International Civil Aviation Organization

WORKING PAPER

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ASSEMBLY — 41ST SESSION

TECHNICAL COMMISSION

Agenda Item 31: Aviation Safety and Air Navigation Standardization

CHARTING A PATH FOR THE USE OF TRUE AZIMUTH IN AVIATION

(Presented by Canada)

EXECUTIVE SUMMARY

Changing from magnetic to True tracks and bearings began as a safety consideration to eliminate latent and systemic threats due to non-conforming magnetic variation values across integrated systems. The continued safety focus has a significant sustainability component with millions of dollars in savings across aircraft operators, ANSPs, airport operators and Aircraft and Avionics manufacturers.

ICAO Annex 4 – *Aeronautical Charts* currently require bearings, tracks and radials to be published in degrees magnetic except under exceptional circumstances where States may need to align bearings, tracks and radials to True North or Grid.

With the switch from analogue to digital aircraft systems, magnetic variation discrepancies have and continue to cause safety and operational errors in performance-based navigation (PBN) procedures, category II/III auto-coupled approaches/landings and ARINC 424 coding for all course and heading legs.

Instrument Procedures and navigation charts are designed with reference to True North and converted to magnetic. Yet, aircraft operators, air navigation service providers, airport operators, and aircraft and avionics manufacturers spend millions annually managing magnetic variation.

The technology available today has rendered the magnetic reference system obsolete. The International Association of Institutes of Navigation (IAIN), with help from Canada, has begun charting a path for the increased use of True azimuth in aviation.

Strategic Objectives:	This working paper relates to Air Navigation Capacity and Efficiency
Financial implications:	Not applicable.
References:	Not applicable.

[1] English and French versions provided by Canada.

1. INTRODUCTION

1.1 During the fifteenth meeting of the IFPP (IFPP/15) in April 2022, the Panel gave its support to the initiative and agreed that the Secretariat should investigate the level of support from States and industry to switch to a "True North" reference system via a questionnaire, before including this in the IFPP work programme.

1.2 This information is supplemental to that presented at the ANC Talk Series on February 28, 2022, and further details Canada's support for the change to True North operations.

1.3 Canada and the International Association of Institutes of Navigation have investigated aviation's use of navigation that references true north instead of magnetic north.

1.4 All aviation partners expend significant effort to update changing magnetic variation (MAGVAR) values in current aeronautical information, aircraft and airports. Modern avionics carry out navigation calculations with reference to true north and then convert the data for pilot displays to magnetic (by applying a magnetic variation based on a magnetic model). Airports conduct all of their surveys and base references with reference to true north and convert to magnetic for publication and runway numbering. Aeronautical information is developed in true and then has magnetic variation applied for publication. Conventional navigation aids are sighted referenced to true north and then rotated to the current magnetic declination.

1.5 Changing from magnetic to True tracks and bearings began as a safety consideration to eliminate latent and systemic threats due to non-conforming magnetic variation values across integrated systems. The continued safety focus has a significant sustainability component with millions of dollars in savings across aircraft operators, ANSPs, airport operators and Aircraft and Avionics manufacturers.

2. BACKGROUND

2.1 At the 12th Air Navigation Conference in 2012 (AN-Conf/12), Canada introduced a motion to move from a magnetic to a True North reference system (AN-Conf/12-WP/147). Following that presentation, section 6.5.25 of the AN-Conf/12 "REPORT OF THE COMMITTEE TO THE CONFERENCE ON AGENDA ITEM 6" stated:

> *The meeting was informed that a significant effort is currently expended to update aeronautical information with changing magnetic variation (MAGVAR). Modern avionics carry out navigation calculations with reference to true north and then convert the information for pilot displays to Magnetic (by applying a magnetic variation based on a magnetic model), or True heading or True Track, depending on aircraft capability. It was suggested that having all operations referenced to true north would enhance the overall safety floor and save considerable effort in maintaining MAGVAR tables. The meeting noted the information and concluded that any States interested in the matter could conduct further studies of the technical and operational impact of the proposal, and of the expected costs and benefits to all aviation stakeholders.*

2.2 Over the subsequent years, Canada continued to study the feasibility and benefits of expanding areas where bearings, tracks and radials are aligned to True North and returned in 2018 to AN-

Conf/13 with additional details. Following that presentation, section 3.44 of the AN-Conf/13 "REPORT OF COMMITTEE A TO THE CONFERENCE ON AGENDA ITEM 3" stated:

> *AN-Conf/13-WP/114, presented by Canada, outlined a proposal regarding the adoption of "True North" as a reference for all operations, citing the ongoing costs of applying magnetic variation to both charts and aircraft systems. The Committee was informed that the Twelfth Air Navigation Conference (2012) had called upon States interested in the matter to conduct further studies on the technical and operational impact of the proposal, as well as on the expected costs and benefits to all aviation stakeholders. The Committee agreed that, in light of the lack of such studies being carried out or reported to ICAO, ICAO should investigate the technical and operational impact and/or merits, as well as the potential cost of the proposed change across the spectrum of aviation activities and across all regions prior to progressing on adoption of "True North" as a global reference.*

2.3 Furthermore, as a result of the discussion at AN-Conf/13, the report to the Committee also outlined the following recommendation:

> *Recommendation 3.5/4 — True North*
>
> *That ICAO conduct a detailed study into the technical, operational, and economic feasibility of changing to a "True North" reference system.*

2.4 At the High-Level Conference on COVID-19 (HLCC-21), Canada introduced information paper HLCC 2021-WP/150. This paper highlighted continuing work to enable the change.

