QUIETER OPERATIONS
A GUIDE FOR PILOTS AND CONTROLLERS

INMB
INDUSTRY NOISE MANAGEMENT BOARD

FOREWORD

It takes a cross-industry effort to ensure that every flight happens safely and efficiently – airlines, air navigation services, airport authorities, manufacturers and regulators all have a role. Indeed, most of the aviation industry's achievements have been realized by moving forward together in a spirit of collaboration. Contributions can come in many shapes and sizes.

This document is one of several steps being taken by industry – in a similar collaborative fashion – to reduce how our industry impacts the communities we serve and live in. While noise is an unavoidable consequence of aircraft operations, by working together we can reduce the industry's noise footprint.

Those efforts are being made on several fronts. From the manufacturing of significantly quieter aircraft, to the design of routes that avoid residentially populated areas, to unlocking the potential of satellite-based navigation with new international standards, improvements are coming from many partners in the aviation industry. Many of these activities are foundational, changing the platforms and improving the standards and environments we collectively operate in.

More opportunities lie beyond those transformational efforts, in the day-to-day, the tactical front-line work of moving people and goods across Canada and the world. That is where the *Quieter Operations: A Guide for Pilots and Controllers* aims to provide value.

Intended as both an educational piece and a commitment to do better, the Guide encourages pilots and air traffic controllers to safely employ noise-sensitive operating practices at Toronto Pearson in consideration of their impacts on communities. The concept is simple: even small changes can make a difference.

At the core of the Guide are operating practices that consider airframe noise, such as flap and landing gear deployment; flight profiles, such as the use of quieter continuous descent profiles; nighttime operations that provide the opportunity to better avoid residential areas during periods of low traffic volume – and more.

The contributions vary in scope, impact, and benefit, but together can contribute to a reduction in community impacts from aircraft noise for surrounding communities.

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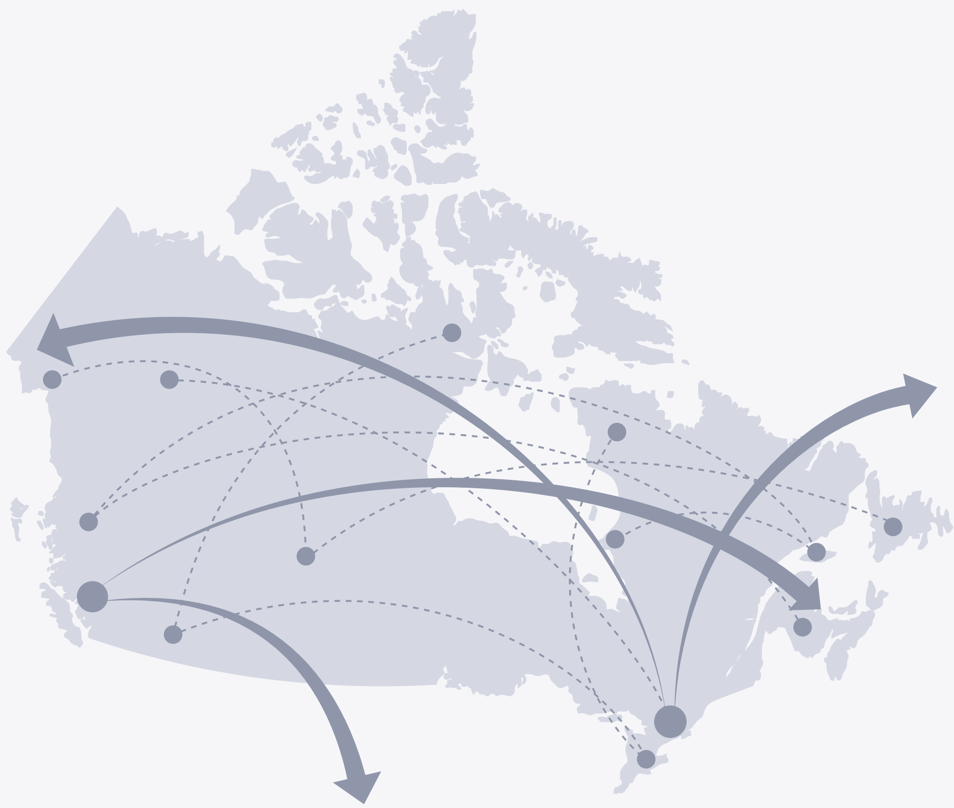
NACC
National Airlines Council of Canada

