Air Traffic Services & Flight Instruction

Day 2, 0800-0930
Presenter: Kurtis Arnold
Performance-Based navigation (PBN) defines performance requirements for aircraft navigating on an ATS route, terminal procedure or in a designated airspace. It is ICAO’s effort and objective to redefine the regional differences of various Area Navigation (RNAV) and Required Navigation Performance (RNP) specifications into a globally harmonized set of PBN applications. To better understand the concept of PBN, let’s take a look at the events leading up to PBN, benefits associated with the use of PBN, and what is being done to implement PBN around the world.

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The global aviation community is facing significant challenges. As demand for air transportation services increase, States are faced with finding solutions to safely increase capacity, efficiency, and access, e.g. to terrain challenged airports. These constraints are largely a result of reliance upon conventional ground-based navigation aids (e.g., VOR, NDB, ILS), which limit routes and procedures to the physical locations of ground-based navigation aids. These ground-based systems have served the aviation community well since inception; however, they do not permit the flexibility of point-to-point operations available with PBN to meet the challenges of today and the future.

ICAO has adopted PBN to address these challenges. Through the application of Area Navigation (RNAV) and Required Navigation Performance (RNP) specifications, PBN provides the means for flexible routes and terminal procedures. The illustrations depict the constraints associated with conventional, ground-based sensor specific routes/procedures and the flexibility and benefits of performance-based, non-sensor specific navigation (both RNAV and RNP).

PBN is helping the global aviation community reduce aviation congestion, conserve fuel, protect the environment, reduce the impact of aircraft noise and maintain reliable, all-weather operations, even at the most challenging airports. It provides operators with greater flexibility and better operating returns while increasing the safety of regional and national airspace systems.

**PBN Is Environment-Friendly**
- Reduces emissions by saving fuel. 3.19 kg of CO₂ emissions are eliminated for every 1 kg of fuel savings achieved through shorter and vertically optimized PBN flight paths. IATA estimates that globally, shorter PBN routes could cut CO₂ emissions by 13 million tonnes per year. Additionally, PBN provides a mechanism for optimized profile descents that allow aircraft to descend from high altitudes to the airport at minimum thrust settings.
- Reduces noise pollution. Consistent, precise paths can be routed to avoid noise sensitive areas. Noise levels can often be reduced through use of optimized profile descents, which allow lower, quieter thrust levels.
PBN Improves Safety
- Reduces the risk of Controlled Flight Into Terrain (CFIT) accidents by providing a very precise lateral and vertical flight path
- Provides consistent, predictable and stabilized approaches. Aircraft arrive at the runway aligned with the centerline, in the same configuration and at the same speed every time.
- Reduces diversions caused by adverse weather conditions, enabling aircraft to reliably access airports with lower visibility restrictions.

PBN Improves Operating Returns
- Reduces fuel waste through shorter flight tracks, optimized profile descents and fewer diversions. Enables more direct and closely spaced parallel tracks en route for increased fuel efficiency and reduced flight time variance.
- Creates new market opportunities by providing safe access to terrain and weather challenged destinations. PBN also provides a path for airline growth as emissions caps are implemented around the world.
- Provides a degree of precision approach capability without the investment required for expensive ground-based infrastructure.
- Improves customer satisfaction/customer loyalty by allowing airlines to more consistently access airports serviced at higher on-time rates.

PBN Increases Airspace Capacity
- Increases traffic capacity through more efficient routes and smoother flows. Reduces airspace conflicts between adjacent airports and prohibited or special use airspace.

The Global Rollout of PBN
At the 2007 36th International Civil Aviation Organization (ICAO) General Assembly, States agreed to Resolution 36/23, which urges all States to implement routes and airport procedures in accordance with the ICAO PBN criteria. Regional PBN Implementation Task Forces were developed to coordinate the regional implementation programs.

From a global perspective ICAO and IATA formed the Global PBN Task Force, where States and industry are collaborating on global solutions, such as the required operational approval process and the development of educational material for PBN. A detailed reference library for PBN is available at http://www.icao.int/pbn. Additional enquiries can be sent to pbn@icao.int.
Navigate this: RNAV and RNP primer

If satellite navigation is supposed to make things better, then how come navigating the sometimes confusing terminology is so difficult? As the world moves forward with the implementation of satellite navigation, we thought it appropriate and timely to provide an overview of the subject and the terms used to discuss it.

What is RNAV?

Area Navigation, or RNAV, enables aircraft to fly on any desired flight path within the coverage of ground or space-based navigation aids, within the limits of the capability of the self-contained aircraft systems or a combination of both capabilities.

RNAV certified aircraft have better access to, and flexibility for, point-to-point operations, rather than being required to navigate between ground-based navigation aids such as VOR and NDBs.

Aircraft require DME/DME, DME/DME/IRS or GNSS navigation capability that meets 95% accuracy requirements to qualify for RNAV operations. For example, for RNAV 1 operations, the navigation system must demonstrate ±1 NM navigation accuracy 95% of the flying time.

What is RNP?

Required Navigation Performance, or RNP, is RNAV with the addition of an onboard performance monitoring and alerting capability.

This means that the onboard aircraft navigation equipment is able to monitor the navigation performance it achieves and inform the crew if the requirement is not met during an operation. The main benefit of this capability is that it enables reduced obstacle clearance or closer route spacing without intervention by air traffic control.

The term Required Navigation Performance is now being removed from ICAO documents, and replaced by Performance-based Navigation. RNP only serves as an acronym to designate those navigation specifications requiring on-board performance monitoring and alerting.

