loss multiplied by the flight path distance in the turn. This will result in an equivalent obstacle height that can be analyzed as a "straight-out" obstacle in the air operator's aerodrome analysis programs.

(8) For bank angles greater than 15 degrees, the 35-foot obstacle clearance relative to the net take-off flight path should be determined from the lowest part of the banked airplane.

Note:

This is an important consideration for large aeroplanes. For example, the wing tip of a B777-300ER (having a wingspan of 212.6 feet) can be 27.5 feet below its wings level height (not accounting for wing deflection) in a 15 degree banked turn.

13.2 Turn Radius

For a fixed bank angle, the radius of turn will vary with aircraft True Airspeed (TAS) and wind. This in turn will determine the resultant ground track during the turn.

13.2.1 Effects of True Airspeed (TAS)

(1) For turns conducted at a constant Indicated Airspeed (IAS), such as the one engine inoperative IAS (V2 or V2 plus an increment), TAS will increase with increasing altitude and temperature. V2 (IAS) will increase with aircraft weight, which in turn will cause the TAS and turn radius to increase in proportion. As TAS is directly related to weight and temperature, a turn analysis can be established on the ground tracks determined between two extreme weight and temperature conditions. It is acceptable to do a turn analysis based on a single critical temperature if that temperature produces results, which are conservative for all other temperatures.

(2) A ground track based on the minimum dispatch weight at the coldest planned departure will give the tightest turn radius. A ground track based on the maximum dispatch weight at the warmest planned departure will provide the largest turn radius. This analysis for an EODP can be extended to more than one aircraft type in a fleet to establish the minimum and maximum turn radii if an EODP analysis to be used for a fleet.

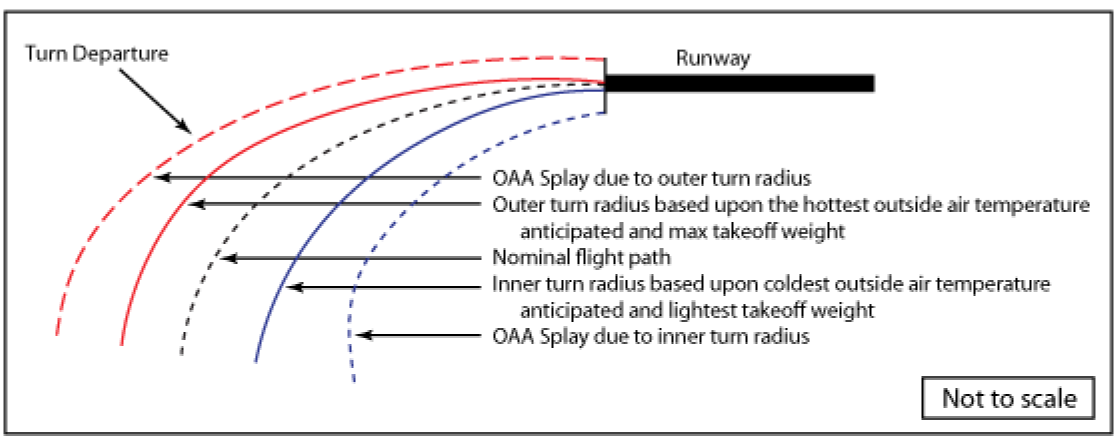

Figure 13.1 Adjustment of Splay in a Turn (Ref. Fig 6.1.1, CAAP 235-4(0))

(3) When applying an area analysis method, the specified OAA half-widths (i.e., one-half of the lateral OAA width) should be applied to the inside of the minimum turn radius and the outside of the maximum turn radius. An average turn radius may be used to calculate distances along track. (Ref Section 10.5 of this AC).

(4) A single intended track may be used for analysis if it is representative of operational procedures. (For turning departures, this implies the bank angle is varied to keep a constant turning radius

with varying speeds. The expanded OAA will be centred upon the single track. The FTE related to the navigational and flight guidance used in maintaining the intended track should be considered. (Ref. Section 10.5 of this AC).

13.2.2 Effects of Wind

(1) The Net Take-off Flight Path regulations require factoring of headwind and tailwind components for the purpose of climb gradient computations. When applying the headwind and tailwind components corrections along a turn, the distance of any obstacle must be adjusted along an equivalent still air straight out flight path. Crosswind components should not be factored, when used for the purpose of computing lateral deviation from the ground track.

Note:

The Certification requirements require that the AFM provide factored headwind and tailwind components.

(2) The wind may be held constant in velocity and direction throughout the turn analysis unless known local weather phenomena indicate otherwise. As discussed in Section 11.2(4) of this AC, the air operator should take into account available wind gradient information near the aerodrome and flight path including the effects of significant terrain on the wind that may be reasonably expected.

(3) When applying an Area Analysis Method, and an OAA that accounts for aircraft weight and temperature has been constructed, the resultant ground track resulting from the effects of the wind should be superimposed onto the OAA to ensure the track remains within the OAA. If the ground track falls outside of the OAA, the OAA should be adjusted further as required or limits on allowable winds may need to be imposed for a particular departure. Alternatively the turn and wind effects on the OAA can be analyzed concurrently.

13.3 Minimum Height To Commence Turns

(1) Track changes should not be allowed to commence until the next take-off flight path has achieved a height equal to one half of the wingspan, but not less than a height of 50 feet as per the Net Take-Off Flight Path regulations. The net take-off flight path must thereafter clear obstacles by 35 feet. The required obstacle clearance margin should be based on the lowest part of the banked aeroplane in the turn. (Ref. Section 13.1 (6) of this AC). The JAA regulations (JAR-OPS 1.495, *Take-off obstacle clearance*), require that any part of the net take-off flight path clear obstacles vertically by at least 50 feet when the aeroplane is banked more than 15 degrees.

(2) An immediate turn can be set to commence when the minimum safe height established to begin the turn has been reached. This point can occur over the runway or can be set to commence at the departure end of the runway. Obstacles prior to the end of the runway need not be accounted for, unless a turn is made prior to the end of the runway.

13.3.1 Defined fixes for turns

The starting point of any turns should be defined by a navigational fix, visual or other fixed reference rather than a predefined altitude value. The starting point of turns defined by a predefined altitude will be a function of the aircraft's performance capability and will therefore be variable. In such cases, any variability in the starting point of a turn should be accounted for.

13.4 Acceleration during turns

(1) Acceleration segments should not be planned during turns, as increasing TAS during the turn will result in an increasing turn radius. Acceleration during a turn can complicate planning and may require an increase in the half-width of an OAA to ensure the aircraft does not drift outside of the OAA. Furthermore, the distance along the 3rd segment will be increased because of the reduction of acceleration capability associated with the gradient loss in a turn.