NAV CANADA

This document was drafted by the Industry Noise Management Board, which brings together technical expertise from the National Airlines Council of Canada, the Greater Toronto Airports Authority and NAV CANADA to consider opportunities to reduce noise impacts through safe procedural improvements.

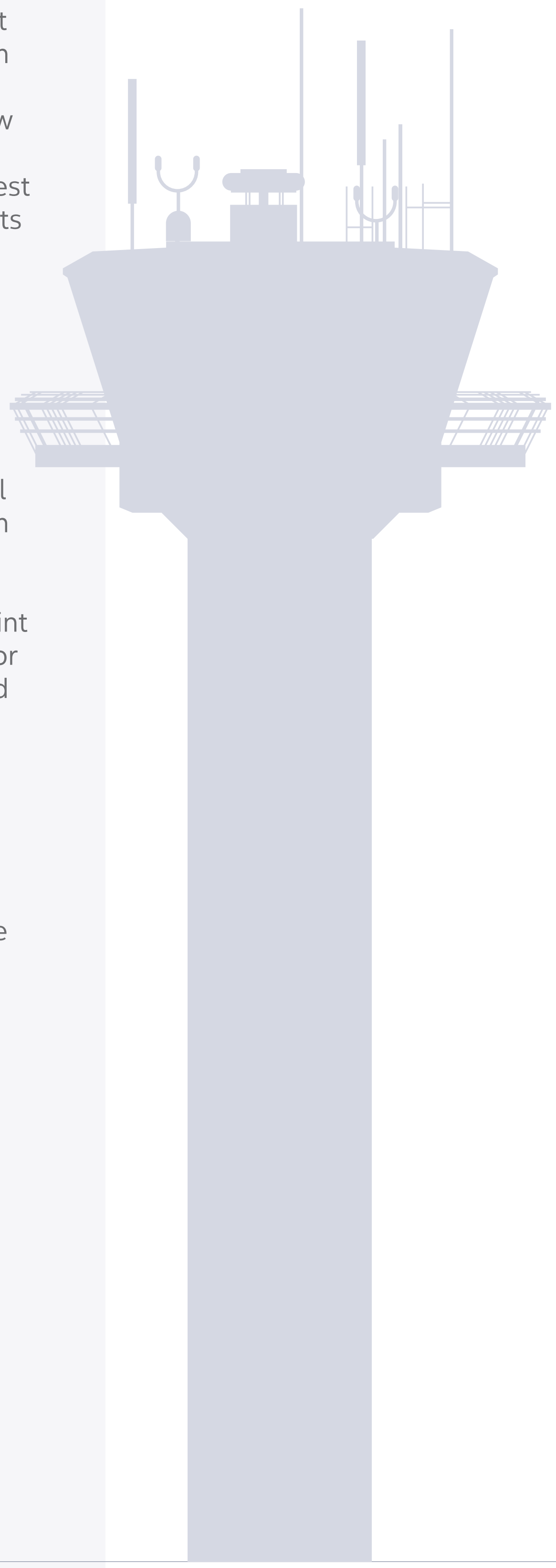
The aviation industry in Canada connects Canadians to each other and the world, and propels the economy forward. More than **400,000** Canadians are directly or indirectly employed by the sector.



