

CANSO LATIN AMERICA AND CARIBBEAN CONFERENCE 2022

Orlando, Florida, USA

6 – 8 December 2022

In coordination with





canso.org

TRANSITION TO TRUE NORTH









PRESENTER



Anthony MacKay

Director, Operational Safety NAV CANADA NAV CANADA

Moving From Magnetic to True North in Aviation

Anthony MacKay Director Operational Safety NAV CANADA

Bart Banning ATM Architect LVNL and President of NIN







Serving a world in motion **navcanada.ca**

THE ISSUE Which way is North?

- Modern aircraft, air traffic and IFR procedure design systems begin in TRUE
- > Tables are then devised to translate that data to magnetic for the user
 - Not all tables hold the same values
 - Older tables in systems may not be updated
 - Translations may not be matched
- > Much effort is and has been expended to manage MAG VAR
- > The questions should be:
 - Why do we still navigate by reference to Magnetic North? Why do we not switch to TRUE?



WORK SINCE 2019...

- International Association Of Institutes Of Navigation (IAIN)
 - International working group to work the problem
- > NAV CANADA & Transport Canada
 - National working group to work the problem (CPAAT)
 - > Concept of Operations complete
 - > Implementation Plan being developed
- > Instrument Flight Procedures Panel (IFPP)
 - Briefed and voted to move ahead with True North
- > ICAO
 - State letters released and survey of States, ANSP, Air Operators, Airports and OEMs underway



BACKGROUND

ANC 12, 13 and HLCC

- > Canada presented papers to the ANC detailing the change to switch to a True North Reference system in aviation
 - AN-Conf/12-WP/147
 - AN-Conf/13-WP/114
 - HLCC 2021-WP/150 SAF/115
- > Para 6.5.25 of the AN-Conf/12 report to Agenda Item 6 stated
 - ...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
- > Para 3.44 of the AN-Conf/13 report to Agenda Item 3 stated
 - ...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."
 - **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.

BACKGROUND

ANC 12, 13 and HLCC

- > HLCC 2021-WP/150 SAF/115
 - Informed readers of the progress in studies to date
 - In response to RECOMMENDATION 3.5/4 from AN-CONF/13
 - A Canadian Working Group has been stood up to develop the CONOPS and transition plan for Canada with a target timeline of 2030 to effect the change
 - Under the International Association of Institutes of Navigation (IAIN), the Attitude Heading Reference Transition Action Group (AHRTAG) has been active with monthly international meetings to study the change to True internationally
 - > IFPP has voted to continue work
 - ICAO Webinar 75% voted yes, 22% tell me more, 3% no. Mostly states and ANSPs
- > This presentation is meant to inform you of the work to date.

CANADA'S EXPERIENCE

- Canada has always operated with airspace referenced to True and Magnetic
 - Northern Domestic Airspace = True
 - Southern Domestic Airspace = Magnetic
- In NDA all ILS, VOR and NDBs at set to TRUE with 0 degrees declination
- All conventional and PBN airways are reference to True
- > All terminal procedures are referenced to True
 - ILS, LOC, NDB, TACAN
 - PBN LNAV, LNAV/VNAV, RNP AR, LPV



CANADA'S EXPERIENCE

Southern Domestic MAG VAR Issues

- In SDA all procedures are referenced to Magnetic. Mag Var is maintained:
 - ILS, NDB maintained within ±2°
 - > CAT II/III ILS maintained within ±1°
 - PBN, NDB airways/routes maintained within ±2°
 - PBN, NDB IAPs maintained within ±2°
 - VOR and TACAN technical alignment maintained within ±3° for enroute and approach
 - Surveillance RADAR, ADSB, MLAT maintained IAW Mag Var tables reference date and time.
- Hence we have the same issues in SDA as other ANSPs



THE ISSUE WITH MAGNETIC VARIATION

Magnetic Variation doesn't have to be right – it does have to match

- > In the analogue world it was not as important. In the digital world it is.
 - Magnetic variation/station declination doesn't have to be right but it must match across databases
 - Anchorage ILS CAT II/III issue aircraft unstable in heading during approach
 - > Vancouver and St. John's CAT II/III issue same as Anchorage
 - > Autoland aircraft moving off the centreline when the aircraft enters the flare
 - Flight Management System flight path leg disconnects on non-RNAV IAP procedure legs
 - Synthetic Vision System and Enhanced Vision System images not aligned to the real world
 - > Runways not aligned with electronic images