(2) Turns should be planned when the thrust (power) setting, airspeed, and configuration of the aeroplane are constant. This simplifies the planning required for a turn since many AFM's do not

publish data for any segment of the engine-out departure procedure unless the conditions are constant. Turn data is normally published for the second and final take-off segments.

(3) A turn may need to be commenced as soon as practical after take-off, to avoid turning during the acceleration segment. Alternatively turns may need to be delayed until the final take-off segment has been established.

(4) Some electronic AFM's may be able to support the analysis associated with a turn during an acceleration segment. Turns during acceleration segments may also be possible where track guidance to maintain the required track during the turn is available.

13.5 Additional Considerations for Turning Departures

(1) Weather minima may need to be increased for departures with turns, to ensure there are sufficient visual cues to avoid obstacles. Visual guidance may be necessary for navigational accuracy.

(2) Specific training should be provided to flight crews for "Complex" Engine Out Departures. Complex EODPs are EODPs that require immediate turns, multiple turns, or turns with variable bank angles. Complex EODPs may include shuttle climbs, speed restrictions, specific configurations, or any other unique operational requirements. (Refer to Section 17.0 of this AC)

14.0 ADDITIONAL CONSIDERATIONS

14.1 AFM Data

(1) Unless otherwise authorized, AFM data must be used for one-engine-inoperative take-off analysis. It is recognized that many AFMs generally contain only the one-engine inoperative performance for loss of an engine at V1 on take-off. All-engines-operating performance must also be considered to determine the airplane's flight path in the event of an engine failure at a point on the flight path after V1. The best available all-engines-operating data should be used consistent with best engineering practices.

(2) Air operators may find appropriate acceptable data in various sources, such as community noise documents, performance engineer's handbooks, flight characteristics manuals, and manufacturers' computer programs.

(3) Certain aerodromes may present situations outside the boundaries covered by the AFM. AFM data may not be extrapolated without an authorized deviation from Transport Canada. Application for such deviation, with supporting data, should be forwarded to the Standards Branch through the air operator's Principal Operations Inspector (POI).

14.2 Acceleration Segment (Cleanup) Altitudes

(1) Under the aircraft certification requirements for Take-off path, a Transport Category aeroplane must climb (at a minimum speed of V2) until it is 400 feet above the take-off surface. Four hundred feet is the minimum gross height the acceleration segment may begin, and can be increased to achieve the required obstacle clearance, provided all applicable constraints are met. Once the aeroplane has reached the acceleration altitude, it must have available a minimum climb gradient of 1.2% for two-engine aeroplanes, 1.5% for three-engine aeroplanes and 1.7% for four engine aeroplanes. It is this climb capability that is used to accelerate the aeroplane to the engine out en-route climb speed while reconfiguring the aeroplane to the en-route climb configuration (flap cleanup).

(2) For standardization of operating procedures, many air operators select a standard cleanup altitude that is higher than that required for obstacle clearance at most aerodromes. The standard cleanup altitude is selected to ensure that the required obstacle clearance is met during colder than standard temperatures, and that the acceleration and cleanup may be accomplished within the take-off thrust time limits during warmer than standard temperatures.

(3) The obstacle analysis is usually based on a level-off for cleanup, but there is no operational requirement to level-off, especially if the aeroplane can meet the minimum climb gradient requirements at the start of the acceleration segment. A level-off may be required in the case of a distant obstacle that must be cleared in the final segment.

Note:

The standard acceleration altitude should ensure that geometric height requirements are met under all expected conditions of temperature and pressure.

(4) The terrain and obstacles at certain aerodromes may require a higher-than-standard cleanup altitude to be used and may still allow acceleration and cleanup to be accomplished within the take-off thrust time limit.

14.3 Vertical Flight Path Profiles

(1) Figure 2.3.1 is an illustration of the Net Flight Path as related to the Actual (or Gross) Flight Path. The Net Flight Path is defined in the aircraft certification requirements as the Gross Flight Path reduced by a specified margin (FAR 25.115 - Take-off Flight Path). This definition may lead to confusion when using the Net Flight Path for engine out departure analysis.

(2) For engine out departure analysis, the Net Flight Path is established from an assessment of obstacles found within an OAA or from a Flight Track Analysis Method. Obstacles will establish the required gradient to be met for a specific departure and will define an Obstacle Flight Path as shown in Figure 2.3.1. The Net Flight Path is the Obstacle Flight Path with the addition of a 35 foot margin. The Actual (or Gross) Flight Path is the Net Flight Path with the addition of the percentage margin provided in 14 CFR § 25.115.

(3) The limiting weight to achieve a Net Flight Path is derived from the AFM. The Actual (or Gross) path is the vertical path the aeroplane is expected to achieve at the weight derived from the AFM for the corresponding Net Flight Path.

(4) The vertical take-off flight path can be constructed to achieve the optimum acceleration height for obstacle clearance and/or a standard cleanup altitude for an air operator. The flight path is normally constructed in accordance with the performance data provided in the AFM.

There are three basic take-off flight profiles:

(a) a minimum acceleration height profile (Figure 14.1);

(b) a maximum acceleration height profile (Figure 14.2); and

(c) an extended second segment profile (Figure 14.3).

(5) An evaluation of all three profiles may be necessary to maximize the take-off weight. A turn away from an obstacle or terrain may yield the highest obstacle limited take-off weight. As discussed in Section 14.2 (2) of this AC, an air operator may select a standard cleanup altitude (acceleration height) above the minimum and below the maximum acceleration heights.

(6) The minimum acceleration height profile may be optimal for the case where a distant obstacle must be cleared in the final take-off segment. This profile can be used when an aeroplane in the en-route climb configuration at maximum continuous thrust has a greater climb gradient capability than in the second segment climb configuration at take-off thrust.

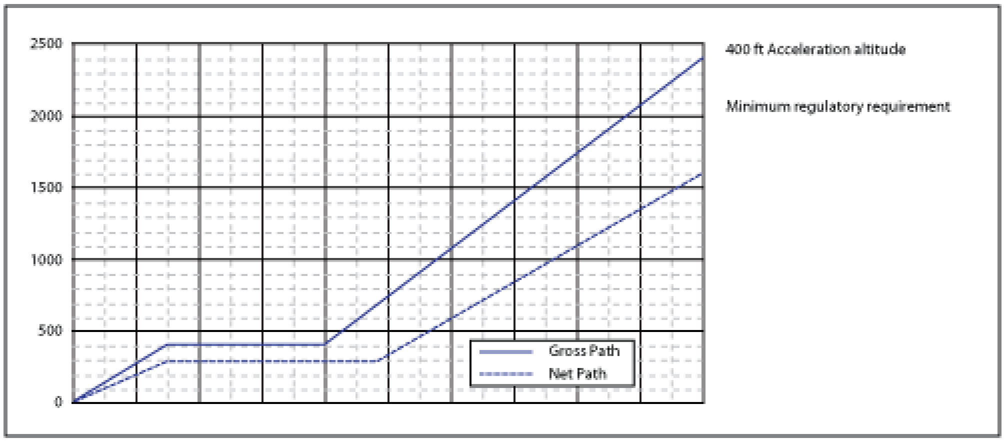

Figure 14.1 Minimum Acceleration Height Profile (Ref. Fig. 8.1.1, CAAP 235-4(0))

(7) The maximum acceleration height profile can be used when a higher than standard acceleration height is required to clear closer obstacles, while allowing the third segment to be completed within the engine thrust time limit established in the AFM.