1.0 CONTINUOUS DESCENT OPERATIONS

1.1 WHAT IT IS AND THE BENEFIT

Continuous Descent Operations (CDO) are designed to reduce aircraft noise by enabling arriving aircraft to fly a continuous descending path while minimizing level flight segments. It is achieved by combining procedure design with appropriate ATC clearances that allow the crew to optimize their rate of descent accordingly. When given a descent clearance by Air Traffic Control (ATC), pilots will descend at the rate best suited to achieve a continuous descent. Reducing level flight segments to a minimum reduces the need for aircraft engine thrust, thereby decreasing engine noise.



1.2 HOW IT'S ACHIEVED

1.2.1 Descent guidance

As aircraft approach the downwind segment of the Standard Terminal Arrival (STAR) procedures, ATC may provide pilots a waypoint at which they can expect a vector for the base turn, along with a designated altitude. Pilots will then adjust their rate of descent to achieve a quieter continuous descent flight path to arrive at the base vector point at that assigned altitude. In some cases, airspace design may allow for controllers to direct an aircraft off a published procedure and proceed direct to the base vector point.

1.3 PILOT GUIDANCE

Air operators are expected to familiarize themselves with the CDO User Instructions published in the *Canada Air Pilot*, and consider the best means for their pilots to manage descent to the anticipated base leg turning waypoints for their specific aircraft types, through use of aircraft flight management system vertical navigation capabilities. Air operators should provide their pilots with the training and route support guidance necessary to enable CDO.

The published CDO User Instructions remind pilots to anticipate a vectored base leg, however controller instructions may vary based on traffic separation requirements. If the pilot is unable to meet the crossing altitude, the downwind may be extended. Regardless, the instructions to pilots are clear: never turn base without a clearance. If the controller has not issued the base leg turn instruction, the pilot is expected to continue flying the STAR.

1.4 CONTROLLER GUIDANCE

Controllers are expected to provide downwind descent guidance that will enable pilots to fly CDO until they are ready to be vectored onto the base leg. Downwind descent clearances should be issued as early as practical, and include a level crossing altitude for one of the downwind waypoints. The optimum continuous descent for each arrival will vary depending on the type of aircraft, its actual weight, the wind, air temperature, atmospheric pressure and icing conditions. Effective CDO requires lateral and vertical paths planned early enough to provide the pilot with enough time to plan the descent and program the onboard systems accordingly. Air traffic controller awareness of CDO-enabling procedures should be included in recurrent training.

2.0 LOW POWER/LOW DRAG

2.1 WHAT IT IS AND THE BENEFIT

Low power/low drag is a noise reduction configuration for arriving aircraft in which the pilot delays extension of the wing flaps and landing gear as long as practical, subject to compliance with ATC speed control requirements and the safe operation of the aircraft. This broadly means the aircraft is flown in as clean and quiet a configuration as possible, for as long as possible consistent with stable approach criteria.

2.2 HOW IT'S ACHIEVED

2.2.1 Approach flap setting

Minimized noise emissions and fuel efficiencies due to reduced thrust settings are possible with delayed flap extension, when atmospheric conditions and flight profiles permit. In accordance with standard operating procedures pilots are encouraged, where possible, to use minimum flap settings to meet necessary speed restrictions, and to minimize the speeds at which the flaps are selected. Managing aircraft speed without using flaps as the primary tool to slow down can significantly reduce noise emissions. Although delayed flap extension can reduce noise emissions and save significant amounts of fuel over time, it should be emphasized that the first priority is always to manage aircraft energy and be in a position to land at the appropriate time.

2.2.2 Landing gear deployment

Noise generated with landing gear deployment and the subsequent increased thrust and airflow disruption is a contributing factor to the overall noise levels generated by an aircraft approaching to land.

When possible, pilots are encouraged to delay landing gear deployment as well as minimize the speed when the deployment is carried out. Where practicable, the landing gear should not be deployed until established on final approach and descending below 2000′ above the airport elevation.