THE ISSUE WITH MAGNETIC VARIATION

Magnetic Variation doesn't have to be right – it does have to match

- Sources of mag var on a modern aircraft and its use (at times they don't perfectly match)
 - IRUs internal mag var tables
 - Flight Management systems
 - Embedded base mag/var tables; VHF NAV aid reference mag var; Airport reference mag var; Procedure design mag var
 - Synthetic Vison, Enhanced Vision, and Head Up Guidance Systems can use different sources leading to mismatches
 - ANSPs and States update EPOC for procedure design every five years. Many aircraft use tables projected for 5 to 10 years or just do not update at all

NEGATIVE OPERATIONAL IMPACT TO SAFETY Overview

- > Various mag values across platforms **Systematic and Latent Errors**
 - Standby compass accuracy is regulated by states
 - No state regulation on application or use of Mag Var EPOCH validity in aircraft systems
- > This introduces cost and potential error into the system
 - > Updating aircraft FMS and IRU mag var tables every five to ten years
 - One carrier reported (2016) a cost of \$21m for 200 aircraft; another reported \$1.2m for one fleet type of 32 aircraft. Costs are aircraft age dependent (field loadable or repair facility). Nav Canada DH8-100 was \$500k USD.
 - Updating IAPs, Enroute Charts (VFR & IFR) and rotating VORs
 - For Canada ~\$800k per year (~4504 Procedures, 119 VORs)
 - > Updating Airport data, runway numbering, signage for Mag Var Changes
 - Est. \$10,000 per hold line (Paint, Signs, Data) (L) CYYZ ~ \$1.1m, (M)CYHZ ~ \$150k, (S)CYDF ~ \$40k

PROPOSED CHANGE TO TRUE Overview

- Modern aircraft, surveillance systems, IAPs are all designed to function in true
 - Everything navigation system in a modern aircraft does the 'math' in True and then converts the information to magnetic for the pilot
 - All of Canada's surveillance systems operate in True and then add in magnetic variation to display to the controller
 - All IAPs in Canada are designed in True and then have magnetic variation/declination added to the design file for charting and nav databases
- > Develop a Canadian Con-ops to change to True and propose to ICAO
 - Con-Ops developed by a cross functional Canadian Aviation Team
 - Implementation Plan underway

CANADIAN CON OPS – AREAS OF STUDY CON-OPS TOC

Table of Contents

1. Con	Ops Introduction
1.1.	ConOps Objective 6
1.2.	ConOps Background
1.3.	ConOps Scope 7
1.4.	ConOps Approach 7
2. Cur	rent Operational Situation
2.1.	Background on Earths Magnetism
2.2.	ICAO SARPs and PANS
2.3.	Canadian Aviation Regulations
2.4.	Description of Canadian Domestic Airspace 12
2.5.	Description of Current Operations in Canadian Southern Domestic Airspace 13
2.6.	Description of Current Operations in Canadian Northern Domestic Airspace 14
2.7.	Magnetic Variation Challenges and Opportunities
3. Proj	posed System
3.1.	Overview of the Proposed System 18
3.2.	Assumptions and Dependencies
3.3.	Other Considerations
4. Ope	erational Scenarios
4.1.	Large Air Transport Aircraft 19
4.2.	Aircraft with a gyro-magnetic compass 20
4.3.	Aircraft with Directional Gyros manually reset to a Direct Reading Compass 20
4.4.	Aircraft with a Direct Reading Compass only
F 0	
5. Ope	erational Impacts

7.	Requ	uirements	24
	7.1.	Canadian Regulatory Requirements	24
	7.2.	Domestic ANSP/ATM Requirements	24
	7.3.	Adjacent ANSP/ATM Requirements	24
	7.4.	Transition Requirements Between True/Magnetic Airspace	24
	7.5.	Communication, Navigation and Surveillance Requirements	24
	7.6.	Airspace Requirements	25
	7.7.	Airport Requirements	25
	7.8.	Publication requirements	25
	7.9.	Weather Reporting Requirements	26
	7.10.	Customer/Stakeholder Requirements	26
	7.11.	Other External Stakeholder Requirements	26
	7.12.	International/ICAO Requirements	26
8	. Ana	lysis of Proposed System	27
	8.1.	Summary of Advantages	27
	8.2.	Summary of Disadvantages or Limitations	28
9	Terr	ns and Acronyms	29
1(0. R	eferences	29
1	1. A	ppendices	29

CANADA's WG MAKEUP

Canadian Performance-based Aviation Action Team (CPAAT)

- True North Sub-working members:
 - Transport Canada
 - Nav Canada
 - Airlines
 - Business Aviation
 - General Aviation COPA
 - Air Taxi
 - Flight Training
 - Airports
 - Helicopter Association
 - DND/RCAF



CON OPS - CHANGING TO TRUE When and how?