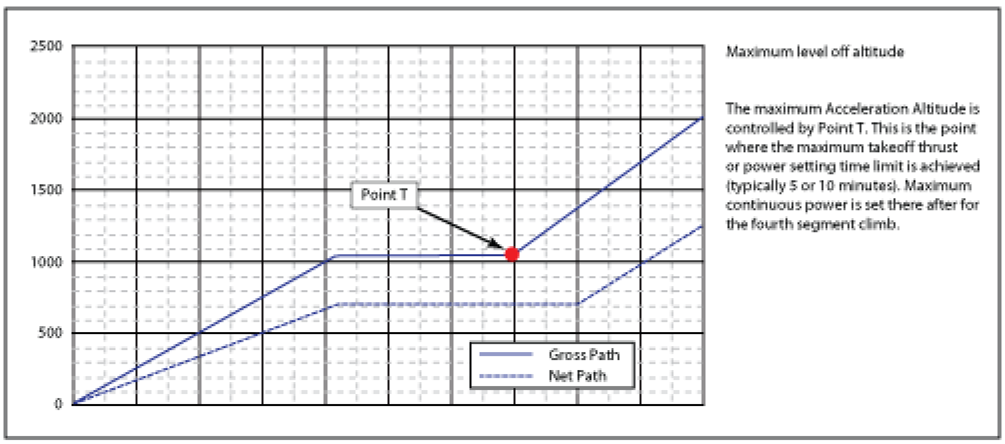

Figure 14.2 Maximum Level-off Altitude Profile (Ref. Fig. 8.1.1, CAAP 235-4(0))

(8) The extended second segment is optimal for close-in limiting obstacles, especially if there are no further obstacles in the take-off flight path. The aeroplane is climbed in the second segment until the engine time limit at maximum take-off thrust (or power) is reached. The aeroplane is then cleaned up to the en-route climb configuration at maximum continuous thrust. It is necessary to ensure that at the end of the extended second segment, the aeroplane still has the climb gradient capabilities of 1.2%, 1.5% and 1.7% as required for two, three and four engine aeroplanes respectively.

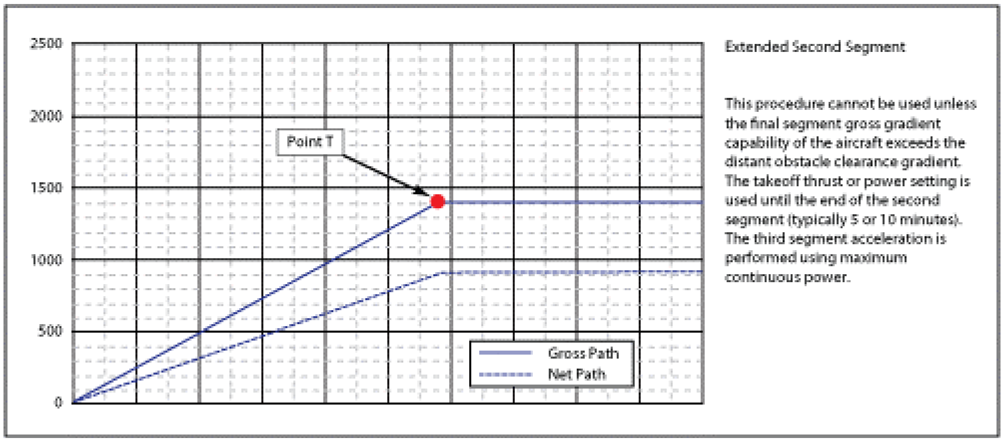

Figure 14.3 Extended Second Segment Profile (Ref. Fig. 8.1.1, CAAP 235-4(0))

14.4 Validation Flights

(1) Consideration should be given to conducting a flight or simulator evaluation to confirm a flight crews' ability to fly an actual EODP and to uncover any potential problems associated with those procedures. Problems may occur if the EODP differs significantly from the All-Engines Operating procedures, or if terrain makes course guidance questionable at the One-Engine-Inoperative altitudes. Assessments should be made to ensure that Engine Out Departure paths are compatible with TAWS alerting envelopes.

(2) It should be emphasized that the purpose of this flight or simulator evaluation is not to prove the validity of the performance data or to demonstrate obstacle clearance. Flight-crew workload considerations and minimum control speed characteristics are best evaluated in a simulator. Any validation performed in a simulator, requires that the simulator be appropriately modeled and qualified. If an actual validation flight in an aircraft is required, it is recommended that a pre-validation flight be conducted in the simulator to simulate actual evaluation/validation conditions and procedures. It may also be possible that prior experience gained by another aircraft type and/or air operator may provide sufficient confirmation of the procedure. Validation flights in an aircraft should be conducted under day VMC. *Under NO circumstances should validation flights be conducted with passengers or non-essential personnel on board*.

(3) A confirmation flight with a simulated engine failure at V1 is not recommended.

Acceptable techniques used for these flights include:

(a) Initiating the procedure from a low pass over the runway at configurations, speeds and altitudes that represent take-off conditions.

(b) Using a thrust/power setting on all engines calculated to give a thrust/weight ratio representative of one-engine-inoperative conditions.

(c) Setting one engine to flight idle to give a thrust/weight ratio representative of one-engine-inoperative conditions.

14.5 Wet or Contaminated Runway Screen Height

(1) Aeroplanes certified for engine out performance on wet or contaminated runways have a reduced screen height of 15 feet compared to the normal screen height of 35 feet for a dry runway.

(2) While the obstacle clearance regulations require that the net take-off flight path start at 35 feet at the end of the take-off distance, the gross flight path starts at 15 feet. If an engine failure occurs at V1 during take-off from a, wet or a contaminated runway, an aeroplane can initially be as much as 20 feet below the net take-off flight path, and close-in obstacles can be cleared by as little as 15 feet. The aeroplane will be exposed to a reduced margin of safety until it climbs above the gross take-off flight path based on a 35-foot obstacle clearance along the net take-off flight path.