2.3 PILOT GUIDANCE

Air operators should ensure their procedures provide the guidance pilots need to safely operate their specific aircraft type in the optimal low power, low drag configuration.

2.4 CONTROLLER GUIDANCE

From an Air Traffic Control perspective, providing pilots with downwind descent guidance as early as possible can help pilots establish and maintain low power/low drag configurations for as long as possible.

3.0 NIGHT APPROACHES

3.1 WHAT IT IS AND THE BENEFIT

Aircraft noise can be more noticeable for some residents during the night as ambient community and household noise levels are typically lower. Lower demand and fewer aircraft provide the opportunity to utilize approaches designed for use during night-time restricted hours that impact fewer people.

3.2 HOW ITS ACHIEVED

3.2.1 New night approach procedures

Specific night-time approaches have been developed to minimize noise by routing aircraft over non-residential use land where possible. The flight path for these arrival aircraft has been designed to minimize the noise footprint for the approach phase of the flight.

3.3 PILOT GUIDANCE

In addition to respecting all Noise Operating Restrictions and Noise Abatement Procedures in place, pilots should be reminded of the importance of maximizing the use of nighttime approaches.
Rather than using straight-in or “T” base leg transitions, nighttime approach procedures employ transitions to final that, in some cases, could include multiple legs in the initial approach segment. Pilots can

expect to be cleared directly to the initial approach waypoint, then subsequently cleared for the approach including the appropriate transition. As the flight paths for the night-time approaches have been designed to minimize the noise footprint for the approach phase of the arrival, the vertical profile may not be optimized for the transition from the STAR procedure. The clearance to the initial approach waypoint should typically be issued in the terminal area, as early as practicable. Pilots need to anticipate a possible change in vertical profile, after proceeding direct to the initial approach waypoint, that may leave the aircraft high. In some instances, pilots may need to use additional drag to regain the vertical profile or request additional spacing from controllers on some STAR and runway pairings.

