

ENR 4. RADIO NAVIGATION AIDS/SYSTEMS

ENR 4.1 Radio Navigation Aids — Enroute

For an alphabetical list of stations providing radio navigation services for enroute purposes in Canada, refer to the following publications:

Canada Flight Supplement, Section D, “Radio Navigation and Communications – Radio Navigation Aids by Location,” or *Canada Flight Supplement* and *Water Aerodrome Supplement*, Section D, “Radio Navigation Aids by Indicator”

Also in the *Canada Flight Supplement* and the *Water Aerodrome Supplement*, Section B, “Aerodrome/Facility Directory,” the table for each aerodrome may have a subheading NAV (navigation) that contains information on radio navigation and landing aids associated with the instrument approach and the terminal area procedures at the aerodrome.

ENR 4.2 Special Navigation Systems

There are no special navigation systems for civil aviation purposes in Canada.

ENR 4.3 Global Navigation Satellite System (GNSS)

The Global Navigation Satellite System (GNSS) indicated in Table 4.3, “Global Navigation Satellite System,” may be used for enroute, terminal and approach operations in Canada. The systems in Table 4.3 also meet the requirements of ICAO Annex 10.

Table 4.3, Global Navigation Satellite System

Element	Name	Nominal Service Area	Operating Authority	Remarks
Constellation	Global Orbiting Navigation Satellite System (GLONASS)	Canadian Domestic Airspace	Ministry of Defence of the Russian Federation	Enroute, terminal, and non-precision approaches (NPA).
Constellation	Global Positioning System (GPS)	Canadian Domestic Airspace	US Department of Defense	Enroute, terminal, and non-precision approaches (NPA).
Satellite Based Augmentation System	European Geostationary Navigation Overlay Service (EGNOS)	Eastern Canada: Thunder Bay to St. John’s to approximately N50°	European Space Agency (ESA)	Augmentation to GNSS for enroute, terminal, and NPA.
Satellite Based Augmentation System	Wide Area Augmentation System (WAAS)	Canadian Domestic Airspace to approximately N70° (subject to visibility of at least one WAAS geostationary satellite (GEO))	US Federal Aviation Administration (FAA)	Augmentation to GNSS for enroute, terminal, NPA, lateral and vertical navigation (LNAV/VNAV), localizer performance (LP) and localizer performance with vertical guidance (LPV) approaches.

The acceptable GNSS equipment standards are identified in AIP Canada ENR 4.3.1 “GNSS Equipment Requirements”. The GNSS equipment installation on Canadian registered aircraft must be approved in accordance with the appropriate sections of the *Canadian Aviation Regulations* (CARs), Part V – Airworthiness, and installed for use in accordance with AC20-130A and/or AC20-138() as applicable.

Equipment and installations approved by other Aviation Authorities (AAs) to equivalent requirements are also deemed acceptable for operations within Canada.

The pilot-in-command (PIC) must also ensure that the available equipment can satisfy the requirements of CAR 605.18(j) — Power-driven Aircraft–IFR.

Aircraft using non-WAAS/SBAS based augmentation systems to support GPS installations (TSO-C129, TSO-C129a or TSO-C196 All Revisions (AR)) for navigation under IFR must be equipped with an alternate approved and operational means of navigation suitable for the proposed flight. Provided that RAIM is available, monitoring of the alternative navigation equipment is not required. Procedures must be established for use in the event that the loss of RAIM capability is predicted to occur. In situations where RAIM is predicted to be unavailable, the flight must rely on other approved navigation equipment, re-route to where RAIM is available, delay departure, or cancel the flight.

If TSO-C145/C146 equipment is used to satisfy the RNAV requirement, the pilot/operator need not perform the RAIM prediction if WAAS coverage is confirmed to be available along the entire route of flight. In areas where WAAS coverage is not available, operators using TSO-C145/C146 receivers are required to check GPS RAIM availability.