(3) An air operator should conduct a risk assessment for the area of reduced obstacle clearance to establish any mitigations necessary to increase the margin of safety to that of a 35 foot screen height. Take-off weight may have to be reduced to minimize the exposure of the aeroplane when below the net take-off flight path. Any turns should be avoided until the lowest part of the aircraft is at least 50 feet above an obstacle. (Refer to Section 13.3).

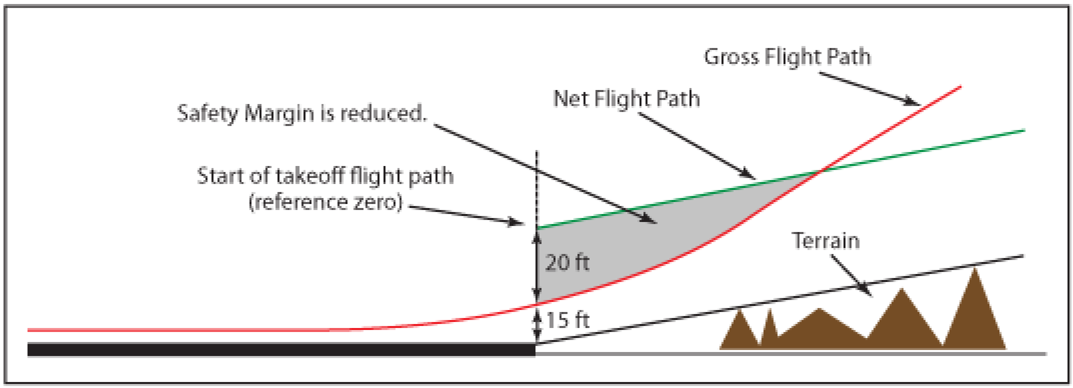

Fig. 14.4 Wet Runway Obstacle Clearance (Ref. Fig. A3.0.1, CAAP 235-4(0))

14.6 Improved Climb Performance

(1) Improved climb performance (also known as Overspeed) when certified in the AFM, is used to increase the maximum allowable take-off weight when an aircraft is climb limited. To use improved climb, the aeroplane take-off weight must not be limited by field performance requirements (i.e. there is excess runway available), nor limited by tire speed, brake energy and obstacle clearance performance.

(2) The improved climb procedure increases the normal V2 and because of that, increases the climb capability of the aircraft. V1 and VR must also be increased if V2 is increased. An increased V2 improves bank angle protection. This is accomplished by increasing the margin over the stall speed for the specific take-off configuration of the aircraft.

15.0 MISSED APPROACHES, REJECTED LANDINGS AND BALKED LANDINGS

15.1 General

(1) Part 704 and 705 of the CARs do not require an obstacle clearance analysis for one-engine-inoperative missed approaches, rejected or balked landings. The aircraft certification requirements provide for landing weight limits to achieve a one-engine inoperative approach climb gradient as a function of temperature and altitude, but without regard to obstacle clearance requirements.

(2) Published missed approach procedures, similar to published IFR departure procedures are predicated on all engines operating. The air operator should consider the possibility of an engine failure during flight, including missed approaches. This becomes increasingly important when the

published missed approach requires a non-standard climb gradient to be achieved and/or requires turns to avoid obstacles.

(3) While it is not necessary to perform an engine inoperative obstacle clearance analysis for each flight, dispatch, or landing weight limitation, it is appropriate to provide guidance and information to the flight crews on the safest way to perform such a manoeuvre, should it be required. The intent is to identify the best option or options for a safe lateral ground track and flight path to follow in the event that a missed approach, rejected or balked landing is necessary. To accomplish this, the air operator may develop the methods and criteria for the analysis of one-engine-inoperative procedures, which best reflect that air operator’s operational procedures.

(4) In general, published missed approach procedures provide adequate terrain clearance. However, further analysis may be required in the following circumstances:

(a) the published missed approach procedure has a non-standard climb gradient requirement;

(b) departure procedure for the runway has a published minimum climb gradient;

(c) an EODP procedure is required; or

(d) there are runways that are used for landing but not for take-off.

Note:

A non-standard climb gradient is normally published when a standard IFR climb gradient exceeds 200 feet /NM (3.3%). The IFR climb gradient whether standard or non-standard, is the minimum climb gradient necessary to clear obstacles plus an additional margin as a function of the distance (e.g. 48 feet/NM) from the point where the required gradient originates.

Note:

Air operators should incorporate procedures for converting required climb gradients to required climb rates as a function of ground speed in pilot and dispatcher airplane performance sections of their approved training programs.

15.2 Go-Around, Missed Approach, Rejected Landing, Balked Landing

(1) For the purposes of this AC, a distinction needs to be made between a go-around, missed approach, a rejected landing and a balked landing.

(a) Go-Around: A transition from an approach to a stabilized climb.

(b) Missed Approach: The flight path followed by an aircraft after discontinuation of an approach procedure and initiation of a go-around. Typically a “missed approach” follows a published missed approach segment of an instrument approach procedure, or follows radar vectors to a missed approach point, return to landing, or diversion to an alternate.

(c) Rejected Landing: A discontinued landing attempt. A rejected landing typically is initiated at low altitude but prior to touchdown. If from or following an instrument approach it typically is considered to be initiated below DA(H) or MDA(H). A rejected landing may be initiated in either VMC or (Instrument Meteorological Conditions (IMC). A rejected landing typically leads to or results in a “go around” and if following an instrument approach, a “Missed Approach”. If related to the consideration of aircraft configuration(s) or performance it is sometimes referred to as a “Balked Landing”.

(d) Balked Landing: A discontinued landing attempt. The term is often used in conjunction with aircraft configuration or performance assessment, as in “Balked landing climb gradient. Also see “Rejected Landing.”

(2) A one-engine-inoperative missed approach from the MDA, DA or DH or above can normally be flown by following the published missed approach procedure. This however may not be possible under some performance limiting conditions, such as the cases provided in Section 15.1(4) of this AC.

(3) A rejected or balked landing may require some other procedure (e.g., following the same EODP as used for take-off). In any case, the pilot should be advised of the appropriate course of action when the published missed approach procedure cannot be safely executed.

15.3 Assessment Considerations

(1) Air operators may accomplish such assessments generically for a particular runway, procedure, aircraft type, and expected performance, and need not perform this assessment for each specific flight. Air operators may use simplifying assumptions to account for the transition, reconfiguration, and acceleration distances following go-around (e.g., use expected landing weights, anticipated landing flap settings).

(2) The air operator should use the best available information or methods from applicable AFMs or supplementary information from aircraft or engine manufacturers. If performance or flight path data are not otherwise available to support the necessary analysis from the above sources, the air operator may develop, compute, demonstrate, or determine such information to the extent necessary to provide for safe obstacle clearance.