While RNAV still means area navigation, it also serves as an acronym for navigation specifications not requiring on-board performance monitoring and alerting.

Therefore, a descriptor such as RNAV SIDs and STARs may in fact designate all area navigation SIDs and STARs, both RNAV and RNP. On the other hand RNAV 1 SIDs and STARs only define SIDs and STARs of one particular navigation specification — RNAV 1.

What is Performance-based Navigation?

Performance Based Navigation (PBN) is simply a framework for defining navigation performance requirements.

It specifies the aircraft’s RNAV system performance requirements in terms of the accuracy, integrity, continuity and functionality needed for the proposed operations in the context of a particular airspace. It includes both RNAV and RNP performance specifications.

For PBN in Canada, GNSS is the key enabler, while in Europe and the U.S., ground-based navigation aids are still being considered as part of the airspace concept design.

How are they designated?

The ICAO PBN Manual (DOC 9613) provides an explanation of the navigation specifications and designations for RNAV and RNP, and for which airspace or environment they are intended. Basically, certain navigation specifications are more appropriate for certain types of airspace.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Application</th>
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<tbody>
<tr>
<td>RNP APCH</td>
<td>Approach Procedures</td>
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<tr>
<td>RNP AR APCH</td>
<td>Approach Procedures (Challenging terrain/obstacles or high density airports)</td>
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<td>RNAV 1 and 2</td>
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The RNP specification includes a requirement for on-board performance monitoring and alerting while the RNAV specification does not.

As an example, RNAV 1 designation, which is used for SIDs and STARs in a terminal radar environment, means that the aircraft’s navigation accuracy must be within 1 nautical mile either side of the track, 95% of the time, based on Total System Error (TSE).

What is WAAS?

The Wide Area Augmentation System, or WAAS, is a Space-Based Augmentation System (SBAS) that supports the existing GPS constellation. WAAS monitors GPS signals across a North American network of ground-based reference stations and uplinks corrections, integrity and ranging data via master stations for rebroadcast from two geostationary (GEO) satellites to all aircraft receivers within the coverage footprint.

There are four reference stations in Canada (Winnipeg, Iqaluit, Goose Bay and Gander) that, together with existing U.S. stations, provide signal coverage throughout much of Canada.

Aircraft navigation accuracy means it remains within x nautical miles either side of the defined flight path.
The main benefit for aircraft equipped with WAAS avionics is a high availability of more accurate navigation in both the enroute and approach phases of flight. WAAS provides 1-2 metre navigation accuracy, and allows for approach procedures with both lateral and vertical guidance, down to ILS approach minima.

These LPV (localizer precision, vertical guidance) procedures provide a capability that is better than barometric vertical (BARO-VNAV) guidance. This means that where the WAAS signal is available ILS-like procedures can be designed to ILS equivalent minima, without any requirement for ground-based navigation aid infrastructure.

What are LNAV/VNAV and LNAV approach procedures?

ICAO uses the term Approach Procedure with Vertical Guidance (APV) for approaches that offer vertical navigation guidance. There are two ways to achieve vertical guidance; one is from the barometric altimeter, and the other from an SBAS signal (WAAS in North America). Therefore an RNP APCH procedure can either offer lateral guidance (LNAV), lateral guidance with barometric vertical guidance (LNAV/VNAV), or WAAS lateral and vertical guidance (LPV).

For every RNP APCH procedure, NAV CANADA publishes LNAV/VNAV and LPV minima where benefits can be gained. Essentially, LNAV minima mean that the aircraft is using GNSS lateral guidance only, with no vertical guidance. LNAV/VNAV minima mean the aircraft is using GPS for lateral navigation and using the Flight Management System to fly a 3 degree glidepath using barometric information.

LPV means the aircraft is using the WAAS signal for both lateral navigation and vertical guidance. The vertical guidance is more accurate than barometric guidance, and this accuracy allows for an ILS-like procedure.

What is the role of airports?

Survey data of the approach and runway area is necessary for LNAV/VNAV, LPV and ILS designs to confirm the obstacles in the final approach areas so that the lowest possible minima can be attained. Airports play a key role in providing the airport data that is essential for the design of all RNP procedures and precision approaches.

In addition, the runway certification affects the minima for any approach. A runway that is certified ‘non-instrument’ cannot have instrument approaches that have minima below 500’ Above Ground Level (AGL) while for a runway that is certified ‘non-precision’, the approach minima cannot be below 250’ AGL and 3/4 statute mile visibility.

So if an airport runway is certified non-instrument, the design of an LPV and LNAV/VNAV procedure has minimal impact on airport accessibility.

RNAV approach plate from the Canada Air Pilot.

So what does the future hold?

NAV CANADA is moving ahead with the implementation of PBN and has developed a PBN implementation plan with our customers. The plan provides for the gradual implementation of PBN over the next five years. The main enabler for PBN in Canada is GNSS but short-term consideration will be given for DME/DME/IRS navigation capability.

With PBN implemented, NAV CANADA will be able to facilitate more efficient design of airspace and procedures, to improve safety, airport accessibility, airspace capacity, predictability and operational efficiency and to minimize the reliance on ground-based navigation aid infrastructure. This will lead to further efficiencies for both NAV CANADA and our customers.
This aeronautical information/data is published for OPS SPEC 605

RNAV (RNP) Y RWY 34

- VNAV PATH must be annunciated beyond this point.
- SPECIAL PATH must be annunciated beyond this point.
- AIRCREW AUTHORIZATION REQUIRED

MISSED APPROACH:
Climb to 8700' via the RNAV (RNP) Missed Approach track to ADRUP and hold as published. Maximum holding speed 230 KIAS.