- > Pick a date in the future (2030)
 - IRU equipped aircraft could go to True with MAG/TRUE switch



- New AHRUs (Fibre Optic Gyro (FOG), Micro Electromechanical Systems (MEMS) technologies do not need flux valves for magnetic sense)
 - Honeywell Super AH-2100; Northrop Grumman LCR-100, 110, 200, 300; Collins AHS-4000 (22k)
 - Light aircraft GNSS equipped (GNSS functions in True)
- Light aircraft can still use a magnetic compass and convert to True
 - > Set runway heading prior to take-off
 - > Add/subtract E&W variation after compass reading when setting Directional Gyro
 - > GPS/NDB Method

General Aviation – Light Aircraft

- VFR users technically still use track/drift lines on VFR 1:500000 Aeronautical Chart although most use some form of GPS and electronic moving map
- IFR GA aircraft would need to have a procedure to deal with East/West variation between the heading observation from the wet compass to setting the HSI
 - Most procedures are now track based with the exception of vectors, NDB IAPs and heading based legs in vector SIDs and downwind legs on STARs



General Aviation – Light Aircraft

- VFR Use the True Heading from the VFR 1:500000 Aeronautical Chart
- Read the magnetic heading from the Compass
- ± the magnetic variation from the flight log to convert mag to true to set the directional gyro
- The HDG (M) column would not be used during the planning stage

DA	TE:		T/O:		LDG:			F	LT TU	ME	_						
	FROM	TO	ALT/FL	SAFETY ALT	W/V	TAS	TK(T)	HD	G(T	VAR		HDG(N	Λ	G/S	DIST	TIME	ETA
C	XFORD	LUDLOW	2500	3100	180/10	103	302	29	17	4W		301		108	60	33	
L	UDLOW	HAWARDEN	2500	3100	180/10	103	349	34	8	4W		357		112	49	26	
AL	TERNATE																
на	WARDEN	LIVERPOOL	2000		180/10	103	026	02	28	4W		032	V	112	10	51/2	
	FU	EL (U.S. GAL	LS)							С	OM	IMUNI	C/	TIONS			
	TO DESTI	NATION	10				STAT	ION	FRE	Q S	STA	TION	F	REQ	STATIO	N FRE	Q
	TO ALTER	RNATE	1				OX T	WR	125.3	25	C	x	3	67.5			
	10%CONT	INGENCY	1.1				BZN F	RAD	124.2	75	HA	AW	3	40.0			
	45 MIN HO	OLDING	7.5				SHC	в	123.5	50	w	PL		323			
	MINIMUM	RESERVE	5				WP	L	128.	0							
	TOTAL RE	EQUIRED	25				SHB F	RAD	120.7	75							
	TOTAL OF	N BOARD	55				HWD 1	rwR	123.3	5							
	ENDURA	NCE	5½ hrs				LVP 1	WR	119.8	5							
	-																

VFR FLIGHT LOG

Regional Aircraft

- The challenge is most regional aircraft (<50 seats) use a magnetic sense to feed the AHRU
 - Regional airlines have been searching for new IRU like options based on AHRU obsolescence (AH-600) and repair costs.
 - Low wing aircraft (CRJs) have had issues with flux valves and interference from rebar in runways (KORD) where they have to depart in free gyro mode.
- > The addition of IRUs or North Seeking AHRUs to replace current AHRUs would also be the foundation for RNP operations
 - Assist them in seeing the benefits of changing to AHRUs that do not rely on flux valves and magnetic alignment, lower life cycle costs, additional operational capability
- With an implementation date out to 2030 the regional carriers should be able to adapt
 - Lobby manufacturers to switch to non-magnetic AHRUs in new aircraft or new certifications
 - Avionics manufactures have products available, or, in development to meet the 2030 timeline
 - Low cost convertors to switch MAG to True at the AHRU