15.4 Engine out Missed Approach Procedure (EOMAP)

(1) Air operators should develop EOMAPs for all instrument approach procedures where the aircraft with an engine inoperative, is not able to comply with the climb gradient performance requirements of the published missed approach procedures.

(2) Flight Crews should be aware of the pilot-in-command authority to declare an emergency, to gain the authority to deviate from a published missed approach procedure, or ATC clearances and instructions. Declaring an emergency may assist the flight crew in coping with the degraded performance and increased workload associated with an engine failure while navigating to remain clear of obstacles and/or terrain.

(3) If an air operator chooses to use an EODP in lieu of a published missed approach path, the air operator must first demonstrate that the aircraft has the navigational capability to overfly the landing threshold, track the runway centerline and overfly the runway end while maintaining the specified lateral obstacle clearance requirements. Furthermore, the aircraft system and navigational capability needs to be assessed to ensure that the aircraft can be flown to the required tolerance in IMC and crew procedures must be in place to adequately address this manoeuvre.

Note:

Establishment of a missed approach path may require the use of a Flight Track Analysis (FTA) method. When using an Area Analysis method, careful attention should be made to the ability of the aeroplane to navigate along the desired missed approach path. The OAA based on the ICAO splay (referred to in Section 9.1 and Appendix B of this AC), is more suitable than the OAA defined in sections 10.2 and 10.3 and Appendix A of this AC because of its larger dimensions.

(4) In the absence of an EOMAP, the following methods can be applied to ensure that obstacle clearance is maintained during an engine inoperative missed approach:

(a) Limiting the approach climb weight and thus the landing weight such that the aircraft can comply with the published gradient (200 feet per nautical mile or 3.3% if not published) at the minimum safe altitudes with an engine inoperative; and

(b) Raising the minimum altitudes (MDA, DA or DH) to reduce the missed approach climb gradient to a value that can be achieved at a typical landing weight for the particular route with an engine inoperative (Fig 15.1). An appropriate procedure design approval may be necessary to depict alternate or multiple minima on an instrument approach procedure;

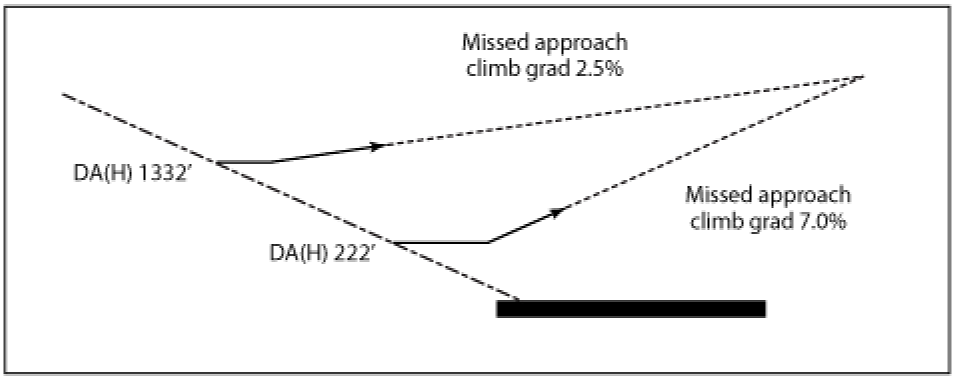

Figure 15.1 Multiple Minima for a Missed Approach (Ref. Fig. 3.0.2, CAAP 235-4(0))

(5) The operational considerations should include:

(a) Configuration transitions from approach to missed approach configuration, including expected flap settings and flap retraction procedures;

(b) Expected speed changes;

(c) Appropriate engine failure and shutdown (feathering if applicable) provisions, if the approach was assumed to be initiated with all engines operative;

(d) Any lateral differences of the published missed approach flight path from the corresponding take-off flight path;

(e) Suitable obstacle clearance until reaching instrument approach, missed approach, or enroute procedurally protected airspace;

(f) Any performance or gradient loss during turning flight;

(g) Methods used for take-off analysis (such as improved climb), one-engine inoperative maximum angle climb, or other such techniques may be used; and

(h) Air operators may make obstacle clearance assumptions similar to those applied to corresponding take-off flight paths in the determination of net vertical flight path clearance or lateral track obstacle clearance.

15.5 Specific Assessment Conditions for Balked Landing

(1) A “balked landing” starts at the end of the Touch Down Zone (TDZ). The TDZ is considered to be the first one-third of the available landing distance, or 3,000 feet, whichever is less. Air operators may propose to use a different designation for a TDZ, when appropriate for the purposes of this provision. For example, alternate consideration of a TDZ may be appropriate for runways:

(a) that are less than 6,000 feet in length and which do not have standard TDZ markings;

(b) that are short and require special aircraft performance information or procedures for landing;

(c) that are for Short Take-off and Landing (STOL) aircraft; or

(d) where markings or lighting dictate that a different TDZ designation would be more appropriate.

(2) An engine failure occurs at the initiation of the balked landing from an all-engines operating configuration.

(3) Balked landing initiation speed $\geq$ VREF or VGA (Go around speed) (as applicable);

(4) Balked landing initiation height is equal to the specified elevation of the TDZ;

(5) Balked landing initiation configuration is normal landing flaps and gear down;

(6) At the initiation of the manoeuvre, all engines are at least at go-around thrust (or power).

Note:

A Balked Landing is considered to be distinctly different from a “Low Energy Landing Regime”. For the purposes of this AC, 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. An attempt to conduct a rejected or balked landing from a low-energy landing regime may result in ground contact. For the purposes of this AC, any assessments for the balked landing case assume the aeroplane is not in a low-energy landing regime.

15.6 “One-Way” Aerodromes or Other Special Situations

(1) Where obstacle clearance is determined by the air operator to be critical, such as for:

- (a) Aerodromes in mountainous terrain that have runways that are used predominantly for landing in one direction and take-off in the opposite direction (“one way in” and “opposite way out”); or
- (b) Runways at which the planned landing weight is greater than the allowable take-off weight.

(2) The air operator should provide the following guidance to the flight crew:

- (a) the flight path that provides the best ground track for obstacle clearance; and
- (b) the maximum weight(s) at which a missed approach or rejected landing can safely be accomplished under various conditions of temperature, wind, and aircraft configuration.

16.0 PILOT INFORMATION

16.1 Coordination and Promulgation

The development and implementation of EODPs and unique departure and go-around procedures should be coordinated with an air operator’s flight operations department. Flight crews should receive instructions through an appropriate means regarding these procedures. Based on the complexity, these instructions could be in the form of flight operations bulletins, revisions to selected flight crew manuals, take-off charts, approach charts, NOTAMs, or special ground or simulator training.