VANCOUVER Center
ATIS 133.5
*KELOWNA Tower
ATIS 119.6
*KELOWNA Ground
ATIS 121.7
PREDICTION Radio
RNP (RNP) Y RWY 34

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Benefits and Safety

**ADS-B/TIS-B/FIS-B services** provide several new or greatly improved operational capabilities. Service providers will use the new surveillance capability to enable enhanced Air Traffic Control (ATC) services. Users employ the surveillance and broadcast services capability to support flight operations. These services help to prevent accidents by providing increased situational awareness to air traffic controllers and pilots by providing:

- Air-to-air surveillance capability
- Surveillance to areas that do not currently have surveillance coverage
- Real-time, in-the-cockpit, traffic and aeronautical information (i.e. weather, Temporary Flight Restrictions (TFRs), and special use airspace information)

**Capacity and Efficiency**

Airspace can be better utilized by providing the capability for both reduced separation as well as greater predictability in departure and arrival times. Benefits include:

- Radar-like separation procedures in remote or non-radar areas, possibly decreasing travel time
- Support for common separation standards (horizontal and vertical) in all classes of airspace
- Improved ability to manage traffic and aircraft fleets
- Improved air traffic controller ability to plan arrivals and departures for aircraft far in advance
- Infrastructure necessary to operate the National Airspace System at reduced cost

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**Surveillance and Broadcast Services**

**Traffic Information Service - Broadcast (TIS-B)**

TIS-B broadcasts surveillance data to equipment in the aircraft and provides ADS-B equipped aircraft with position reports from secondary surveillance sources for non-ADS-B equipped aircraft.

**Flight Information Service - Broadcast (FIS-B)**

FIS-B Transmits graphical National Weather Service products, Temporary Flight Restrictions (TFRs) and special use airspace information.

**Automatic Dependent Surveillance - Broadcast (ADS-B)**

- **Automatic**: Periodically transmits information with no pilot or operator input required
- **Dependent**: Position and velocity vector are derived from the Global Positioning System (GPS) or a Flight Management System (FMS)

The ADS-B system is a crucial component of the Next Generation Air Transportation System (NextGen). It provides surveillance and situational awareness simultaneously to pilots and air traffic control facilities. ADS-B is designed to improve the safety, capacity and efficiency of the National Airspace System while providing a flexible expandable platform to accommodate future air traffic growth. ADS-B provides improved situational awareness with the following information in the cockpit:

- Heading
- Altitude
- Speed
- Aircraft category
- Call sign
- Distance

For further information, contact: Amy Kirkham 202-385-8394 Amy.ctr.Kirkham@faa.gov www.adsb.gov
8.9 CLEARANCES—LEAVING OR ENTERING CONTROLLED AIRSPACE

ATC will use the phrase “while in controlled airspace” in conjunction with the altitude if an aircraft will be entering or leaving controlled airspace. In addition, ATC will specify the lateral point and altitude at which an aircraft is to leave or enter controlled airspace if the instruction is required for separation purposes (see Note).

Example:
LEAVE ENTER CONTROLLED AIRSPACE
(number) MILES (direction) OF (fix) AT (altitude).

NOTE: The altitude assigned by ATC need only reflect the minimum safe IFR altitude within controlled airspace. A pilot should be alert to the possibility of a higher minimum IFR altitude outside of controlled airspace. If uncertain (or unable to determine) when to enter or leave the area where the higher minima is applied, a request for clearance to maintain an altitude that will accommodate the higher minimum IFR altitude should be made.

8.10 CLEARANCE LIMIT

The clearance limit, as specified in an ATC clearance, is the point to which an aircraft is cleared. Further clearance is delivered to a flight prior to arrival at the clearance limit. However, occasions may arise when this may not be possible. In the event that further clearance is not received, the pilot is to hold at the clearance limit, maintain the last assigned altitude and request further clearance. If communications cannot be established with ATC, the pilot should then proceed in accordance with communications failure procedures as described in RAC 6.3.2.

The responsibility rests with the pilot to determine whether or not a received clearance can be complied with in the event of a communications failure. Under such circumstances, a clearance may be refused, but such refusal should specify acceptable alternatives.

8.11 CLASS G AIRSPACE—RECOMMENDED OPERATING PROCEDURES—EN ROUTE

When aircraft are manoeuvring in the vicinity of uncontrolled aerodromes or cruising in Class G airspace, the lack of information on the movements of other aircraft operating in close proximity may occasion a potential hazard to all concerned. To alleviate this situation, all pilots are advised that:

(a) when operating in Class G airspace, they should continuously monitor frequency 126.7 MHz whenever practicable;

(b) position reports should be made over all NAVAIDs along the route of flight to the nearest station having air-to-ground communications capability. These reports should be made on frequency 126.7 MHz whenever practicable. If it is necessary to use another frequency to establish communications with the ground station, the report should also be broadcast on 126.7 MHz for information of other aircraft in the area. The report should contain present position, track, altitude, altimeter setting in use, next position and ETA;

(c) immediately before changing altitude, commencing an instrument approach or departing IFR, pilots should broadcast their intentions on 126.7 MHz whenever practicable. Such broadcasts shall contain adequate information to enable other pilots to be fully aware of the position and intentions so that they can determine if there will be any conflict with their flight paths;

(d) at aerodromes where an MF has been designated, arriving pilots shall first broadcast their intentions on 126.7 MHz before changing to the MF. If conflicting IFR traffic becomes evident, this change should be delayed until the conflict is resolved. Pilots departing IFR should broadcast their intentions on 126.7 MHz, in addition to the MF, prior to takeoff; and

(e) the preceding reporting requirements are considered as the minimum necessary. Pilots are encouraged to make additional reports whenever the possibility of conflicting IFR traffic is suspected. An example would be reporting prior to overflying a facility where cross traffic is probable or where there is a published instrument approach procedure.