Regional Aircraft

- Airworthiness directives limiting operations for > out of date magnetic variation are becoming more common.
 - Loss of CAT II/III operations in regional aircraft fleet
 - Airborne holding operations restricted if using the flight management system
 - Leads to navigation errors and an unsafe condition that must be managed by the flight crew

Transports Transport Canada Canada

TP 7245E 1 of 2 AD Number: CF-2019-40

AIRWORTHINESS DIRECTIVE

This Airworthiness Directive (AD) is issued pursuant to Canadian Aviation Regulation (CAR) 521.427. No person shall conduct a take-off or permit a take-off to be conducted in an aircraft that is in their legal custody and control, unless the requirements of CAR 605.84 pertaining to ADs are met. Standard 625 -Aircraft Equipment and Maintenance Standards Appendix H provides information concerning alternative means of compliance (AMOC) to ADs.

Number:	Effective Date:
CF-2019-40	15 November 2019
ATA:	Type Certificate:
34	A-131

Subject:

Navigation System - Flight Management System (FMS), Inertial Reference System (IRS) and Attitude and Heading Reference System (AHRS) – Outdated Magnetic Variation (MV) Tables

Applicability:

Bombardier Inc. model CL-600-2B19, CL-600-2C10, CL-600-2C11, CL-600-2D15, CL-600-2D24 and CL-600-2E25 aeroplanes, all serial numbers.

Compliance:

As indicated below, unless already accomplished.

Background:

Outdated MV tables inside navigation systems can affect their performance and result in the presentation of misleading magnetic heading references on the Primary Flight Displays (PFDs) and Multi-Function Displays (MFDs) positioning the aeroplane outside of the terrain and obstacle protection provided by instrument flight procedures and flight route designs. Some Bombardier Regional Jets have navigation units with MV tables that are obsolete which can lead to significantly inaccurate heading, course and bearings calculations.

This AD mandates the Airplane Flight Manual (AFM) update to the FMS, IRS and AHRS limitations to address the above mentioned unsafe condition.

Corrective Actions:

 Within 30 days from the effective date of this AD, amend the applicable Transport Canada (TC) annroved AFM by incomprating the revision to the Chapter 02 - Limitations - Navigation System

Airline Narrow Body and Wide-body Aircraft

- Large aircraft generally have Inertial Reference Units on board today
- Just need the ability to switch from MAG to TRUE to bypass the mag var values
- Some operators indicate they operate in Oceanic
 Airspace in True
- Operators on Polar Routes operate in the Keyhole in True but not necessarily in Canadian NDA in True
- Savings to be had for air carriers/operators with the elimination of 5 years Epoch updates
 - Million's in savings based on 5 year EPOCH cycle if aircraft matched ANSP update cycle



Airline Narrow Body and Wide-body Aircraft

 Limitations to operations with out of date magnetic variation tables

A319/A320/A321 AIRCRAFT TECHNICAL BULLETINS

ATB 271: OEB 151-ST JOHNS (CYYT) IMMEDIATE RESTRICTIONS

06-12-12

EFFECTIVITY: AIRCRAFT

In addition to Anchorage and Fairbanks, effective immediately, the autoland and rollout restrictions of OEB 151 will also be applicable to those aircraft operating into.

St Johns (CYYT) without an updated ADIRU MAGVAR table.

SPECIFICALLY:

- Autoland is not allowed
- Roll out is not allowed
- CAT II approaches without autoland are still allowed

Affected aircraft will not be subject to the restrictions once their ADIRU MAGVAR tables are updated. These aircraft will be identified by a logbook sticker on the inside cover stating:

MAGVAR TABLE UPDATED - OEB 151 CANCELLED FOR THIS AIRCRAFT

It is expected that the ADIRU MAGVAR tables on the affected aircraft will all be updated by July 2008. Once all aircraft are modified, this ATB will be cancelled, a new ATB will be issued stating that all aircraft are modified, and all logbook placards will then be removed.

ATB 320 - NEW IRS LIMITATIONS - REVISED

2022-FEB-15

THIS ATB CANCELS AND SUPERSEDES ATB 312

The reason for revising this ATB is to identify aircraft fine as being retrofitted with latest IRS MagVar tables.