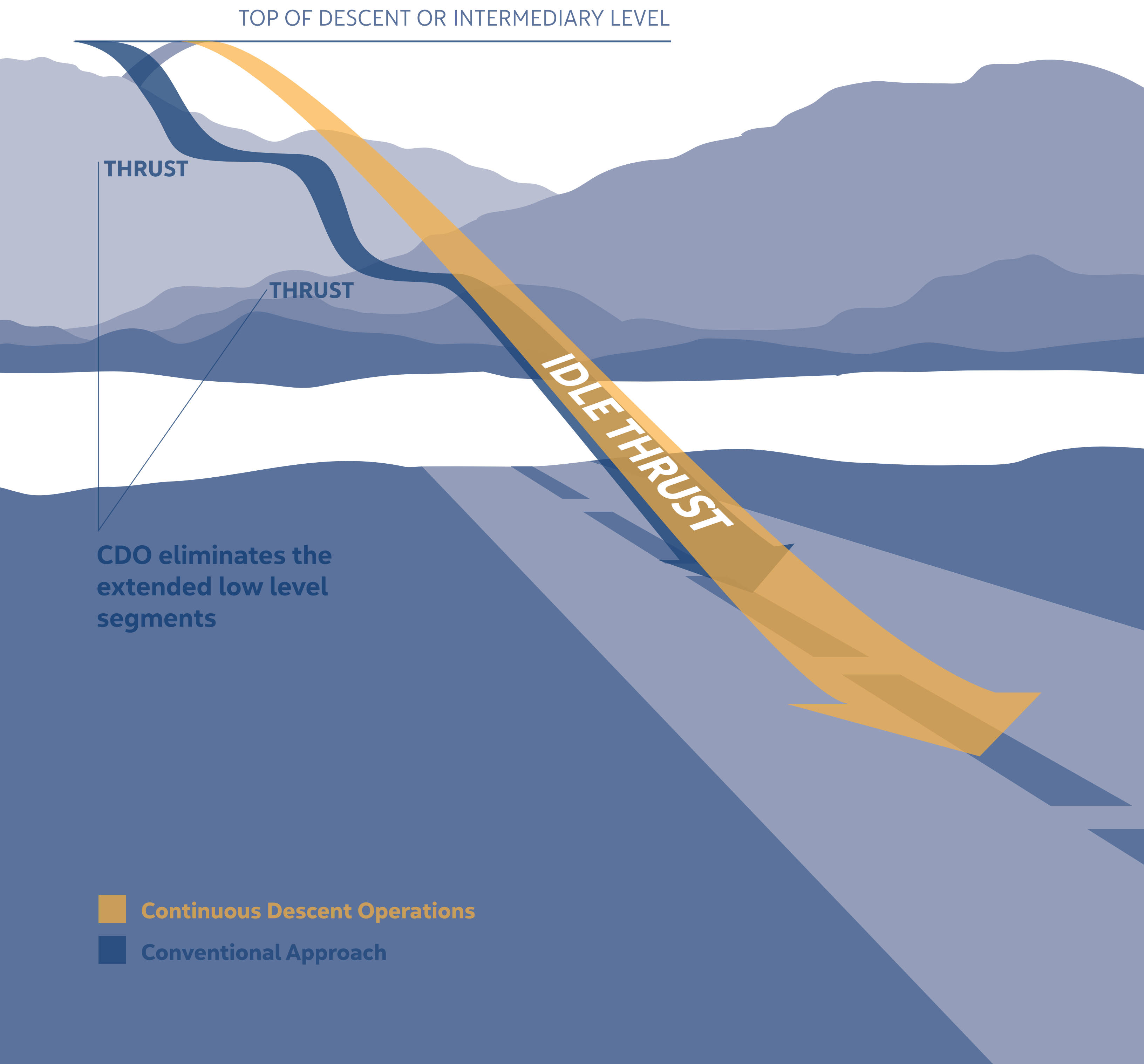
When night-time approaches are in use, the automatic terminal information service (ATIS) will advertise the appropriate approach as the primary instrument approach, and thus controllers would expect the pilot to have set up for that approach. If unable to fly the approach advertised on ATIS, pilots are reminded of the requirement to advise Toronto Centre (enroute controller) as soon as practicable that they are unable to comply with the ATIS, and that an alternate approach is necessary. Pilots may still request the published night-time approaches even if they are not advertised on the ATIS.

3.4 CONTROLLER GUIDANCE

The nighttime approaches should be advertised on the ATIS as the primary approach as soon as traffic conditions have reduced to a level that permits continuous usage. It is explained to pilots that these procedures require relatively low traffic levels to be operationally feasible, and a spike in traffic could result in the need to provide vectors to final, or issue a clearance for another approach type.

Controllers should be mindful of the vertical profile challenges that can occur when using published nighttime approaches and proactively offer pilots extra spacing if they appear constrained.

The ATIS will only advertise a published night-time approach as the primary approach when conditions permit , but be mindful that pilots may still request the published night-time approach when not advertised.


TOP OF DESCENT OR INTERMEDIARY LEVEL
THRUST
THRUST
IDLE THRUST
CDO eliminates the extended low level segments
Continuous Descent Operations
Conventional Approach

A Continuous Descent Operation (CDO) is a method by which an aircraft approaches an airport prior to landing by flying on a continuously descending flight path, with minimal level flight segments, using minimum engine thrust and ideally employing a low drag configuration.