NOTE: There is no frequency comparable to 126.7 MHz for use by aircraft equipped only with UHF; however, pertinent UHF traffic information will be relayed on the MF by the flight service specialist.

9.0 INSTRUMENT FLIGHT RULES (IFR) – ARRIVAL PROCEDURES

9.1 ATIS BROADCASTS

If ATIS is available, all pilots should use it to obtain the basic arrival or departure and aerodrome information as soon as it is practicable.

9.2 STAR

In order to simplify clearance procedures, coded STARs have been designated at some airports. STARs are published in the CAP. No pilot is required to accept a STAR clearance; if any doubt exists as to the meaning, a detailed clearance should be requested.
9.2.1 Conventional STAR

A conventional STAR is defined as a STAR that can be flown by a pilot using ground-based NAVAIDs or specified headings. Most conventional STARs end with ATC providing radar vectors to the aircraft. A conventional STAR should be filed on a flight plan. If a conventional STAR is filed, ATC expects the aircraft to fly the STAR as depicted.

9.2.2 RNAV Equipment

With the widespread deployment of RNAV systems and the advent of GPS-based navigation, greater flexibility is now possible in defined routings, procedures, and airspace design. This permits an associated increase in flight safety as well as a potential for significant fuel savings and reduced pilot-controller communications.

Pilots interested in flying RNAV STAR procedures should file them as part of their flight plan and must have the following equipment:

(a) At least one RNAV system or FMS certified for terminal use that meets either of the following standards:
   • AC 20-130 or later approved, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors; or
   • AC 20-138 or later approved, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for use as a VFR and IFR Supplemental Navigation System, and TSO C129a, Airborne Supplemental Navigation Equipment Using the Global Positioning System (GPS);

(b) If the RNAV system or FMS does not use a GPS sensor, then at least one automatic radio-updated inertial reference unit (IRU);

(c) A current database containing the waypoints for the RNAV STAR to be flown that can be automatically loaded into the RNAV system or FMS active flight plan;

(d) A flight director system capable of following the RNAV system or FMS lateral flight path; and

(e) An electronic map display.

Where the DTW and FACF are not joined (“OPEN” procedure), there will be a discontinuity in the database flight plan. This has caused problems with some onboard equipment when attempting to link the procedure after receiving the approach clearance prior to the DTW. Therefore, prior to filing an RNAV STAR as part of the flight plan, pilots should have procedures in place to ensure that, when required, they will be able to successfully link the DTW to the FACF.

NOTE: If the pilot is unable to successfully link the procedure, advise ATC in order to receive radar vectors to the FACF.

Pilots should also be aware that above 180 KIAS (knots indicated airspeed), turn anticipation may not function properly between the DTW and FACF.

9.2.3 RNAV STAR Procedure

Definition:
An RNAV STAR is an IFR air traffic control arrival procedure, coded and included in an aircraft’s navigational database, published in graphic and textual form to be used by aircraft appropriately equipped and authorized to conduct this procedure.

General Procedures
The RNAV STAR defines a lateral route for an aircraft to fly from a significant point along the en route phase of flight to the approach phase without, or with minimal, ATC intervention. Vertical constraints and speed restrictions may be depicted as required on any RNAV STAR. All vertical constraints and speed restrictions, including those at the DTW or FACF, depicted on an RNAV STAR are to be honoured by the pilot at all times, unless otherwise authorized by ATC.

Vertical Constraints
Vertical constraints may be included for terrain clearance as well as for operational reasons. If an altitude below a depicted constraint is issued by ATC, it is the pilot’s responsibility to meet all depicted altitude constraints along the route, unless otherwise authorized by ATC. When an approach clearance is issued, all vertical constraints are to be honoured, unless otherwise authorized by ATC.

Example:
An aircraft maintaining 12 000 ft is cleared to descend to 6 000 ft and the next (subsequent) waypoints along the RNAV STAR route have altitude restrictions of 9 000 ft and 7 000 ft or above, respectively. The altitude restrictions as depicted must be honoured. The aircraft must cross the first at 9 000 ft and the next at 7 000 ft or above, even when ATC has cleared the aircraft to descend to 6 000 ft.

Speed Restrictions
Speed restrictions are included for operational reasons. Similar to vertical restrictions, all speed restrictions are to be honoured as depicted, unless otherwise authorized by ATC. The speed restriction depicted at all DTWs (max. 200 KT) is to be honoured even after an approach clearance has been issued. It is the pilot’s responsibility to adhere to all depicted speed restrictions, unless otherwise authorized by ATC.

Flight Planning
An RNAV STAR should be included in a flight plan when filed. Any aircraft and crew meeting the RNAV Equipment List and authorized to fly RNAV procedures may include the RNAV STAR in their flight plan. When included in a flight plan, the RNAV STAR automatically becomes part of the flight-planned route. Since the RNAV STAR is considered an integral part of the route, it will be included in the initial ATC clearance. Any
altitude constraint or speed restriction depicted on the RNAV STAR chart form part of the initial ATC clearance. ATC will not reissue the RNAV STAR clearance at the destination unless there is a need to reinstate the RNAV STAR.