The purpose of IRS limitations is to prohibit certain flight operations in geographic areas where the accuracy of the magnetic north-referenced parameters in older IRS MagVar tables are no longer sufficient to satisfy the airplane type design requirements. IRS MagVar tables are revised every 10 years.

The fleet is in process of being retrofitted with new IRS MagVar tables to remove the area and airport restrictions mentioned below. Currently, all 787-9s have been retrofitted <u>but not all 787-8s</u>. The retrofit completion of the 787-8s is expected in 2022. Once a specific aircraft has completed this retrofit, it will be identified on the OFP through a Crew Alert and this ATB will revised.

AOM 1.01.34 P4 is revised as follows:

INERTIAL REFERENCE SYSTEM (IRS)

All flight operations based on magnetic heading or magnetic track angle are prohibited in geographic areas where the loaded IRS Magnetic Variation (MagVar) table errors are greater than 5 degrees. *

* To comply with this limitation, Flight Crew shall select HEADING REF switch to TRUE when operating north of 65N of latitude instead of 70N of latitude per FOM 8.9.2.4.

* All aircraft are compliant with this limitation.

All autopilot/flight director ILS (excluding GLS) approach and landing operations that use magnetic north referenced courses or bearings are prohibited in geographic areas where the loaded IRS MagVar table errors are greater than 3 degrees. **

** To comply with this limitation, the following table lists the airports affected by IRS MagVar table errors greater than 3 degrees. Any ILS and LOC approaches are prohibited at these airports. All other types of approaches are not affected.

Airport code	Airport name and location
SFJ / BGSF	Kangerlussuaq, Greenland
KEF / BIKF	Keflavik, Iceland
YFB / CYFB	Iqaluit, Canada
YXY/CYXY	Whitehorse, Canada
LYR / ENSB	Longyear, Norway
EDF / PAED	Elmendorf AFB, USA
FAI / PAFA	Fairbanks, USA
AKN / PAKN	King Salmon, USA
ANC / PANC	Anchorage, USA

** All aircraft are compliant with this limitation.

CON OPS – HOW?

NAV CANADA conducted a Change Flight Test

- > Flight Test 'True' database
 - Jeppesen took all the data (flight test database) for airports, airways, IAPs and changed all the magnetic variation to '00' for a flight test area in eastern Canada
 - NAV CANADA flight test aircraft flew a mixed flight plan of V/J airways, PBN airways, NDB, VOR and PBN procedures in True Mode to see if switching the database would be that easy.
 - Flight Test was successful for all aircraft systems conventional, PBN, EGPWS, EFB, HGS. No off nominal events observed.





CON OPS – HOW?

NAV CANADA conducted a Change Flight Test

- > Flight Test 'True' database
 - The current ARINC 424 navigation database data records and data fields can be maintained with 0° entered as the mag var value in columns 52 thru 56 AND column 86 set to TRUE Indication. In this manner, navigation data will be reflected as TRUE regardless of the FMS method to determine and operate in True.
 - While this ensures the navigation database records will reflect TRUE values only, the FMS/IRU would still need to be operated in TRUE to provide TRUE heading from the IRU or AHRS heading source and to allow the FMS to not use the main embedded mag var map in the FMS.
 - Some ANSPs are publishing True and Magnetic on charts now and that could be an interim step leading to up to the day of change globally or regionally as determined by the TRUE North implementation plan (yet to be determined).

CON OPS – WEATHER

All weather wind reports are referenced to True

- > Pilots would no longer have to convert winds from True to Mag in printed weather
- Tower systems to report wind for take-off and landing would not need to convert winds from True to MAG
- ATIS and AWOS systems would not need updated magnetic variation to convert winds from True to Mag

CON OPS - CHANGING TO TRUE

States (ANSPs/Airports) Affected

- > Yellow = $\pm 4^{\circ}$ variation
- > Magenta = $\pm 10^{\circ}$ variation
- > Green = Ops in True Today
- > Reducing impact of the change
 - Procedures within ±4° variation could be adjusted early or left as is until the next review date
 - Airports within the ±10° could update numbering, signage and data at their convenience prior to, or, after the transition to True.