Subject to aircraft operating limitations specified in the Aircraft Flight Manual or Flight Manual Supplement, Aircraft equipped with TSO-C145 or TSO-C146 GNSS based Navigation Sensors may not need to carry a non-GNSS alternate means of navigation. However, certain operations may require dual installation as necessary to fulfill availability and/or continuity requirements.

In the event of loss of GNSS navigation performance accuracy or integrity which results in the inability to support the planned flight operation, the pilot-in-command must advise air traffic services as soon as practical, stating “unable RNAV [DUE TO (REASON, E.G. LOSS OF GNSS)]”.

GNSS-based approaches are charted as “RNAV (GNSS) RWY XX”, denoting that GNSS navigation shall be used for approach guidance, and the prefix “RNAV” is used in radio communications. Approaches flown using GNSS must be retrieved from a current navigation database. The PIC is responsible for ensuring the on-board navigation data is current, appropriate for the region of intended operation and includes the appropriate navigation aids, waypoints, and relevant coded terminal airspace procedures for the departure, arrival, and alternate airfields.

Navigation databases must be current for the duration of the flight. If the AIRAC cycle is due to change during flight, operators and pilots must have established procedures to ensure the accuracy of the navigation data, including the suitability of navigation facilities, routes and procedures for safe flight operations.

GNSS overlay approaches are identified in the *Canada Air Pilot* (CAP) with the letters GNSS in parentheses and in small capitals after the runway designation [e.g. NDB RWY 04 (GNSS)]. When conducting GNSS overlay approaches:

- if installed, the VOR, distance measuring equipment (DME), and/or NDB onboard navigation equipment does not need to be functioning; and
- the underlying approach navigation aid(s) (NAVAID[s]) do(es) not need to be functioning.

For flight within Canadian minimum navigation performance specifications (CMNPS) airspace or required navigation performance capability (RNP) airspace see AIP Part 2 Enroute section 2.2.1. GNSS equipment identified in ENR 4.3.1 “GNSS Equipment Requirements”, can serve as the long range navigation system when in CMNPS or RNP airspace.

4.3.1 GNSS Equipment Requirements

The acceptable GNSS equipment Minimum Operational Performance Specifications (MOPS) as identified by the FAA Technical Standard Orders, are defined in Table 4.3.1 “GNSS Equipment Requirements”. These TSOs are published by the U.S. Federal Aviation Administration (FAA) and adopted by reference by Transport Canada. TSOs or equipment approvals issued by other Aviation Authorities based on the same or equivalent underlying MOPS are also acceptable. For ease of readability only the FAA TSO has been referenced in this document.

Phase of Flight	Equipment Requirements ¹	
	GNSS Stand Alone	GNSS In Multi Sensor System
Enroute & Terminal	TSO-C129a ² Class A	TSO-C129(AR) ² Class B or C
	TSO-C146 (AR)	TSO-C196 All Revision (AR) ²
		TSO-C145 (AR) Class 1, 2 or 3
Approaches <i>LNAV Minima</i>	TSO-C129a Class A1	TSO-C129(AR), Class, B1, B3, C1 or C3
	TSO-C146 (AR) Class 1, 2 or 3	TSO-C196 (AR)
		TSO-C145 (AR) Class 1, 2 or 3
Approaches <i>LNAV/VNAV Minima</i>	TSO-C146 (AR) Class 2 or 3	TSO-C129(AR) ³ , Class, B1, B3, C1 or C3
		TSO-C196 (AR) ³
		TSO-C145 (AR) Class 2 or 3
Approaches <i>LP⁴ or LPV Minima</i>	TSO-C146 (AR) Class 3 or 4	TSO-C145 (AR) Class 3 or 4
		TSO-C146 (AR) Class Delta 4