16.2 Required Flight Crew Information

The air operator should advise flight crews of the following (this may be accomplished as a general policy for all aerodromes with exceptions stated as applicable, or specified for each aerodrome):

- (a) how to obtain V-speeds consistent with the allowable weights, with particular attention given to the effects of wind, slope, improved climb performance, and contaminants;
- (b) the intended track in case of an engine failure. (Some air operators have a standard policy of flying runway heading after an engine failure; others routinely assume the All-Engines operating ground track unless specifically stated otherwise.) In any case, the intended track should be apparent to the flight-crew, and failure at any point along the track should be taken into account;
- (c) speeds (relative to V2) and bank angles to be flown; All-Engines Operating and One Engine Inoperative;
- (d) the points along the flight path at which the flap retraction sequence and thrust reduction are to be initiated;

(e) initial turns should be well defined. (“Immediate” turns should be specified with a minimum altitude for initiation of the turn or a readily identifiable location relative to the runway or navigational fix); and

(f) heights or altitudes to commence an acceleration segment and/or flap retraction and cleanup;

(g) any critical obstacles or terrain

Note:

Current performance information may be provided to flight crews by dispatch centers that is relevant to each flight operation. Such information may be passed to flight crews as a result of a dispatch conference, using radio communications, Aircraft Communications Addressing and Reporting System (ACARS), Electronic Flight Bags (EFB), on-board printers, etc.

16.3 Crew Briefing

A pre-take off briefing should include the critical information for contingencies applicable to an engine failure during take off. Similar an approach briefing should include the contingencies applicable to an engine failure during an approach and/or missed approach or go-around with an engine inoperative.

16.3.1 Pre-take-off briefing

The pre-take-off briefing should include the following elements as applicable, to prepare the flight crew for an engine failure during take-off:

(a) engine inoperative departure tracks to follow;

(b) review of any critical obstacles or terrain;

(c) required navigation aids to be used during an engine-out departure;

(d) selection of appropriate engine-out departure track, if more than one departure track is published;

(e) airspeeds to be used for engine-out departure;

(f) communication with ATC and declaration of Emergency;

(g) acceleration altitude and configurations for cleanup;

(h) minimum altitude and any associated waypoints to commence a turn;

(i) minimum safe altitude from which to return to the aerodrome or to proceed to destination or suitable alternate;

(j) Maximum Landing Weight Considerations; and

(k) any other information provided on the EODP.

16.3.2 Approach Briefing

The approach briefing should include the following elements as applicable, to prepare the flight crew for an engine failure during approach and and/or missed approach or go-around with an engine inoperative:

(a) engine inoperative missed approach tracks to follow;

(b) review of any critical obstacles or terrain;

(c) configurations for an approach with an engine inoperative and configurations for an engine inoperative go-around;

(d) use of any higher minimum altitudes (MDA, DA, DH);

(e) required navigation aids to be used during an EOMAP;

(f) selection of appropriate engine-out missed-approach track, if more than one missed approach track is published;

(g) communication with ATC and declaration of Emergency;

(h) minimum altitude and any associated waypoints to commence a turn;

(i) acceleration altitude and configurations for cleanup;

(j) minimum safe altitude from which to return to the aerodrome or to proceed to destination or suitable alternate;

(k) Maximum Landing Weight Considerations; and

(l) any other information provided on the EOMAP.

17.0 TRAINING REQUIREMENTS

An air operator should establish a ground and flight training program for flight crews to include the following items as applicable to the operation:

17.1 Ground Training Program

(1) Regulatory requirements applicable to Engine Out Procedures including required clearances and criteria for EODPs. (Sections 1.0–3.0 of this AC);

(2) General differences and independence between AEO and OEI Departure Criteria (Section 6.1 of this AC);

(3) Authority of Pilot in Command when declaring an emergency and expectations from ATS (Section 6.1 of this AC);

(4) EODPs – general description, depictions, practical interpretation and use (Section 6.2 of this AC);

(5) EODPs that incorporate multiple tracks including decision points, weather requirements and routing considerations (Section 6.3 of this AC);

(6) Required flight tolerances that flight crew must maintain (Section 6.4 of this AC);

(7) Depiction of critical obstacles (or terrain), and identification of temporary and transient obstacles (Section 7.0 of this AC);

(8) Determination of validity of an Engine Out Procedure and use of NOTAM information (Section 7.7 of this AC);

(9) Identification of the End of the Take-off Flight Path and procedures to return to departure aerodrome or continue to a suitable alternate aerodrome (Sections 8.0 of this AC);

(10) Required navigational equipment for course guidance, wind and/or weather limitations related to the method of EODP analysis used (area analysis or flight track analysis as applicable) (Sections 9.0 – 11.0 of this AC);

(11) General dimensions of OAA used if an Area Analysis method used (Section 10.0 of this AC);

(12) The effects of wind and any gusts and turbulence on the aircraft's ground track and climb gradient (Sections 10.0, 11.0 and 13.0 of this AC);

(13) Selection, set-up and use of aeroplane navigation equipment necessary for Course Guidance including ground and aeroplane based systems (Section 12.0 of this AC);

(14) Identifications and use of visual references for use in EODPs based on a visual EODP, including effects of pitch and bank attitudes and any visual anomalies (Section 12.4 of this AC);

(15) Limiting environmental conditions applicable to visual EODP (Section 12.4 of this AC);

(16) Expected bank angles during turning Engine Out Procedures and whether bank angles must be fixed or may be varied (Section 13.0 of this AC);

(17) Maximum bank angles as a function of height above ground and effect of bank angles on clearances between the net flight path and the lowest part of the aircraft (Section 13.0 of this AC);

(18) Effect of weight, altitude and temperature on TAS, and effect of TAS on aircraft’s ground track during turning Engine Out Departures. (Section 13.0 of this AC);

(19) Effect of wind on aircraft’s ground track during a turning Engine Out Departure (Section 13.0 of this AC);

(20) The minimum height to commence a turn and defined fixes for beginning the turn (Section 13.0 of this AC);

(21) The effect of acceleration on turn radius and in turn on the aircraft’s ground track should turns be required during an acceleration segment (Section 13.0 of this AC);

(22) Specific considerations for “Complex” Engine Out Procedures (Section 13.5 of this AC);

(23) General characteristics of the (vertical) Take-off Vertical Flight Path, including the minimum allowable or any standard altitudes to start the acceleration segment, procedures for cleanup and the relationship between net and gross take-off flight paths (Section 14.0 of this AC);

(24) Conditions when a published missed approach may not be safely executed with an engine inoperative, and guidance and information on the safest way to conduct an engine inoperative missed approach to ensure obstacle clearance (Section 15.0 of this AC);

(25) Distinction between engine inoperative missed approach, rejected landing and balked landing and inadvertent entry of aircraft into a low-energy landing regime (Section15.0 of this AC);

(26) Procedures, pilot information and guidance on how to conduct an EOMAP including the general dimensions of an OAA and required pilotage and navigation capability (Section 15.3 of this AC);

(27) Specific procedures for “One-Way” Aerodromes or other special situations (Section 15.5 of this AC);

(28) Pilot Information and Required Flight Crew Information (Section 16.0 of this AC); and

(29) Required information for Pre-Take-off and Approach Briefing (Section 16.0 of this AC).