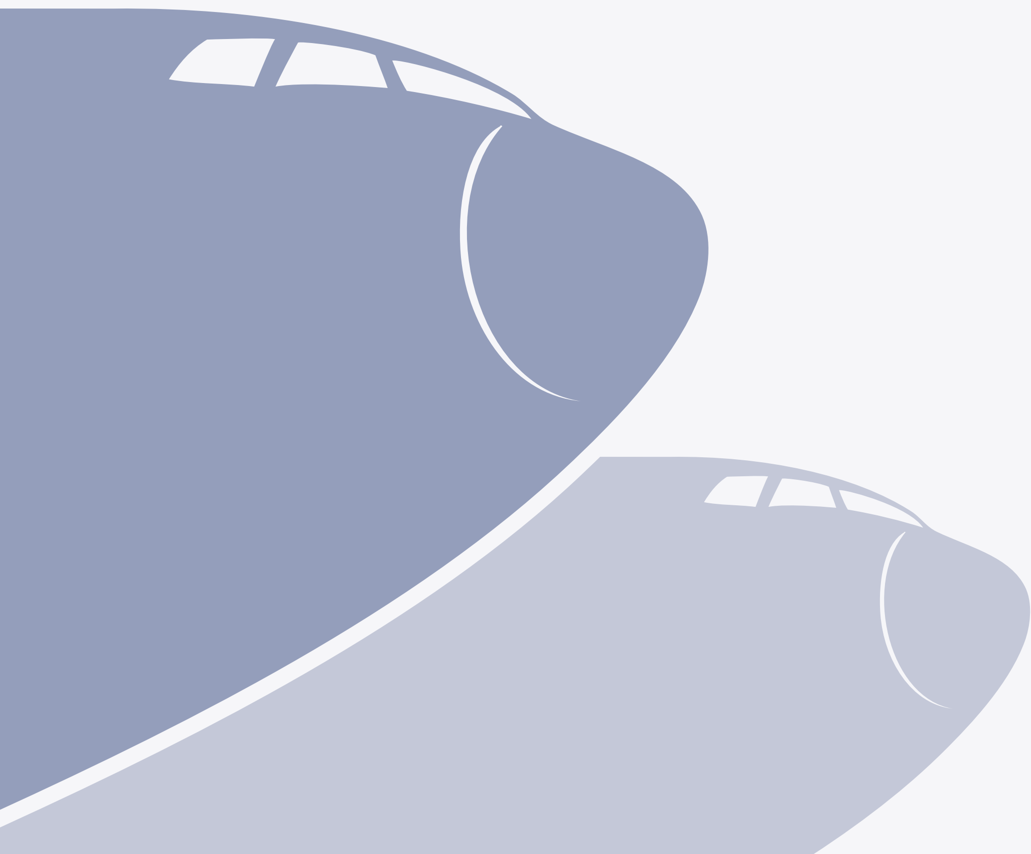
For the purposes of reporting in the context of noise management, an aircraft will be considered on a CDO if there is no level flight, allowing for one phase of level flight no longer than 2 nautical miles. (A level phase is needed in some instances to decelerate and configure the aircraft or to establish on a landing guidance system). Reporting will focus on lower altitude phases of flight and portions with significant traffic frequency (such as downwind segments) where CDO can provide a noise benefit.

Continuous Descent Operations that allow aircraft to descend on a low thrust setting and in a quieter profile are proven to result in noise reductions of **1 to 5 dBa**, in addition to reducing emissions.

OUR COMMITMENT

Reducing the impacts of aviation noise requires a shared and continuing commitment to improvement, informed by dialogue with industry stakeholders and communities. In addition to requirements outlined in aeronautical publications, this document intends to increase awareness and use of practices that reduce noise.

The future holds more promise as new technologies improve medium and long-term traffic planning by controllers and pilots. As new opportunities arise that are suitable for this Guidance Document, they will be considered by the Industry Noise Management Board.



BACKGROUND ON THE INMB AND THE GUIDELINES

Starting in June 2015, the GTAA and NAV CANADA undertook a collaborative effort known as the Six Ideas to study and pursue new means of providing noise relief to the communities affected by Toronto Pearson's operations. The ideas include a combination of procedural and runway usage changes.