US/UK World Magnetic Model - Epoch 2020.0 Main Field Declination (D)



2030 LATIN AMERICA & CARIBBEAN

	NOTE: Rows without Count	try names means that	the 3 letter country code is not in the	he Countries worksheet						
				Number of countries on screen =47						
	Get Country Stats			Number of runways on screen =4193						
				Number of runways missing coordina	tes on screen =196			Runways Requiring	g changes	
							3173	1092	852	#NAME?
Country 3 letter Ident	Country Name	World Region	Sub region 🗸	Total# of runways in country	Runways with coodinates	Runways without coodinates	With True	With Mag	Currently 🚽	Mag > True 🔽
GRD	Grenada	Americas	Latin America and the Caribbean	4	4	0	4	2	2	
GTM	Guatemala	Americas	Latin America and the Caribbean	16	16	0	6	8	4	YES
GUF	French Guiana	Americas	Latin America and the Caribbean	18	18	0	18	0	0	
GUY	Guyana	Americas	Latin America and the Caribbean	44	42	2	44	4	2	
HND	Honduras	Americas	Latin America and the Caribbean	40	38	2	6	6	4	
HTI	Haiti	Americas	Latin America and the Caribbean	10	10	0	8	4	2	
JAM	Jamaica	Americas	Latin America and the Caribbean	14	12	2	6	2	0	
KNA	Saint Kitts and Nevis	Americas	Latin America and the Caribbean	2	2	0	2	0	0	
LCA	Saint Lucia	Americas	Latin America and the Caribbean	4	4	0	4	2	2	
MEX	Mexico	Americas	Latin America and the Caribbean	206	200	6	168	96	76	
MSR	Montserrat	Americas	Latin America and the Caribbean	2	2	0	2	2	0	
MTQ	Martinique	Americas	Latin America and the Caribbean	2	2	0	2	0	0	
NIC	Nicaragua	Americas	Latin America and the Caribbean	32	32	0	2	8	6	YES
PAN	Panama	Americas	Latin America and the Caribbean	62	48	14	32	26	24	
PER	Peru	Americas	Latin America and the Caribbean	162	156	6	24	77	61	YES
PRI	Puerto Rico	Americas	Latin America and the Caribbean	22	20	2	20	6	4	
PRY	Paraguay	Americas	Latin America and the Caribbean	38	28	10	36	28	24	
SLV	El Salvador	Americas	Latin America and the Caribbean	8	8	0	0	0	0	
SUR	Suriname	Americas	Latin America and the Caribbean	12	12	0	12	2	0	
TCA	Turks and Caicos Islands	Americas	Latin America and the Caribbean	14	14	0	14	0	0	
πо	Trinidad and Tobago	Americas	Latin America and the Caribbean	6	6	0	6	4	2	
URY	Uruguay	Americas	Latin America and the Caribbean	68	54	14	60	24	20	
VCT	Saint Vincent and the Grenadines	Americas	Latin America and the Caribbean	10	10	0	10	2	2	
VEN	Venezuela (Bolivarian Republic of)	Americas	Latin America and the Caribbean	196	196	0	162	68	58	
VGB	Virgin Islands (British)	Americas	Latin America and the Caribbean	8	4	4	8	6	4	
VIR	Virgin Islands (U.S.)	Americas	Latin America and the Caribbean	4	4	0	4	0	0	
ABW	Aruba	Americas	Latin America and the Caribbean	2	2	0	2	2	2	
			SUBTOTALS	4193	3997	196	3173	1092	852	6

4193 LAC Runways analyzed3173 would need to be renumbered in TRUE1092 would need to renumbered in MAG 852are out of MAG alignment today 1020 would be left alone switching to TRUE4193 will be renumbered over time in MAG

2030 WORLD WIDE AIRPORT IMPACT AIRAC cycle 21-11/2020 EPOCH

NAV CANADA

			1								
GET CO	UNT	C	Country Selection								
Runway Category	Country Code										
HARD	VORLD	WORLD		-							
Run	way Length categories			Requiring changes							
From	То	# of RWY's	With True	With Mag	Now with Mag						
0 ft	4000 ft	8133	4826	2622	2046						
4000 ft	6000 ft	8144	4902	2717	1822						
6000 ft	8000 ft	3867	2082	1165	791						
8000 ft	10000 ft	3183	1499	890	561						
10000 ft	12000 ft	1633	774	411	271						
12000 ft	14000 ft	698	287	217	153						
14000 ft	16000 ft	68	40	20	10						
16000 ft	25000 ft	6	6	2	2						
	Total	25732	14416	8044	5656						
KML Point Color	Category										
TEXT	HARD	GENERATE GLOB	AL KML								
TEXT	SOFT	AIRPORT FI	LE								
TEXT	WATER/ICE/SNOW										