17.2 Flight Training Program

Flight training should be provided to the maximum extent possible, in a suitably qualified Full Flight Simulator (FFS). Training in an aeroplane should only be provided if sufficient safety mitigations are provided to ensure that there is no degradation in required safety levels. An appropriate risk-assessment should be conducted prior to any aeroplane training to ensure all potential hazards are identified and the appropriate mitigations are put in place.

17.2.1 EODPs

(1) Initial and recurrent flight training should provide for a continued take-off with an engine failure at the most critical point in the take-off, typically at V1, until the aircraft has reached a minimum safe altitude in an appropriate configuration to return for a landing or continue to an alternate aerodrome.

(2) In general, flight training should be provided for aerodromes in an air operator’s route structure that have the most challenging engine out departure procedure and under the most limiting weather conditions applicable to the departure. This would include aerodromes having EODPs or “complex” EODPs (Section 13.5 of this AC). Training need not be provided for more than one aerodrome unless there are special considerations at other aerodromes that must be addressed. Sufficient training should be provided for a flight crew to demonstrate proficiency in engine out departures at such aerodromes.

(3) For air operators authorized to conduct EODP’s based on visual course guidance (Section 12.4 of this AC), flight training in a full flight simulator should be provided. The full flight simulator should have a visual model with sufficient fidelity to identify all the visual cues and features necessary to conduct the visual navigation.

17.2.2 EOMAPs

(1) Initial and recurrent flight training should be provided for an engine-inoperative approach and go-around or for an engine-failure during missed approach. This training should include the procedures necessary to transition from the approach to the missed approach until the aircraft has reached a minimum safe altitude to return for a landing or continue to an alternate aerodrome.

(2) Training should be provided at aerodromes that have a published EOMAP. In general, flight training should be provided for the aerodrome in an air operator’s route structure that has the most challenging EOMAPs and under the most limiting weather conditions applicable to the departure. Training need not be provided for more than one aerodrome unless there are special considerations at other aerodromes that must be addressed. Sufficient training should be provided for a flight crew to demonstrate proficiency in EOMAPs at such aerodromes.

18.0 TCCA APPROVAL OF EODPS AND EOMAPS

(1) TCCA does not approve individual EODPs or EOMAPs that an air operator may publish, but approves the Company Operations Manual (COM) sections pertaining to compliance with the Net Take-off Flight Path regulations. It is recognized that the quantity of information necessary to design engine-out procedures is too large to be contained within a COM. For this reason a separate design or procedures manual referenced in the COM is appropriate. Any additional documentation or manuals will not require approval by TCCA, but should include the applicable information and criteria provided within this AC.

(2) It is recognized that many air operators contract out the design of EODPs and EOMAPs to third party procedure designers. As a certificate holder, it is still the air operator’s responsibility to thoroughly understand the Engine Out Procedures they are using and to be prepared to demonstrate compliance with the applicable regulations and standards.

(3) During any audits, reviews or safety assessments, TCCA may examine individual procedures, the COM and any associated manuals. During these reviews TCCA may request that the air operator demonstrate that EODPs or EOMAPs:

- (a) comply with all relevant regulatory requirements;
- (b) comply with the AFM;
- (c) are safe;
- (d) provide the required obstacle clearance;
- (e) can be executed by flight crews of average skill; and
- (f) contain the correct and required information.

(4) The methods and guidelines presented in this AC are not the only acceptable methods. An air operator who desires to use an alternate means should ensure that alternate assumptions, methods and criteria used are well documented and substantiated.

19.0 CONTACT OFFICE

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Suggestions for amendment to this document are invited and should be submitted via the Transport Canada Civil Aviation Issues Reporting System (CAIRS) at the following Internet address:

http://www.tc.gc.ca/wcms-sgcw/civilaviation/cairs-755.htm

or by e-mail at: CAIRS_NCR@tc.gc.ca

Original signed by

D.B. Sherritt
Director, Standards
Civil Aviation

APPENDIX A—OBSTACLE ACCOUNTABILITY AREA

Figure A.1 OAA for Straight-Out Departure (Ref. FAA AC 120-91, Appendix 1, Fig. 1)