When a flight plan has been filed that includes an RNAV STAR, and/or the pilot receives and acknowledges a clearance that includes an RNAV STAR, the pilot is expected to fly the cleared route from the entry point, associated with the RNAV STAR, to the termination point. The RNAV STAR will be included with the initial ATC clearance and normally it is not reissued.

**Canceling an RNAV STAR**

ATC or the pilot may cancel an RNAV STAR if required. An RNAV STAR is automatically cancelled when ATC assigns radar vectors or when the aircraft is cleared to a waypoint not contained within the RNAV STAR. If, for any reason, an RNAV STAR has been cancelled, it has to be reissued if ATC or the pilot wish to resume flight on the previously filed RNAV STAR.

**Amended Routes**

Controllers may elect to amend (shorten) RNAV STAR routes by clearing the aircraft from one waypoint to another intermediate waypoint depicted within the RNAV STAR. When amending a route within the charted RNAV STAR (waypoint to waypoint), ATC will conclude by stating, “balance of the route unchanged,” or issue the entire route, if required.

Aircraft may be cleared direct to a DTW or FACF in conjunction with an approach clearance. Even though an approach clearance has been issued, pilots are required to honour all depicted altitude restrictions and speed constraints, unless otherwise authorized by ATC.

**RNAV STAR Procedures**

There are two types of RNAV STAR procedures: “open” and “closed.”

**Definition:**

An **OPEN RNAV STAR** terminates at a DTW. This procedure is used for aircraft approaching the landing runway via the downwind leg to the DTW.

**Open RNAV STAR Procedures**

Open RNAV STAR procedures provide a continuous lateral route from the RNAV STAR entry point to the DTW, followed by a heading. All depicted altitudes must be honoured, even when a lower altitude has been issued by ATC, unless otherwise authorized by ATC. The pilot shall comply with all ATC-assigned altitudes in accordance with ATC clearances received and acknowledged by the pilot. The pilot is to maintain the depicted heading after the DTW, unless otherwise authorized by ATC. ATC is responsible for providing vectors to the aircraft to a point from which the aircraft can fly the straight-in approach. All depicted speed restrictions must be honoured, unless otherwise authorized by ATC.

**Closing the Open RNAV STAR**

Controllers have the option of either closing the RNAV STAR by issuing an approach clearance at least 3 mi. prior to the DTW, or leaving it open. When an approach clearance has not been received at least 3 mi. prior to the DTW, the aircraft is expected to fly the depicted heading after the DTW. At some point after the DTW, the controller will close the procedure by issuing vectors to position the aircraft to permit interception of the final approach course to fly the straight-in.

A controller may exercise the option to “close the procedure” by issuing an approach clearance at least 3 mi. prior to the DTW. When the controller issues an approach clearance at a point 3 mi. or more from the DTW, the **OPEN RNAV STAR** is “closed.” When the approach clearance is issued (prior to the DTW), the pilot is expected to fly the lateral RNAV STAR route to the DTW and then to the FACF (turn anticipation), intercept the final approach course, and fly the straight-in approach to the landing runway. This procedure is detailed in the “text box” on each RNAV STAR chart.

**A CLOSED RNAV STAR terminates at a FACF.** Normally used when the inbound track is within plus or minus 90˚, of the final approach course to the runway.
Closed RNAV STAR Procedures

Closed RNAV STAR procedures provide a continuous lateral route from the RNAV STAR entry point to the FACF of the runway intended for landing. All depicted altitudes must be honoured, even when a lower altitude has been issued by ATC, unless otherwise authorized by ATC. The pilot shall comply with all ATC-assigned altitudes in accordance with ATC clearances received and acknowledged by the pilot, and when an approach clearance has been issued, intercept the localizer/final approach course at the FACF and fly the straight-in approach.

Approach Clearance (Closed Procedure)

If an approach clearance is received while flying a “closed procedure,” the pilot is expected to follow the lateral route to the FACF, complying with all altitude and speed constraints, unless otherwise authorized by ATC. The pilot will connect to the IAP and fly the straight-in approach.

Approach Clearance (Open Procedure)

If an approach clearance is received at least 3 mi. prior to the DTW, when flying the “open procedure,” the pilot is expected to follow the lateral route to the DTW, then to the FACF, intercept the final approach and fly the straight-in approach. Turn anticipation is to be expected at both the DTW and the FACF, and all depicted altitudes and speeds shall be complied with, unless otherwise authorized by ATC.

If an approach clearance has not been received at least 3 mi. prior to the DTW, the pilot is expected to continue to the DTW and fly the heading after the DTW as depicted. The controller will issue vectors to intercept the final approach from which a straight-in approach can be flown.

Communications Issues

Upon reaching the entry point of the RNAV STAR, and communications with ATC cannot be established, the pilot is expected to fly the lateral route of the RNAV STAR associated with the runway specified on the ATIS. After indicating a loss of communications (Squawk 7600), the pilot is expected to comply with all assigned and depicted altitudes and speeds.

If an approach clearance has not been received by the time the aircraft reaches the FACF (Closed Procedure), and communications with ATC cannot be established, the pilot is expected to intercept the final approach course and fly the straight-in IAP to the landing runway. All IAP from the RNAV STAR are to be flown straight-in since procedure turns do not form part of the RNAV STAR procedure.

When an aircraft has not received any additional clearances or instructions after commencing the RNAV STAR (leaving the en route), and prior to reaching the DTW (Open Procedure), and loss of communications has been indicated, it is expected that the pilot will continue to the DTW, then to the FACF, intercept final, and fly the straight-in approach while honouring all depicted altitude restrictions and speed constraints.