Following a two-year process that included extensive community engagement, the GTAA released an updated five- year Noise Management Action Plan that outlines ten new commitments related to consultation, environmental responsibility, operational changes, monitoring and reporting aircraft noise, and industry collaboration.

In summer 2016, NAV CANADA announced a review of Toronto airspace to determine whether all reasonable actions to reduce aircraft noise were being considered with respect to design and operation of the Toronto area airspace for aircraft operating in and out of Toronto Pearson. NAV CANADA responded and accepted or partially accepted all of the recommendations from the report.

Two of the recommendations accepted by NAV CANADA include the establishment of an Independent Noise Management Board (INMB) and the development of an Industry 'Code of Practice'. This document – *Quieter Operations: A Guide for Pilots and the Controllers* – serves as the industry's first code on operational practices that reduce noise impacts.

The Industry Noise Management Board was established in 2018 to bring together technical expertise from airlines, airports, Transport Canada and NAV CANADA. Together, they look at operating practices from around the world and consider their applicability to reduce aircraft noise here in Canada.

APPENDIX – BACKGROUND TERMS AND CONCEPTS

To assist the reader, the following background aviation terms and concepts have been copied from the Independent Toronto Airspace Noise Review performed by Helios, available in full here: http://www.navcanada.ca/EN/about-us/Pages/CYYZ-Third-Party.aspx

Airfield Traffic Pattern

Traffic patterns are typically rectangular in shape, and include the runway which runs along one long edge of the rectangle. Each leg of the traffic pattern has a specific name, indicated below:

- **Downwind:** A long flight path parallel to, but in the opposite direction of, the landing runway. This can be flown at level altitude, or can be used to descend.
- **Base leg:** A short flight path typically at right angles to the approach and extended centreline of the landing runway. This can be flown either level or descending.
- **Final approach:** A descending flight path in the direction of landing along the extended runway centreline, from the base leg to the landing runway.

Vectoring

Aircraft vectoring is an ANS provided to aircraft by ATC, and is used to achieve separation between aircraft, to aid the navigation of flights, and to guide arriving aircraft to a position from which they can continue their final approach to the runway. It is the controller's responsibility to choose an airfield traffic pattern for the aircraft to fly, composed of specific legs or vectors, and to instruct the pilot to fly specific headings at appropriate times to safely descend the aircraft. Vectoring plays a significant role in the way controllers' process traffic.

Standard Arrival Routes

When an aircraft flies from airport to airport using IFR, they do so by flying along standard routes marked on published (printed) charts, which act like roads in the sky. These 'airways' allow an aircraft to get from A to B in a controlled and structured manner instead of flying any route they wish. The advantage of this is that once a pilot has declared his/her intended route, air traffic controllers do not need to provide vectors and instructions throughout the journey.

A STAR is a designated instrument flight rule arrival route linking a significant point, normally on an air traffic service route, with a point from which a published instrument approach procedure can be commenced.

Waypoints

Waypoints are named points in space which form a route in the sky, along which aircraft navigate. These routes are often composed of both beacons and waypoints. A waypoint is defined by its geographic coordinates, or its bearing and distance from a beacon, and has a name which normally takes the form of a five-letter capitalised word. A waypoint may be a simple named point in space, helping to 'mark out the route', or it may be associated with existing physical navigational aids, route intersections or fixes. For example, waypoints are often used to indicate a change in direction, speed or altitude along a desired path.

Final Approach Track

The final approach track is the last leg in an aircraft's approach to landing, when the aircraft is lined up with the runway and descending for landing. At some airports, an ILS is used to help navigate an aircraft on the final approach track safely to the runway. An ILS transmits radio signals in two cone-like beams along part of the final approach track, to aid aircraft arrival. One beam (localiser beam) provides lateral positioning guidance and the second beam (glidepath beam) provides the vertical guidance. Once an aircraft is established on the ILS, it will follow a fixed descent path towards the runway.