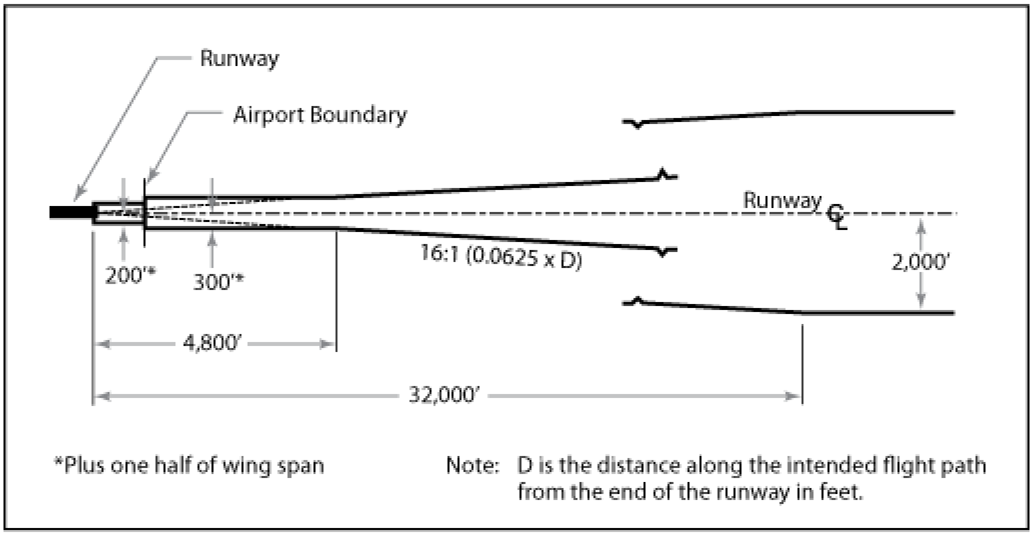
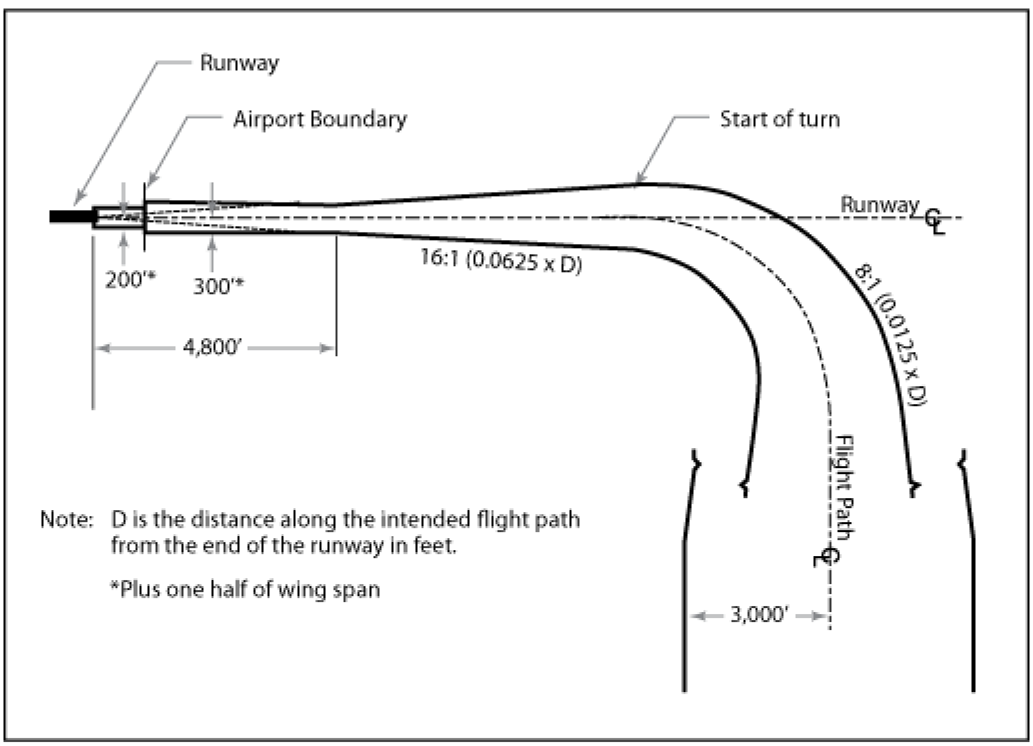


Figure A.2 OAA for Turning Departure (Ref. FAA AC 120-91, Appendix 1, Fig. 2)



APPENDIX B—ICAO OBSTACLE ACCOUNTABILITY AREA

Lateral Clearance Requirements—Take-off Obstacle Splay Information

The take-off splay or lateral obstacle containment area represents an area surrounding the take-off flight path, within which all obstacles must be cleared, assuming they are all projected on the intended track. The contours of this area are defined in the table below, as extracted from ICAO Annex 6 – *Operation of Aircraft*, Attachment C, to ICAO Annex 6 – Part 1 *Aeroplane Performance Operating Limitations* - Example 3, Section 3, *Take-off Obstacle Clearance Limitations*.

Section 3.1 – General

- Aeroplane is not banked until the clearance of the net take-off flight path above the obstacles is at least 15.2m (50 feet) and that the bank thereafter does not exceed 15 degrees.
- The net take-off flight path is considered for the altitude of the aerodrome and for the ambient temperature and wind component existing at the time of take-off.

Section	Operation	Heading Change	Half Splay Requirement	Max Half Splay Width	Comments
3.1.1 a)	VMC by Day	< 15 deg	90 m (~300 ft) +0.125D*	300 m (~1000 ft)	Obstacles at a distance of 300 m on either side of the intended track need not be cleared.
3.1.1 b)	With Navigation aids such that pilot can maintain the aeroplane on the intended track with the same precision as for operations specified in 3.1.1a	< 15 deg	90 m (~300 ft) +0.125D*	300 m (~1000 ft)	Obstacles at a distance of 300 m on either side of the intended track need not be cleared.
3.1.2	IMC or VMC by Night and IMC	≤ 15 Deg	90 m (~300 ft) +0.125D*	600 m (~2000 ft)	Obstacles at a distance of 600 m on either side of the intended track need not be cleared.
3.1.2	IMC or VMC by Night and IMC	> 15 Deg	90 m (~300 ft) +0.125D*	900 m (~3000 ft)	Obstacles at a distance of 900 m on either side of the intended track need not be cleared.

*The distance measured horizontally along the planned flight path and commencing at the end of the take-off distance available.

APPENDIX C—TP 12772 USE OF CAP DEPARTURE CRITERIA AS AN OBSTACLE ACCOUNTABILITY AREA

(1) TP12772—*Aeroplane Performance* provides a graphical method of using the gradients published in the CAP departure procedures to comply with the obstacle clearance requirements of the CARs. This method provides a means to plot the vertical take-off flight path to ensure that the aeroplane climbs at or above an obstacle clearance surface associated with a specific gross climb gradient. This method is intended as a means of compliance with the obstacle clearance requirements without conducting an aerodrome analysis.

(2) The published departure gradient is based on TP308 criteria, which has a broader obstacle assessment area than the Area Analysis methods described in Section 10.0 of this AC or the ICAO splay. This may result in a higher required climb gradient, and therefore a lower allowable max take-off weight.

(3) The TP12772 method provides two charts, one for aeroplanes with “certified engine-out performance”, and one for those without. In general aeroplanes with certified engine out performance are those that are certified to the FAR 23 Commuter Category, the FAR 25 Transport Category or equivalent.

(4) The chart for the aeroplanes with certified engine out performance plots the obstacle clearance surface as the gross gradients reduced by 48ft/NM (0.8%). The charts for aeroplanes “without certified engine out performance” do not have a reduction to the gross gradient and begin with a reference zero at 50 feet, rather than 35 feet.

(5) The use of these charts requires the use of the appropriate AFM performance data and the appropriate adjustment whether the AFM data is presented in terms of allowable weights to meet a gross or net climb gradient.

(6) OCSs have traditionally started at 35 feet above the departure end of the runway, whereas current departure procedure design criteria provides for the OCS to start at the runway surface. The TP12772 charts for aeroplanes with certified take-off performance are designed for use with the OCSs starting at 35 feet above the runway departure end. The TP12772 charts therefore provide for a steeper initial climb gradient to transition from 35 feet above the runway departure end to 35 feet above the OCS. This initial gradient becomes the limiting gradient for the departure procedure.

(7) Full implementation of the current departure procedure design criteria may not be completed until 2013, and it is not possible to readily identify to which criteria a departure procedure has been designed to. The methodology of TP 12772 does not provide for the more recent departure procedure design criteria.

(8) The TP12772 charts end at 1500 feet above the take-off surface. These charts may not be appropriate for extended second segment climbs, or climbs required to clear distant obstacles.