If an aircraft has passed the DTW (Open Procedure), and has not received any additional instructions or clearances, and after loss of communications has been indicated, it is expected that the pilot will proceed direct to the FACF, and fly the straight-in approach while honouring the depicted altitude at the FACF.

All IAP from the RNAV STAR are to be flown straight-in; procedure turns do not form part of this procedure and, therefore, are not authorized.

9.3 Approach Clearance

When using direct controller pilot communications, ATC normally advises pilots of the ceiling, visibility, wind, runway, altimeter setting, approach aid in use, and pertinent aerodrome conditions (CRFI, RSC, etc.) immediately prior to or shortly after descent clearance. Upon acknowledging receipt of the current ATIS broadcast, the pilot is advised by ATC of the current airport conditions only if they are changing rapidly.

Aircraft destined to airports which underlie controlled low level airspace and for which there is a published instrument approach procedure, will be cleared out of controlled airspace (vertically) via the published instrument approach procedure.

Example:

ATC CLEARS (aircraft identification) OUT OF CONTROLLED AIRSPACE VIA (name, type) APPROACH.

Aircraft destined to airports which underlie controlled low level airspace and for which there is not a published instrument approach procedure will be cleared to descend out of controlled airspace and informed of the appropriate minimum IFR altitude.

Example:

ATC CLEARS (aircraft identification) TO DESCEND OUT OF CONTROLLED AIRSPACE VICINITY OF (aerodrome name). THE (minimum IFR altitude) IS (number) feet.
ALL ALTITUDES WILL BE ISSUED BY ATC

If RNAV STAR includes a DTW, the following procedures apply.

If approach clearance is NOT RECEIVED prior to DTW
- Fly depicted heading →
- Expect radar vectors to final

If approach clearance RECEIVED prior to DTW
- Fly RNAV STAR via DTW, then
- Via FACF, then
- Fly the STRAIGHT-IN approach

ATIS 124.6
ARR 128.17 (Outer) 133.1 134.225 (Inner)
352.7
TWR 119.55(N) 118.7(S)
226.5

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Canada Air Pilot
Effective 0901Z 17 DEC 2009 to 0901Z 11 FEB 2010

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HANDA FIVE ARR (OPALE.HANDA 5)

ALL ALTITUDES WILL BE ISSUED BY ATC
If RNAV STAR includes a DTW, the following procedures apply.
- Fly depicted heading •••••
- Expect radar vectors to final
If approach clearance RECEIVED prior to DTW
- Fly RNAV STAR via DTW, then
- Via FACF, then
- Fly the STRAIGHT-IN approach

HANDA FIVE ARR
(OPALE.HANDA 5)

(FACF)
ERERO
N51 18.80
W114 01.27

(ATIS) 114.8 127.2
(ARR) 125.9
(TWR) 118.4 236.6
(GND) 121.9 125.35 275.8

7500
Max 200 kt

6500

283°

103°

16°

052°

16°

12,000

10,000

8,000
Max 200 kt

HANDA
N50 54.02
W114 47.79

ADSEK
N51 06.20
W114 13.27

ARBUJC
N51 12.81
W114 16.85

LIBUTON
N51 18.80
W114 09.24

6500

OPALE
N50 51.17
W114 59.59

Expect 250 kt or less

CARLTON
N50 56.85
W114 35.96

10,000
Max 220 kt

16,000

12,000

(VITEM)
N51 01.39
W114 16.72

Chart not to scale

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TO AIRCRAFT ON THE GROUND:

| # | BLINKING RUNWAY LIGHTS | Advises vehicles and pedestrians to vacate runways immediately. |

4.2.12  Departure Procedures – RONLY Aircraft

The procedures which apply to aircraft without radio also apply to aircraft equipped with receiver only, except that an airport controller may request the pilot to acknowledge a transmission in a specific manner. After the initial acknowledgement, no further acknowledgement, other than compliance with clearances and instructions, is necessary, unless otherwise requested by the controller.

4.3  TRAFFIC CIRCUITS — CONTROLLED AERODROMES

The following procedures apply to all aerodromes at which a control tower is in operation.

The traffic circuit consists of the crosswind leg, downwind leg, base leg and final approach leg.

Figure 4.1 – Standard Left-Hand Traffic Circuit

NOTES 1: Circuit normally flown at 1 000 feet AAE.

2: Where a right-hand circuit is required in accordance with CAR 602.96, the opposite of this diagram is applicable.

Entry to the circuit shall be made in such a manner so as to avoid cutting off other aircraft, conforming as closely as possible to the altitude (normally 1 000 ft AAE), speed and size of the circuit being flown by other traffic.

In order to increase safety by reducing the possibility of conflicting with departing traffic, aircraft approaching the active runway from the upwind side are to join the downwind leg abeam a point approximately midway between each end of the runway, taking into account aircraft performance, wind and/or runway length.

Pilots of NORDO and RONLY aircraft, who have made specific arrangements to operate within the control zone (RAC 4.4.5 and RAC 4.4.6), should approach the circuit from the upwind side, join crosswind at circuit height and, taking due account of other traffic, join the circuit on the downwind leg. Pilots are cautioned to remain clear of the approach and/or departure path of the active runway when joining the circuit (see Figure 4.1). Flights which are not in communication with the tower shall, at all times, be on the alert for visual signals. Pilots are reminded that below 3 000 feet AGL and within 10 NM of a controlled aerodrome, aircraft shall not be operated at speeds greater than 200 KT. However, where the minimum safe speed of the aircraft is greater than 200 KT, the aircraft may be operated at the minimum safe speed (CAR 602.32).