25732 World-wide hard surface runways analyzed8044 would need to renumbered in MAG11316 would be left alone switching to TRUE

14416 would need to be renumbered in TRUE 5656 are out of MAG alignment today 25732 will be renumbered over time

2030 LAC VOR/TACAN IMPACT

AIRAC cycle 21-11/2020

NAV CANADA

EPOCH

			Navaid Type	Mag var Re	ference Year					
		PROCESS								
			ALL 🔻	2030	•		Number of Countries or	n screen =47		
							Number of NAVAIDS on	screen =474		
					Country C	Categorization of True no	orth vs Magnetic north d	ifferential	Five and Ten year	Mag VAR changes
Country 3 letter Ident	Country Name	World Region	Sub region	Total # of ALL NAVAID types in the country	Locations between 0 and 3 degrees	Locations between 3 and 5 degree	Locations between 5 and 10 degrees	Locations 10 degrees and greater	# of sites where 5 year Mag var change in excess of 1 degree	# of sites where 10 year Mag var change in excess of 1 degree
NIC	Nicaragua	Americas	Latin America and the Caribbean	3	1	2	0	0	0	3
PRY	Paraguay	Americas	Latin America and the Caribbean	2	0	0	0	2	0	2
TCA	Turks and Caicos Islands	Americas	Latin America and the Caribbean	2	0	0	0	2	0	0
JAM	Jamaica	Americas	Latin America and the Caribbean	2	0	0	2	0	0	2
VIR	Virgin Islands (U.S.)	Americas	Latin America and the Caribbean	2	0	0	0	2	0	0
ABW	Aruba	Americas	Latin America and the Caribbean	2	0	0	0	2	0	2
FLK	Falkland Islands (Malvinas)	Americas	Latin America and the Caribbean	2	2	0	0	0	0	0
SLV	El Salvador	Americas	Latin America and the Caribbean	2	2	0	0	0	0	2
GUY	Guyana	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
GUF	French Guiana	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
GLP	Guadeloupe	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
SUR	Suriname	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
πο	Trinidad and Tobago	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
GRD	Grenada	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
LCA	Saint Lucia	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
ATG	Antigua and Barbuda	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
BLZ	Belize	Americas	Latin America and the Caribbean	1	1	0	0	0	0	1
BMU	Bermuda	Americas	Northern America	1	0	0	0	1	0	0
BRB	Barbados	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
MTQ	Martinique	Americas	Latin America and the Caribbean	1	0	0	0	1	0	0
CYM	Cayman Islands	Americas	Latin America and the Caribbean	1	0	0	1	0	0	1
SXM	Sint Maarten (Dutch part)	Americas	Latin America and the Caribbean	0	0	0	0	0	0	0
VCT	Saint Vincent and the Grenadines	Americas	Latin America and the Caribbean	0	0	0	0	0	0	0
VGB	Virgin Islands (British)	Americas	Latin America and the Caribbean	0	0	0	0	0	0	0
DMA	Dominica	Americas	Latin America and the Caribbean	0	0	0	0	0	0	0
MSR	Montserrat	Americas	Latin America and the Caribbean	0	0	0	0	0	0	0
AIA	Anguilla	Americas	Latin America and the Caribbean	0	0	0	0	0	0	0
KNA	Saint Kitts and Nevis	Americas	Latin America and the Caribbean	0	0	0	0	0	0	0
			SUBTOTALS	474	65	60	132	217	46	367

474 LAC VORs analyzed349 are between 6° and greater of True Today

125 are within 5° of True Today All will require rotation at some point in MAG

New VORs rotated electronically. Older VOR systems typically limited to 8-10° of electronic rotation. TACANs generally a physical rotation.