3. DISCUSSION

3.1 After AN-Conf/13, Canada and the International Association of Institutes of Navigation (IAIN) took up the initiative to assist the aviation sector in transitioning to True tracks, as was done throughout the maritime industry during the previous century.

3.2 IAIN kicked off their global efforts by presenting at ISPA 2017 and a paper titled "Changing from Magnetic to True Tracks in Aviation" at the 2020 European Navigation Conference (ENC2020 in Dresden, Germany). That paper introduced the latest research results and presented coordinating actions initiated with international bodies. The paper outlined the case for converting to True North and identified that the only expected problems would be those of implementation. Although it will take a worldwide effort to transition from magnetic to True reference, it is believed that this one-time exercise will make aviation safer and much more efficient. The paper stated in part:

> *The biggest single problem in trying to implement this change worldwide would be inertia – the large number of countries involved and the difficulty of finding the will to all change at once. Some of these countries do not have a sophisticated aviation environment that could deal with this easily, and in others, such as the United States, the sheer extent of the change would be formidable and might meet opposition from a conservative general aviation lobby. A foreseeable way that it could happen would be if a single country were to file a difference with ICAO and change unilaterally. Once they had proved*

that it worked without problems, we might then expect others to follow progressively.

This is not as unprecedented as it sounds. Some countries use feet as the unit for altitude others use metres. Some use hectopascals as the unit for atmospheric pressure, others use inches of mercury and so on. There is no difference in principle if some were to use Magnetic and others to use True.

IAIN has established a working group in order to coordinate work on the subject and to gain worldwide exposure. They are now working together with CANSO and individual ANSP's. They are also working with IATA and ICAO. The goal is to pick a date in the future, e.g.2030, and progress towards it in a harmonized fashion.

3.3 Due to its proximity to the north pole, a significant portion of airspace managed by Canada has always been designated using True azimuth: Canadian Northern Domestic Airspace. Considering this area already operates in True, it seemed appropriate for Canada to lead IAIN's call for a single country to investigate going first.

3.4 Canada accepted the challenge to develop two documents: a Concept of Operations (ConOps) followed by an Implementation Plan.

3.4.1 The Concept of Operations lays out the current operational situation regarding the use of True and magnetic tracks, introduces a proposed system, explains the operational scenarios, and presents a list of requirements should the operational concept receive approval.

3.4.2 The Implementation Plan lays out a path to safely transition from airspace using a magnetic north based reference system to a True north reference based system.

3.5 The following documents and tools are attached for each state to review and better assess short- and long-term impacts to inform their position on supporting the change.

3.5.1 ICAO ANC MAG to TRUE presentation.

3.5.2 A FAQ on changing from MAG to TRUE.

3.5.3 An IAIN study of ICAO Annex, Documents, Regulations (Canada) requiring an amendment to change from Magnetic to True.

3.5.4 A list of Differences Canada has filed to allow airspace and procedures to be referenced to True.

3.6 Implementing a True North Reference System worldwide will require careful coordination and planning between states. The RVSM transition plan could be used as a template based on the following regions: NAT, Pacific, Northern Canada, Southern Canada and the United States, Europe, Africa, WATRS, CAR-SAM, Australia, W. Pacific, Japan/Kor, Mid East, Caucasus, Asia-EU S, Russia, China.

3.6.1 States/regions could begin to publish magnetic and True data within their state AIPs at any time before the transition date, as ASECNA now does on some of their procedures.

3.6.2 VORs and TACANs could be rotated to True Values (0), beginning with those within +- 5 degrees of the 0-degree isogonal line (using FAA tolerance value of +- 5 degrees). Then rotate Enroute VORs and TACANs within six months of the transition date. Then rotate Approach VORs and TACANs within +- one month of the transition date.

3.6.3 ANSP surveillance systems would need to reference True North on the regional transition date.

3.6.4 Airports that did require a runway numbering change to align to true would be required to publish the runway True bearing value on the date of the change but could manage the actual runway numbering change at a convenient time before or after the change date as is done today. Note: virtually no runways within +- 4 degrees of the current 0-degree isogonal would need to change. Limited runways within the +- 10 degree isogonal lines would require change.

4. CONCLUSION

4.1 Changing from magnetic to True tracks and bearings will eliminate latent and systemic threats due to non-conforming magnetic variation values across integrated systems, increasing the level of safety.

4.2 The continued safety focus has a significant sustainability component with millions of dollars in savings annually across aircraft operators, ANSPs, airport operators and Aircraft and Avionics manufacturers.

4.3 Switching to True North will significantly simplify the design of future navigation and surveillance systems by eliminating changing magnetic variation from navigation databases, aeronautical charts and air navigation systems.

4.4 States are invited to support the change to True North, allowing the secretariat to issue job cards to appropriate panels to progress an ICAO-supported change to True North.

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