Air traffic control

ATC is a service provided by ground-based controllers who direct aircraft on the ground and through controlled airspace, and can provide advisory services to aircraft in non-controlled airspace. The main purpose of ATC is to prevent collisions, organise air traffic flow, and provide information and other support for pilots.

An air traffic controller has access to an ATM system, from which they can gather data about the aircraft in the vicinity and use live streaming to identify the exact location of each aircraft. The ATM visual is black, with coloured lines illustrating flight paths, the airport, airspace blocks and other navigational props. Aircraft figures move around on this screen replicating their position and direction they are heading in real-time.

Causes of aircraft noise

Aircraft noise is predominantly caused by the engines and by air passing over the airframe (i.e. the main body of an aircraft and its wings).

When wind passes over the airframe it causes friction and turbulence, which makes a noise. The amount of noise created can vary depending on the way an aircraft is flown. For example, planes land with their flaps down which creates more friction and hence more noise. Minimising the amount of time with the flaps down will reduce the noise. Air brakes are also used to slow a plane during descent. As with flaps, they increase aircraft drag and hence cause more friction, leading to more noise.

Engine noise is created by the sound of the moving parts of the engine, and by the air being expelled at high speed once it has passed through the mechanics. Thrust is the force generated by the engines of an aircraft to move it through the air. Engine thrust generates noise.

Aircraft energy management

Energy management of an aircraft is important for safe approach and landing at an airport. Aircraft energy is a function of the following primary flight parameters and of their rate of change (trend);

- airspeed and speed trend;
- altitude and vertical speed (or flight path angle);
- aircraft configuration (i.e. drag caused by speed breaks, slats / flaps and / or landing gear); and
- thrust.

It is the responsibility of the pilot to monitor the energy level of an aircraft by controlling all the above parameters. External factors (i.e. the wind) can play an important part, such that an aircraft's speed must be adjusted accordingly to counteract a tail- or headwind. Energy management during descent and deceleration is essential to ensure that an aircraft lands safely, and is aided by using speed breaks, slats / flaps and / or landing gears which all generate drag. Some aircraft level out (maintain altitude) during their descent to efficiently and effectively manage their total energy.

Descent Management

Noise experienced by communities can be reduced if aircraft descent is managed with a noise reduction objective. To achieve a quieter descent, the pilot must use low engine power and minimise drag for as long as is safe, as well as staying as high as possible for as long as possible. Two techniques that are effective at reducing the noise on approach include CDO and low power/low drag.

Continuous Descent Operations

CDOs offer a significant noise benefit at distances of 10 to 20NM from touchdown. The noise benefit of a CDO will vary depending on the altitude and length of level flight associated with a non- CDO, as well as the descent rate and associated thrust settings of the CDO flight. A study conducted by the UK CAA concluded that a typical non-CDO has approximately 5NM of level flight at altitudes from 3,000 to 6,000ft. Compared to a perfect CDO, this results in noise increases of up to 2.5 to 5dB, varying over distance from touchdown.

Low Power / Low Drag

Low power/low drag is the collective term used for describing the lowest noise configuration for a given speed and / or altitude during the approach. Selecting more flap than is required for a given speed will typically lead to more airframe noise, higher engine power due to greater drag and thus higher noise. The effect is however small, typically no more than 1dB.

In contrast, deployment of the landing gear significantly increases aircraft drag and airframe noise, and to maintain the flight path requires increases in engine power and thus also engine noise. The combined effect may be as much as 5dB.

Landing gear are deployed in accordance with airline and manufacturer safety requirements and standard procedures, which vary by aircraft type.

Clean aircraft configuration

Clean configuration is the flight configuration of a fixed-wing aircraft when its external equipment is retracted, to minimise drag and thus maximise airspeed for a given power setting.

For most airplanes, clean configuration means that the wing flaps, slats, spoilers, leading edge flaps and landing gear are retracted as these are the cause of drag due to the lack of streamlined shape.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