CHARTING IN TRUE

Canada does this today. Jepp concept charts to support the transition



CHARTING IN TRUE

As do some ASECNA member States



IMPLEMENTATION PLAN - CHANGING TO TRUE

Canada's Proposed

- > Prior to 2030 provide charting with MAG and (TRUE)
- Airports areas within ±10° can plan runway numbering change at a convenient time in the future.
 Other airports would plan for a change date within ± 2 years of the change date
- > VORs would be rotated to True blocks by:
 - Declination within ±5° of True
 - Enroute VORs
 - VORs with Approach Radials
- ANS Equipment mag variation is table driven and can change on the AIRAC date of change
- After the change, MAG values would be removed from charts during normal revision cycles



STATE INTERESTS

ICAO Annex Impact

- > Canada has filed minimal ICAO differences for its long standing True North Operations
 - 1 difference in Annex 5
 - 1 difference in Annex 15
 - 6 differences to PANS-AIM
- A through review of all ANNEXs has found minor areas of amendment to ANNEX 2, 4, 5, 6, 10, 11, 12, 14, 15 with the majority in Annex 4 regarding the charting of bearings and tracks I.E.
 - ANNEX 4, Chapter 7. ENROUTE CHART ICAO
 - > iii. 7.8 Bearings, tracks and radials
 - 1) 7.8.1 Bearings, tracks and radials <u>shall</u> be magnetic, *except as provided for in 7.8.2*. Where bearings and tracks are additionally provided as true values for RNAV segments, they shall be shown in parentheses to the nearest tenth of a degree, e.g. 290° (294.9°T).
 - > 2) 7.8.2 Recommendation.— In areas of high latitude where it is determined by the appropriate authority that reference to Magnetic North is impractical, another suitable reference, i.e. True North or Grid North, should be used.

ICAO INTERESTS

Considerations

> Safety Impact - Positive.

- ANSP data and charts will match the FMS database, procedure design file, ATS systems. Everyone will
 have the same data instead of dealing with differences as described in FAA INFO LETTER 12009
 (06/26/12) excerpt
 - It is important to understand, however, that RNAV systems, (with the exception of VOR/DME RNAV equipment) navigate by reference to true north and display magnetic course only for pilot reference. As such, a properly functioning RNAV system, containing a current and accurate navigational database, should still fly the correct ground track for any loaded instrument procedure, despite any differences in magnetic course that may be attributed to magnetic variation application.
- Accuracy Example Honeywell LaseRef V

<u>Magnetic Mode</u>		<u>True North M</u>	ode
Between 50 °S and 50 %	±2°	Worldwide	±1°
Between 50 N and 73 N	<u>+3</u> °		
Between 73 N and 79 N	±5°		
Between 79 N and 82 N	<u>+8</u> °		

ICAO INTERESTS

Considerations

- > Financial Impact Positive for aircraft, airports and ANSPs in the long term.
 - Airports and ANSPs will have a ONE TIME charge to make the change to True that can be managed. Data and signage will not need to change for mag var again.
 - Aircraft operators with IRUs would need to enable the MAG/TRUE functions if not currently active.
 - Aircraft operators with mag seeking AHRUs would have a one time charge for north seeking AHRUs or low cost converters.
 - Light aircraft without a slaved system would use a cost neutral procedural method.
 - No more working groups to look at Magnetic Variation issues PARC, RTCA, State WGs, AIM data processes
 - Simplification of avionics design and procedure design in the long term

ICAO INTERESTS

Considerations

- > Security Impact Neutral
- > Environmental Impact Positive
 - Less energy of all types expended for mag var updates
 - GHG reduced to 0 for VOR Rotation flight checks after mag var changes
- > Efficiency Impact Positive
 - No loss of services due to procedures notam'd out of service for mag var issues
 - No loss of CAT II/III services due to mar var differences
 - ANSPs can focus on new procedure development instead of procedure churn to correct mag var on current procedures (reduced procedure maintenance)
- > Expected Implementation Time Positive
 - 2030 to allow ANSPs to enact a plan and for aircraft operators with slaved gyro's to replace obsolete units with non-magnetic north seeking units.

ICAO WEBINAR + VOTE SEPT. 8, 2022



NAV CANADA ► PROPRIETARY

Thank You



Serving a world in motion **navcanada.ca**





QUESTIONS AND ANSWERS







with:



CANSO LATIN AMERICA AND CARIBBEAN CONFERENCE 2022

Orlando, Florida, USA

6 – 8 December 2022

In coordination with





canso.org



CLOSING REMARKS



Javier Vanegas

Director Latin America and Caribbean Affairs

CANSO



Organiser: CANSO



THANK YOU TO OUR SPONSORS







In coordination

with:

Organiser: CANSO

THANK YOU **TO OUR EXHIBITORS**







In coordination

with:

METRON AVIATION AN AIRBUS COMPANY



AN AIRBUS COMPANY

THALES Building a future we can all trust