- Note 1:** The GNSS equipment installation on Canadian registered aircraft must be approved in accordance with the appropriate sections of the *Canadian Aviation Regulations* (CARs), Part V – Airworthiness, and installed for use in accordance with AC20-130A and/or AC20-138() as applicable. Equipment and installations approved by other Aviation Authorities (AAs) to equivalent requirements are also deemed acceptable for operations within Canada.
- Note 2:** TSO-C129(AR) and TSO-C196(AR) GNSS equipment are supplemental Navigation systems and use aircraft based augmentation; they have performance limitations that requires other positioning and navigation systems, appropriate to the operation, to be on-board the aircraft. Per AC20-138A, TSO-129(AR) defines different classes of equipment to support different equipment configurations. These classes are defined in paragraph (a)(2) of TSO-C129(AR). Additional guidance regarding the RNAV and RNP operations that TSO-C129(AR) and TSO-C196(AR) GNSS equipment may support is provided in AC20-138(). Further guidance is provided in the ICAO PBN Manual Doc 9613.
- Note 3:** Acceptable when integrated with a multi-sensor flight management systems (FMS) (TSO-C115b or later) with barometric vertical navigation (BARO VNAV) capability, certified in accordance with FAA AC 20-129 or equivalent.
- Note 4:** WAAS receivers certified prior to TSO-C145b and TSO-C146b, even if they have LPV capability, do not contain LP capability unless the receiver has been upgraded. Receivers capable of flying LP procedures must contain a statement in the Aircraft Flight Manual (AFM), AFM Supplement, or Approved Supplemental Flight Manual stating that the receiver has LP capability, as well as the capability for the other WAAS and GNSS approach procedure types.

4.3.2 Use of GNSS in Lieu of Ground-Based Aids (GNSS Substitution)

GNSS may be used in lieu of DME during departure/enroute/terminal/approach operations; it may be used in lieu of conventional (VOR and NDB) for departure/enroute/terminal operations provided the following conditions are met:

- an integrity alert is not displayed;
- fixes that are part of a terminal instrument procedure are named, charted and retrieved from a current navigation database; and
- when ATS requests a position based on a distance from a DME facility for separation purposes, reported GNSS distance from the same DME facility may be used by stating the distance in miles and the DME facility name (e.g. “30 miles from Sumspot VOR,” vice “30 DME from Sumspot VOR”).

GNSS may not be used in lieu of ground-based aids for:

- VOR and NDB final approach segment LNAV guidance on VOR- or NDB- instrument approach procedures unless the instrument approach procedure is part of the GNSS overlay approach program (see Table 4.3.2 for GNSS substitution examples); or
- LOC LNAV guidance (see Table 4.3.2 for GNSS substitution examples).

Table 4.3.2, GNSS Substitution Examples

Approach Type	Failed Item	GNSS Substitution Allowed
NDB RWY 08R	Aircraft ADF* or approach NDB	No
NDB/DME RWY 08R	Aircraft DME or approach DME	Yes
NDB/DME RWY 08R (GNSS)	Aircraft ADF* or approach NDB	Yes
VOR RWY 09	Aircraft VHF Navigation or approach VOR	No
VOR/DME RWY 09 (GNSS)	Aircraft VHF Navigation or approach VOR	Yes
ILS Y RWY 16	Aircraft ADF*/DME or missed approach NAVAID	Yes

*ADF = automatic direction finder

4.3.3 GNSS Anomaly Reports

GNSS Anomaly reports should be submitted using the report found on the NAV CANADA website here:

<http://www.navcanada.ca/EN/products-and-services/Pages/Post-Flight-Reports.aspx>

ENR 4.4 Name-Code Designators for Significant Points

For an alphabetical list of name-code designators for significant points in Canada, including the geographical coordinates and province information, refer to the current issue of the CFS, section C, PLANNING, “Intersections and reporting point coordinates”.

For the name-code designators for the intersections or fixes used in low level airways and fixed area navigation routes, refer to the [Designated Airspace Handbook](#) (TP 1820E), available in PDF on the Aeronautical Information Products section of the NAV CANADA website:

<www.navcanada.ca>
Products & Services
Aeronautical Information Products
Designated Airspace Handbook
Current Issue

For the ATS routes where the points are located, refer to the appropriate enroute low and high altitude charts, as well as the appropriate terminal area charts.

ENR 4.5 Aeronautical Ground Lights — Enroute

Aeronautical ground lights are found in *Canada Flight Supplement* under the aerodrome they serve or on VFR navigational charts.