4.4  ARRIVAL PROCEDURES — CONTROLLED AIRPORTS

If ATIS is available, all arrivals should monitor this frequency to obtain the basic aerodrome information prior to contacting the tower. (See RAC 1.3 for ATIS information and refer to RAC 5.8 for arrival procedures in Class C airspace, other than a control zone.)

4.4.1  Initial Contact

Pilots must establish and maintain radio communications with the appropriate control tower prior to operating within any control zone served by an operational control tower. Also, if the control zone is Class B or C airspace, the appropriate clearance must be received from the controlling agency prior to entry.

When practical, it is recommended that the pilot make initial contact at least 5 minutes prior to requiring clearance or entering the zone.

4.4.2  Initial Clearance

On initial contact with the tower, unless the pilot advises receipt of ATIS, the airport controller will inform the pilot of runway in use, wind direction and speed, altimeter setting and any other pertinent information. Following this, the pilot will receive clearance to proceed, including any necessary restrictions. The shortest routing to the runway may be expected if traffic permits. Pilots of VFR aircraft should check the CFS (or a VTA chart if applicable) for special procedures at the time of flight planning.

When a pilot is given a clearance “to the circuit” by ATC, it is expected that the aircraft will join the circuit on the downwind leg at circuit height. Depending on the direction of approach to the airport and the runway in use, it may be necessary to proceed crosswind prior to joining the circuit on the downwind leg.
The ATC phraseology “cleared to the circuit” authorizes a pilot to make a right turn in order to join crosswind, or partial right turn to join a left-hand circuit provided that the right turn or partial right turn can be carried out safely.

A straight-in approach is an approach where an aircraft joins the traffic circuit on the final leg without having executed any other portion of the circuit.

When an aircraft is cleared for a right-hand approach while a left-hand circuit is in effect, it shall be flown so as to join the circuit on the right-hand downwind leg, or join directly into the right-hand base leg, as cleared by the airport controller.

Pilot: **KELOWNA TOWER, CESSNA FOXTROT ALFA BRAVO CHARLIE, 15 miles NORTH, 6 500 feet VFR, REQUEST LANDING INSTRUCTIONS.**

Tower: **ALFA BRAVO CHARLIE, KELOWNA TOWER, RUNWAY (number), WIND (direction in degrees magnetic, speed in knots), ALTIMETER (4-figure group in inches), other pertinent instructions or information if deemed necessary, CLEARED TO THE CIRCUIT or CLEARED TO LEFT BASE LEG or CLEARED STRAIGHT-IN APPROACH.**

Pilot: **ALFA BRAVO CHARLIE.**

When a pilot has received current landing information from the tower or the ATIS broadcast, initial clearance may be requested as follows:

Pilot: **VICTORIA TOWER, CESSNA FOXTROT ALFA BRAVO CHARLIE (aircraft position), ALTITUDE, CHECK LANDING INFORMATION (or) WITH INFORMATION (ATIS code), REQUEST CLEARANCE TO THE CIRCUIT (or other type of approach).**

Once established in the circuit as cleared, the pilot is to advise the tower accordingly.

Pilot: **VICTORIA TOWER, ALFA BRAVO CHARLIE DOWNWIND.**

Tower: **ALFA BRAVO CHARLIE NUMBER (approach sequence number). If not Number 1, the tower will give the type, position and colour if significant, of aircraft to follow and other instructions or information.**

Pilot: **ALFA BRAVO CHARLIE.**

**Common ATC Phraseologies:**

- **FOLLOW (aircraft type) NOW ON BASE LEG.**
- **EXTEND DOWNWIND.**
- **WIDEN APPROACH.**

**VFR Holding Procedures**

When it is required by traffic, VFR flights may be asked to ORBIT visually over a geographic location, VFR checkpoint or call-up point (when these are published in the CFS or VTA charts) until they can be cleared to the airport. If the request is not acceptable, pilots should inform ATC and state their intentions.

Pilot: **TORONTO TOWER, CESSNA FOXTROT ALFA BRAVO CHARLIE, OVER PORT CREDIT AT 3 500 feet WITH INFORMATION ROMEO.**

Tower: **ALFA BRAVO CHARLIE, ORBIT THE FOUR STACKS, ANTICIPATE A 5 minute DELAY, TRAFFIC IS A CESSNA 172 OVER THE FOUR STACKS, LAST REPORTED AT 2 000 feet.**

The pilot is expected to proceed to the FOUR STACKS, orbit within visual contact of the checkpoint and be prepared to proceed to the airport immediately upon receipt of a further clearance. Left turns are recommended as terrain and collision avoidance are the pilot’s responsibilities.

Tower: **ALFA BRAVO CHARLIE, REPORT LEFT BASE FOR RUNWAY 24L, CLEARED TO THE CIRCUIT.**

Pilot: **TORONTO TOWER, ALFA BRAVO CHARLIE DEPARTING THE FOUR STACKS AT THIS TIME FOR A LEFT BASE TO RUNWAY 24L.**

**4.4.3 Landing Clearance**

At controlled airports, a pilot must obtain landing clearance prior to landing. Normally, the airport controller will initiate landing clearance without having first received the request from the aircraft; however, should this not occur, the onus remains upon the pilot to request such clearance in sufficient time to accommodate the operating characteristics of the aircraft being flown. NORDO and RONLY aircraft shall be considered as intending to land when they join and conform to the traffic circuit. Landing clearance will normally be given when an aircraft is on final approach. If landing clearance is not received, the pilot shall, except in case of emergency, pull up and make another circuit.

Pilot: **VICTORIA TOWER, ALFA BRAVO CHARLIE LANDING CLEARANCE RUNWAY 26.**

Tower: **ALFA BRAVO CHARLIE, CLEARED TO LAND.**

Pilot: **ALFA BRAVO CHARLIE.**

Controllers may, on occasion, authorize ground traffic to cross the landing runway after a landing clearance has been issued. Any such authorisation by ATC is given with the assurance that the runway will be clear of conflicting traffic at the time the arriving aircraft crosses the landing threshold. When it appears that the runway may not be clear for landing, the pilot will be advised to “CONTINUE APPROACH, POSSIBLE PULL-UP.” When a “pull-up” is necessary (before or after the landing clearance has been issued), the pilot shall abandon the approach and make another circuit.

Tower: **TRAFFIC STILL ON RUNWAY, PULL-UP AND GO AROUND.**

**Common ATC Phraseologies:**

- **CAUTION, POSSIBLE TURBULENCE FROM LANDING (aircraft type and position).**
- **MAKE LEFT/RIGHT 360.**
- **MAKE FULL-STOP LANDING.**
- **CONTACT TOWER/GROUND ON (frequency) WHEN OFF RUNWAY/ NOW.**

The “cleared for the option” procedure has been introduced to give a pilot the option to make a touch-and-go, low approach, missed approach, stop-and-go, or a full stop
landing. This procedure will normally be used during light traffic conditions.

Pilot:  VICTORIA TOWER, ALFA BRAVO CHARLIE, DOWNWIND RUNWAY 27, REQUEST THE OPTION.

Tower:  ALFA BRAVO CHARLIE, CLEARED FOR THE OPTION RUNWAY 27.

4.4.4 Taxiing

A pilot must obtain an ATC authorization to taxi on the manoeuvring area at a controlled airport. Unless otherwise instructed by the airport controller, aircraft are expected to continue in the landing direction to the nearest suitable taxiway, exit the runway without delay and obtain further authorization to taxi. No aircraft should exit a runway onto another runway unless instructed or authorized to do so by ATC. When required, ATC will provide the pilot with instructions for leaving the runway. These instructions will normally be given to the pilot prior to landing or during the landing roll. When an aircraft is instructed to exit onto another runway, the pilot must:

(a) obtain further authorization to taxi; and
(b) remain on tower frequency until clear of that runway or until communication is transferred to ground control.

After landing on a dead-end runway, the pilot will normally be given instructions to backtrack. In all cases, after leaving the runway, unless otherwise instructed by ATC, pilots should continue to taxi forward across the taxi holding position lines or to a point at least 200 ft from the edge of the runway where a taxi holding position line is not available. The aircraft is not considered clear of the runway until all parts of the aircraft are past the taxi holding position line or the 200-ft point. When clearing landing runways onto taxiways or other runways, pilots should exercise good airmanship by continuing to taxi well clear of the hold position while contacting ground control to obtain taxi clearance. This is to prevent aircraft from blocking a runway exit to following aircraft. If unable to establish contact with ground control, pilots should stop and not cross any runway without receiving ATC authorization.

Tower:  ALFA BRAVO CHARLIE (instructions for leaving runway), CONTACT GROUND CONTROL (specific frequency).

Towers will normally provide the aircraft down time only when requested by the pilot.

Normally, aircraft will not be changed to ground control until off the active runway or runways.

Tower:  ALFA BRAVO CHARLIE, TAXI TO (apron or parking area) (any special instructions such as routing, traffic, cautionary or warning regarding construction or repair on the manoeuvring areas).

4.4.5 Arrival Procedures – NORDO Aircraft

Before operating into a controlled aerodrome, pilots shall contact the control tower, inform the tower of their intentions and make arrangements for clearance through visual signals.

NOTE:  Before operating within a control zone with Class C airspace, a clearance shall be obtained from the control tower.

Traffic Circuit – The pilot should approach the traffic circuit from the upwind side of the runway, join crosswind at circuit height abreast a point approximately midway between each end of the runway and join the circuit on the downwind leg. While within the circuit the pilot should conform to the speed and size of the circuit, maintaining a separation from aircraft ahead so that a landing can be made without overtaking it. If it is necessary for a flight to cross the airport prior to joining crosswind, this should be done at least 500 feet above circuit height, and descent to circuit height should be made in the upwind area of the active runway.

Final Approach – Before turning on final approach, a pilot shall check for any aircraft on a straight-in approach.

Landing Clearance – Landing clearance will be given on final approach. If landing clearance is not received, the pilot shall, except in case of emergency, pull up and make another circuit. (Landing clearance may be withheld by the tower when there are preceding aircraft which have not landed or if the runway is occupied.)

Taxiing – No taxi clearance is required after landing, except to cross any runway or to taxi back to a turn-off point. When an aircraft’s landing run carries it past the last available turn-off point, it shall proceed to the end of the runway and taxi to one side, waiting there until instruction is received to taxi back to the nearest turn-off point.

4.4.6 Arrival Procedures – RONLY Aircraft

The procedures which apply to aircraft without radio also apply to aircraft equipped with receiver only, except that an airport controller may request the pilot to acknowledge a transmission in a specified manner. After initial acknowledgement, no further acknowledgement other than compliance with clearances and instructions is necessary, unless otherwise requested by the controller.

4.4.7 Visual Signals

Visual signals used by the tower and their meanings are as follows: