NORTH ATLANTIC MNPS AIRSPACE

OPERATIONS MANUAL

- EIGHTH EDITION

PUBLISHED ON BEHALF OF THE NORTH ATLANTIC SYSTEMS PLANNING GROUP BY THE UK NATIONAL AIR TRAFFIC SERVICES LIMITED, LONDON, APRIL 1999

Exclusion of Liability

A printed or electronic copy of this Manual, plus any associated documentation, is provided to the recipient as is and without any warranties as to its description, condition, quality, fitness for purpose or functionality and for use by the recipient solely for guidance only. Any implied conditions terms or warranties as to the description, condition, quality, fitness for purpose or functionality of the software and associated documentation are hereby excluded.

National Air Traffic Services Limited does not accept any and hereby excludes all liability for any loss or damage (whether direct or indirect) suffered or incurred by the recipient due to any of the following;

- from defects errors or faults or omissions in the printed or electronic copy of this Manual and any of its associated documentation.
- from defects errors or faults or omissions as a result of reproducing/copying the printed or electronic version of this Manual and any of its associated documentation.
- from the recipient's use of the printed or electronic copy of this Manual and any of its associated documentation.

First published December 1979
Second edition September 1980
Third edition December 1981
Fourth edition October 1984
Fifth edition June 1988
Sixth edition December 1993
Seventh edition December 1997
Eighth edition April 1999

Foreword

This Document is for guidance only. Regulatory material relating to North Atlantic aircraft operations is contained in relevant *ICAO Annexes*, *PANS/RAC (Doc.4444)*, *Regional Supplementary Procedures (Doc.7030)*, State *AIPs* and current NOTAMs, which should be read in conjunction with the material contained in this Document.

Edition 8 of this Manual is an updated version of Guidance Material first published in 1979 and is primarily for the information of pilots and dispatchers planning and conducting operations in North Atlantic (NAT) Minimum Navigation Performance Specification (MNPS) Airspace.

This Edition has been produced principally to take account of the expansion in October 1998 of the vertical extent of the airspace in which Reduced Vertical Separation Minimum (RVSM) may be employed and also to provide clarification and/or additional information relating to the use of GNSS, Flight Planning Procedures, Oceanic Clearance Procedures and the use of Data Link Air/Ground Communications within MNPS Airspace.

The Manual has been produced with the approval and on behalf of the North Atlantic Systems Planning Group (NAT SPG); a North Atlantic regional planning body established under the auspices of the International Civil Aviation Organisation (ICAO). This Group is responsible for developing the required procedures, services, facilities and aircraft and operator approval standards employed in the NAT Region.

Joint Editors: Michael Russell
ATM Policy & Development
UK National Air Traffic Services Limited
(Fax No: +44-171-832-5562 - until late 1999
+44-207-832-5562 - from late 1999)
(EMAIL: mike.russell@nats.co.uk)

Alan Gilbert
Director Infrastructure - NAT/NAM Region
International Air Transport Association
(EMAIL: gilberta@iata.org)

This Document will be placed on a number of 'Web Sites' and made available to users via the Internet. It is accessible on the following UK 'Web Site': **http://www.nat-pco.org**. Details of additional Internet access will be promulgated through the Aeronautical Information Service (AIS) of other States.

Further material for the information of States of Registry, and Aircraft Operating Agencies dealing primarily with planning and management aspects of NAT MNPS operations, is contained in *ICAO Consolidated Guidance Material North Atlantic Region (NAT Doc 001, T13.5 N)*, published by the European and North Atlantic Office of ICAO**.**

To assist with the editing of this Manual and to ensure the currency and accuracy of future editions it would be appreciated if readers would submit their comments/suggestions for possible amendments/additions, to the editors at their above fax/EMAIL addresses.

MINIMUM NAVIGATION PERFORMANCE SPECIFICATION AIRSPACE

The vertical dimension of MNPS Airspace is between FL285 and FL420 (i.e. in terms of normally used cruising levels, from FL290 to FL410 inclusive).

The lateral dimensions include the following Control Areas (CTAs):

REYKJAVIK (to the North Pole)
SHANWICK AND GANDER OCEANIC
SANTA MARIA OCEANIC North of 27°N
NEW YORK OCEANIC North of 27°N but excluding the area west of 60°W and south of 38°30'N

Some idea of these dimensions can be obtained from the map on the cover and the maps in Chapters 2 and 4. However, for specific dimensions, reference should be made to *ICAO Regional Supplementary Procedures* (*Doc.7030)* **-** *NAT/RAC para 2.2.1*.

Pilots MUST NOT fly across the North Atlantic within MNPS Airspace, nor at flight levels designated as RVSM Airspace, unless they are in possession of the appropriate Approval(s) issued by the State of Registry or the State of the Operator.

The North Atlantic is the busiest oceanic airspace in the world. In 1997 more than 300,000 flights crossed the North Atlantic and annual traffic growth rates are typically 5 to 10%. For the most part in the North Atlantic, Direct Controller Pilot Communications (DCPC) and Radar Surveillance are unavailable. Aircraft separation assurance and hence safety are nevertheless ensured by demanding the highest standards of horizontal and vertical navigation performance/accuracy and of operating discipline. Within NAT MNPS Airspace a formal Approval Process by the State of Registry of the aircraft or the State of the Operator ensures that aircraft meet defined MNPS Standards and that appropriate crew procedures and training have been adopted.

Glossary of Terms

ACC	Area Control Centre
ADC	Air Data Computer
ADF	Automatic Direction Finding
AFTN	Aeronautical Fixed Telecommunication Network
AIC	Aeronautical Information Circular
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
ARINC	ARINC - formerly Aeronautical Radio Incorporated
ASR	Aviation Safety Report
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
AWPR	Automatic Waypoint Reporting
BOTA	Brest Oceanic Transition Area
BRNAV	Basic Area Navigation
CAR	Caribbean
CDU	Control Display Unit
CMA	Central Monitoring Agency
CTA	Control Area
DCPC	Direct Controller/Pilot Communications
DME	Distance Measuring Equipment
DR	Dead Reckoning
ELT	Emergency Locator Transmitter
ETA	Estimated Time of Arrival
ETOPS	Extended Range Twin-engine Aircraft Operations
EUR	Europe

FAA	Federal Aviation Administration
FDE	Fault Detection and Exclusion
FIR	Flight Information Region
FL	Flight Level
FLAS	Flight Level Allocation Scheme
FMC	Flight Management Computer
FMS	Flight Management System
GLONASS	Global Orbiting Navigation Satellite System
GMU	GPS (Height) Monitoring Unit
GNE	Gross Navigation Error
GNSS	Global Navigation Satellite System
GP	General Purpose
GPS	Global Positioning System
HF	High Frequency
HMU	Height Monitoring Unit
HSI	Horizontal Situation Indicator
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
INS	Inertial Navigation System
IRS	Inertial Reference System
JAA	Joint Aviation Authorities
kHz	Kilohertz
LAT	Latitude
LONG	Longitude
LRNS	Long Range Navigation System
MASPS	Minimum Aircraft System Performance Specification
MEL	Minimum Equipment List

MET	Meteorological
MHz	Megahertz
MNPS	Minimum Navigation Performance Specification
MTT	Minimum Time Track
NAM	North America
NAR	North American Route
NAT	North Atlantic
NAT SPG	North Atlantic Systems Planning Group
NDB	Non Directional Beacon
nm	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
OAC	Oceanic Area Control Centre
OCA	Oceanic Control Area
OTS	Organized Track System
PRM	Preferred Route Message
PTS	Polar Track Structure
RA	Resolution Advisory
RAIM	Receiver-Autonomous Integrity Monitoring
RMI	Remote Magnetic Indicator
RNP	Required Navigation Performance
R/T	Radio Telephony
RVSM	Reduced Vertical Separation Minimum
SAM	South America
SELCAL	Selective Calling
SID	Standard Instrument Departure
SOTA	Shannon Oceanic Transition Area
SSB	Single Sideband

SSR	Secondary Surveillance Radar
SST	Supersonic Transport
TA	Traffic Advisory
TAS	True Airspeed
TCAS	Traffic (Alert and) Collision Avoidance System
TLS	Target Level of Safety
TMI	Track Message Identification
UTC	Co-ordinated Universal Time
VHF	Very High Frequency
VOR	VHF Omni-directional Range
WAH	When Able Higher
WATRS	West Atlantic Route System

CONTENTS

Page

Page

Page

C*harts*

Attachments

Chapter 1: Operational Approval and Aircraft System Requirements for Flight in the NAT MNPS Airspace

Pilots may fly across the North Atlantic within MNPS Airspace or at flight levels designated as RVSM Airspace, only if they are in possession of the appropriate Approval(s) issued by the State of Registry or the State of the Operator.

GENERAL

It is implicit in the concept of MNPS that all flights within the airspace achieve the highest standards of horizontal and vertical navigation performance and accuracy. Formal monitoring programmes are undertaken to quantify the achieved performances and to compare them with established Target Levels of Safety (TLS).

Aircraft operating within MNPS Airspace are required to meet a Minimum Navigation Performance Specification (MNPS) in the horizontal plane through the mandatory carriage and use of a specified level of navigation equipment which has been approved by the State of Registry, or State of the Operator, for the purpose. Such approvals encompass all aspects affecting the expected navigation performance of the aircraft. The requirements are set out in ICAO *NAT Doc 001, T13.5N, 'Consolidated Guidance Material North Atlantic Region'*.

With the introduction of RVSM, aircraft intending to operate at RVSM levels in NAT MNPS Airspace are additionally required to be equipped with altimetry and height keeping systems which meet RVSM Minimum Aircraft System Performance Specifications (MASPS). RVSM MASPS are contained in designated FAA document, *91-RVSM*, and JAA document, *TGL6 (Temporary Guidance Leaflet No. 6).*

NAT Doc 001 is maintained by the ICAO European and North Atlantic Office (Paris) and is provided, together with the RVSM MASPS documents, to assist States of Registry, operators, owners and planning staff who are responsible for issuing or obtaining MNPS/RVSM approvals for aircraft. However, the ultimate responsibility for checking that a NAT MNPS/RVSM flight has the necessary approval(s) rests with the pilot in command. In the case of most regular scheduled flights this check is a matter of simple routine but pilots of special charter flights, private flights, ferry and delivery flights are advised to pay particular attention to this matter. Routine monitoring of NAT traffic regularly reveals examples of pilots of non-approved flights from within these user groups flight planning or requesting clearance within MNPS Airspace or at RVSM levels. All such instances are prejudicial to safety and are referred to relevant State Authorities for further action.

While not a specific element of NAT MNPS approval, pilots and operators are reminded that for flights over the NAT, *ICAO SARPS Annex 6, Part 1, Chapter 6,* requires carriage of Emergency Locator Transmitters (ELTs). It should be further noted that new specifications for these beacons to operate exclusively on frequency 406 MHz (but with a 121.5 MHz search and rescue homing capability) will apply from 2005 although new aircraft will need to be so equipped from 2002.

APPROVAL

Approval for MNPS operations will require the checking by the State of Registry or State of the Operator, of various aspects affecting navigation performance. These aspects include: the navigation equipment used, together with its installation and maintenance procedures; plus the crew navigation procedures employed and the training requirements.

Approval to operate at RVSM levels within MNPS Airspace is subject to additional requirements regarding aircraft height keeping performance in accordance with the MASPS. Each aircraft intended to be flown in RVSM airspace must have State Airworthiness Approval and crews/operators must be specifically State approved for RVSM operations.

NAVIGATION REQUIREMENTS FOR UNRESTRICTED MNPS AIRSPACE OPERATIONS

Longitudinal Navigation

Longitudinal separations between subsequent aircraft following the same track (in-trail) and between aircraft on intersecting tracks in the NAT MNPS Airspace are assessed in terms of differences in ATAs/ETAs at common waypoints. The longitudinal separation minima currently used in the NAT MNPS Airspace are thus expressed in clock minutes. The maintenance of in-trail separations is aided by the application of the Mach Number Technique (See Chapter 8). However, aircraft clock errors resulting in waypoint ATA report errors can lead to an erosion of actual longitudinal separations between aircraft. It is thus vitally important that the time-keeping device intended to be used to indicate waypoint passing times is accurate, and is synchronised to an acceptable UTC time signal before commencing flight in MNPS Airspace. In many modern aircraft, the Master Clock can only be reset while the aircraft is on the ground. Thus the pre-flight procedures for any NAT MNPS operation **must include** a UTC time check and resynchronisation of the aircraft Master Clock. Lists of acceptable time sources for this purpose have been promulgated by NAT ATS Provider States. A non-exhaustive list is shown in Chapter 9 of this Document.

Lateral Navigation

There are two navigational requirements for aircraft planning to operate in MNPS Airspace. One refers to the navigation performance which should be achieved, in terms of accuracy. The second refers to the need to carry standby equipment with comparable performance characteristics (*ICAO Annex 6, Parts I and II, Chapter 7* refer). Thus in order to justify consideration for State approval of unrestricted operation in the MNPS Airspace an aircraft must be equipped with the following:

- **two** fully serviceable Long Range Navigation Systems (LRNSs). A LRNS may be one of the following:
  - one Inertial Navigation System (INS);
  - one Global Navigation Satellite System (GNSS); or
  - one navigation system using the inputs from one or more Inertial Reference System (IRS) or any other sensor system complying with the MNPS requirement.

Note 1: only two GNSSs currently exist: the Global Positioning System (GPS) and the Global Orbiting Navigation Satellite System (GLONASS)

Note 2: a GPS installation must be approved as follows:

If the two required LRNSs are both GPS, they must be approved in accordance with FAA Notice 8110.60 or equivalent JAA or national documentation and their operation approved in accordance with FAA HBAT 95-09 or equivalent national or JAA documentation. If GPS serves as only one of the two required LRNSs, then it must be approved in accordance with FAA TSO-C129 as Class A1, A2, B1, B2, C1 or C2, or with equivalent national or JAA documentation.

Note 3: equivalent approval material for GLONASS is under development and must be available prior to approval of any GLONASS equipped aircraft for MNPS operations.

- each LRNS must be capable of providing to the flight crew a continuous indication of the aircraft position relative to desired track.

- it is highly desirable that the navigation system employed for the provision of steering guidance is capable of being coupled to the autopilot.

ROUTES FOR USE BY AIRCRAFT NOT EQUIPPED WITH TWO LRNSs

Routes for Aircraft with Only One LRNS

A number of special routes have been developed for aircraft equipped with only one LRNS* and carrying normal short-range navigation equipment (VOR, DME, ADF). It should be recognised that these routes are within MNPS Airspace, and that State approval must be obtained prior to flying along them. These routes are also available for interim use by aircraft normally approved for unrestricted MNPS operations that have suffered a partial loss of navigation capability and have only a single remaining functional LRNS. Detailed descriptions of the special routes known as 'Blue Spruce Routes' are included in Chapter 11 of this Document.

**Note: if this single LRNS is a GPS it must be approved in accordance with FAA TSO-C129. Some States may have additional requirements regarding the carriage and use of GPS and pilots should check with their own State of Registry to ascertain what they are.*

Routes for Aircraft with Short-Range Navigation Equipment Only

Aircraft which are equipped only with short-range navigation equipment (VOR, DME, ADF) may operate through MNPS Airspace, along routes G3 or G11, but again State approval is required. (See Chapter 11 for details of these routes.)

It is the responsibility of pilots with limited certification to reject clearances which would otherwise divert them from officially permitted routes.

SPECIAL ARRANGEMENTS FOR THE PENETRATION OF MNPS AIRSPACE BY NON-MNPS APPROVED AIRCRAFT

Aircraft not approved for operation in MNPS Airspace may be cleared by the responsible ATC unit to climb or descend through MNPS Airspace provided:

- the climb or descent can be completed within the coverage of selected VOR/DMEs or NDBs (see *AIP Iceland*) and/or within radar coverage of the ATC unit issuing such clearance and the aircraft is able to maintain Direct Controller/Pilot Communications (DCPC) on VHF; and

- MNPS approved aircraft operating in that part of the MNPS Airspace affected by such climbs or descents are not penalised.

Non-MNPS Approved aircraft may also be cleared to climb or descend through MNPS Airspace for the sole purpose of landing at or departing from an airport which underlies MNPS Airspace but which does not have serviceable short range navaids, radar or DCPC. Details of the required provisions will be found in the AIS publications of the appropriate ATS Provider State.

EQUIPMENT REQUIRED FOR OPERATIONS AT RVSM LEVELS

The minimum equipment standard is embodied in the MASPS for RVSM flight operations. These MASPS require:

- **two** fully serviceable independent primary altitude measurement systems;
- **one** automatic altitude-control system; and
- **one** altitude-alerting device.

A functioning Mode-C SSR Transponder is also required for flight through radar controlled RVSM transition airspace.

The flight control and air data measurement systems of many modern commercial aircraft are designed to provide multiple redundancy. Nevertheless, the Minimum Equipment List (MEL) for RVSM operations must reflect the foregoing minimum requirements. In particular it must be noted that if following a failure of an Air Data Computer (ADC), both the Captain's and Co-pilot's altimeter instruments are connected to a remaining single functional ADC, this arrangement does **not** meet the RVSM MASPS requirement for **two independent primary altimetry systems.**

Airworthiness Approval for RVSM operations may be granted by the appropriate State Authority to individual aircraft, or to a group of aircraft which are nominally identical in aerodynamic design and in items of equipment contributing to height keeping accuracy.

When checking altimeters (pre-flight or in-flight), confirmation is necessary that all altitude indications are within the tolerances specified in the aircraft operating manual. **At least two primary altimeters must at all times agree within plus or minus 200 feet.**

SPECIAL ARRANGEMENTS FOR NON-RVSM APPROVED AIRCRAFT TO:

- Climb/Descend Through RVSM Levels

MNPS approved aircraft that are not approved for RVSM operation will be permitted, subject to traffic, to climb/descend through RVSM levels in order to attain cruising levels above or below RVSM airspace. Flights should climb/descend continuously through the RVSM levels without stopping at any intermediate level and should "Report leaving" current level and "Report reaching" cleared level.

- Operate at RVSM Levels

ATC may provide an altitude reservation for an MNPS approved aircraft that is not approved for RVSM operation to fly at RVSM levels provided that the aircraft:

- is on a delivery flight; or
- was RVSM approved but has suffered an equipment failure and is being returned to its base for repair and/or re-approval; or
- is on a mercy or humanitarian flight.

Operators requiring such an altitude reservation should contact the initial Oceanic Area Control Centre (OAC), normally not more than 12 hours and not less than 4 hours prior to the intended departure time. The altitude reservation approval should be clearly indicated in Item 18 of the ICAO flight plan. It must be noted that the provision of this service is intended exclusively for the purposes indicated above and is not a means for an operator or pilot to circumvent the RVSM approval process. The service will not be provided to aircraft that are not approved for MNPS operations.

PERFORMANCE MONITORING

The horizontal (i.e. latitudinal and longitudinal) and vertical navigation performance of operators within NAT MNPS Airspace is monitored on a continual basis. If a deviation is identified, follow-up action after flight is taken, both with the operator and the State of Registry of the aircraft involved, to establish the cause of the deviation and to confirm the approval of the flight to operate in NAT MNPS and/or RVSM Airspace. The overall navigation performance of all aircraft in the MNPS Airspace is compared to the standards established for the Region, to ensure that the relevant TLSs are being maintained. (See Chapters 9 & 10.)

Chapter 2: The Organised Track System (OTS)

GENERAL

As a result of passenger demand, time zone differences and airport noise restrictions, much of the North Atlantic (NAT) air traffic contributes to two major alternating flows: a westbound flow departing Europe in the morning, and an eastbound flow departing North America in the evening. The effect of these flows is to concentrate most of the traffic unidirectionally, with peak westbound traffic occurring between 1130 UTC and 1800 UTC and peak eastbound traffic occurring between 0100 UTC and 0800 UTC, both at 30°W.

Due to the constraints of large horizontal separation criteria and a limited economical height band (FL310–390) the airspace is congested at peak hours. In order to provide the best service to the bulk of the traffic, a system of organised tracks is constructed to accommodate as many flights as possible within the major flows on or close to their minimum time tracks and profiles. Due to the energetic nature of the NAT weather patterns, including the presence of jet streams, eastbound and westbound minimum time tracks are seldom identical. The creation of a different organised track system is therefore necessary for each of the major flows. Separate Organised Track Structures (OTS) are published each day for eastbound and westbound flows.

It should be appreciated, however, that use of OTS tracks is not mandatory. Currently about half of NAT flights utilise the OTS. Aircraft may fly on random routes which remain clear of the OTS or may fly on any route that joins or leaves an outer track of the OTS. There is also nothing to prevent an operator from planning a route which crosses the OTS. However, in this case, operators must be aware that whilst ATC will make every effort to clear random traffic across the OTS at published levels, re-routes or significant changes in flight level from those planned are very likely to be necessary during most of the OTS traffic periods.

Over the high seas, the NAT Region is Class A airspace (at and above FL55), in which Instrument Flight Rules (IFR) apply at all times. However, airspace utilisation is under continual review, and in addition to the strategic and tactical use of ‘opposite direction’ flight levels during peak flow periods and the application of Mach Number Technique, a 1000 feet vertical separation minimum has been introduced between FL310 and FL390. This is the second phase of a NAT RVSM programme which is ultimately expected to see the introduction of 1000 feet separation from FL290 up to FL410. No major changes in operating procedures are envisaged with the introduction of further phases of the RVSM programme**.**

CONSTRUCTION OF THE ORGANISED TRACK SYSTEM (OTS)

The appropriate OAC constructs the OTS after determination of basic minimum time tracks; with due consideration of airlines' preferred routes (see Chapter 5) and taking into account airspace restrictions such as danger areas and military airspace reservations. The night-time OTS is produced by Gander OAC and the day-time OTS by Shanwick OAC (Prestwick), each incorporating any requirement for tracks within the New York, Reykjavik, Bodø and Santa Maria Oceanic Control Areas (OCAs). OAC planners co-ordinate with adjacent OACs and domestic ATC agencies to ensure that the proposed system is viable. They also take into account the requirements of opposite direction traffic and ensure that sufficient track/flight level profiles are provided to satisfy anticipated traffic demand. The impact on domestic route structures and the serviceability of transition area radars and navaids are checked before the system is finalised.

When the expected volume of traffic justifies it, tracks may be established to cater for the EUR/CAR traffic axis or for traffic between the Iberian Peninsular and North America. Extra care is required when planning these routes as they differ slightly from the 'core tracks' in that they may cross each other (using vertical separations via different flight level allocations), and in some cases may not extend from coast-out to coast-in (necessitating random routeing to join or leave). Similarly, some westbound tracks may commence at 30°W, north of 61°N, to cater for NAT traffic routeing via the Reykjavik OCA and northern Canada.

THE NAT TRACK MESSAGE

The agreed OTS is promulgated by means of the NAT Track Message via the AFTN to all interested addressees. A typical time of publication of the day-time OTS is 0000 UTC and of the night-time OTS is 1200 UTC.

This message gives full details of the co-ordinates of the organised tracks as well as the flight levels that are expected to be in use on each track. In most cases there are also details of domestic entry and exit routeings associated with individual tracks. In the westbound (day-time) system the track most northerly, at its point of origin, is designated Track 'A' (Alpha) and the next most northerly track is designated Track 'B' (Bravo) etc. In the eastbound (night-time) system the most southerly track, at its point of origin, is designated Track 'Z' (Zulu) and the next most southerly track is designated Track 'Y' (Yankee), etc.

Examples of both eastbound and westbound systems and Track Messages are shown in the Appendix to this Chapter.

The originating OAC identifies each NAT Track Message, within the Remarks section appended to the end of the NAT Track message, by means of a 3-digit Track Message Identification (TMI) number equivalent to the Julian calendar date on which that OTS is effective. For example, the OTS effective on February 1st will be identified by TMI 32. (The Julian calendar date is a simple progression of numbered days without reference to months, with numbering starting from the first day of the year.) Any subsequent NAT Track amendments affecting the entry/exit points, route of flight (co-ordinates) or flight level allocation, for an OTS on a given day, will include a successive alphabetic character, i.e. ‘A’, then ‘B’, etc., added to the end of the TMI number.

Remarks may vary periodically depending upon what important aspects of NAT operation Shanwick or Gander wish to bring to the attention of operators. When Edition 8 was produced the Remarks section included mention of: clearance delivery frequency assignments, the vertical extent of MNPS and RVSM Airspace plus a warning on the occurrence of Gross Navigational Errors (GNEs).

The hours of validity of the two Organised Track Systems (OTS) are normally as follows:

Day-time OTS 1130 UTC to 1800 UTC at 30°W
Night-time OTS 0100 UTC to 0800 UTC at 30°W

Changes to these times can be negotiated between Gander and Shanwick OACs and the specific hours of validity for each OTS are indicated in the NAT Track Message. For flight planning, operators should take account of the times specified in the relevant NAT Track Message(s). Tactical extensions to OTS validity times can also be agreed between OACs when required, but these should normally be transparent to operators.

Correct interpretation of the track message by airline dispatchers and aircrews is essential for both economy of operation and in minimising the possibility of misunderstanding leading to the use of incorrect track co-ordinates. Oceanic airspace outside the published OTS is available, subject to application of the appropriate separation criteria and NOTAM restrictions. It is possible to flight plan to join or leave an outer track of the OTS. If an operator wishes to file partly or wholly outside the OTS, knowledge of separation criteria, the forecast upper wind situation and correct interpretation of the NAT Track Message will assist in judging the feasibility of the planned route. When the anticipated volume of traffic does not warrant publication of all available flight levels on a particular track, ATC will publish only those levels required to meet traffic demand. The fact that a specific flight level is not published for a particular track does not necessarily mean that it cannot be made available if requested.

OTS CHANGEOVER PERIODS

To ensure a smooth transition from night-time to day-time OTSs and vice-versa, a period of several hours is interposed between the termination of one system and the commencement of the next. These periods are from 0801 UTC to 1129 UTC: and from 1801 UTC to 0059 UTC.

During the changeover periods some restrictions to flight planned routes and levels are imposed. Eastbound and westbound aircraft operating during these periods should file flight level requests in accordance with the Flight Level Allocation Scheme (FLAS) as published in the *UK and Canada AIPs*.

Note: the FLAS as published in the AIPs applies only to the current phase of NAT RVSM operations. Different flight level allocation schemes which apply when subsequent phases of RVSM operations are implemented will be similarly published as and when these new phases occur.

It should also be recognised that during these times there is often a need for clearances to be individually co-ordinated between OACs and cleared flight levels may not be in accordance with those flight planned. If, for any reason, a flight is expected to be level critical, operators are recommended to contact the initial OAC prior to filing of the flight plan to ascertain the likely availability of levels.

Appendix

Examples of Day-time Westbound and Night-time Eastbound Track Messages and Associated Track Systems

EXAMPLE OF WESTBOUND NAT TRACK MESSAGE

*(NAT-1/2 TRACKS FLS 310/ 390 INCLUSIVE
OCTOBER 8/ 1130Z TO OCTOBER 8/ 1800Z
PART ONE OF TWO PARTS-*

*A 59/10 61/20 61/30 61/40 61/50 60/60 CIMAT
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 390
EUR RTS WEST NIL
NAR N464B N466B N468B N472B N474B-*

*B 58/10 60/20 60/30 60/40 59/50 PRAWN YDP
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST NIL
NAR N322B N328C N334B N336E N346A N348C N352C N356C N362B-*

*C 57/10 59/20 59/30 58/40 56/50 SCROD VALIE
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST NIL
NAR N242B N248B N250C N252B-*

*D 56/10 58/20 58/30 57/40 55/50 OYSTR STEAM
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST NIL
NAR N224C N228A N230B N232B-*

*E 55/10 57/20 57/30 56/40 54/50 CARPE REDBY
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST NIL
NAR N202B N206C N210C-*

END OF PART ONE OF TWO PARTS)

*(NAT-2/2 TRACKS FLS 310/390 INCLUSIVE
AUGUST 14/ 1130Z TO AUGUST 14/ 1800Z
PART TWO OF TWO PARTS-*

*F MASIT 56/20 56/30 55/40 53/50 YAY
EAST LVLS NIL
WEST LVLS 310 320 330 340 350 360 370 380 390
EUR RTS WEST VIA DEVOL
NAR N184B N188B N192B-*

*G 49/15 48/20 45/30 42/40 38/50 35/60 HENCH
EAST LVLS NIL
WEST LVLS 320 340 360
EUR RTS WEST VIA GUNSO
NAR NIL*

*REMARKS:
1. TRACK MESSAGE IDENTIFICATION NUMBER IS 281 AND OPERATORS ARE REMINDED TO INCLUDE THE TMI NUMBER AS PART OF THE OCEANIC CLEARANCE READBACK.
2. MNPS AIRSPACE EXTENDS FROM FL285 TO FL420. OPERATORS ARE REMINDED THAT SPECIFIC MNPS APPROVAL IS REQUIRED TO FLY IN THIS AIRSPACE. IN ADDITION, RVSM APPROVAL IS REQUIRED TO FLY BETWEEN FL310 AND FL390 INCLUSIVE
3. EIGHTY PERCENT OF GROSS NAVIGATION ERRORS OCCUR AFTER A REROUTE. ALWAYS CARRY OUT WAYPOINT CROSS CHECKS
END OF PART TWO OF TWO PARTS)*

[This Diagram is held in a separate file]

Figure 1 - Example of Day-time Westbound Organised Track System

EXAMPLE OF EASTBOUND NAT TRACK MESSAGE

(NAT-1/1 TRACKS FLS 310/390 INCLUSIVE
OCTOBER 9/ 0100Z TO OCTOBER 9/ 0800Z

PART ONE OF ONE PARTS-

W CYMON 51/50 52/40 52/30 52/20 53/15 BURAK
EAST LVLS 310 320 330 340 350 360 370 380 390
WEST LVLS NIL
EUR RTS WEST NIL
NAR N95B N97B-

X YQX 50/50 51/40 51/30 51/20 52/15 DOLIP
EAST LVLS 310 320 330 340 350 360 370 380 390
WEST LVLS NIL
EUR RTS WEST NIL
NAR N79B N83B-

Y VIXUN 49/50 50/40 50/30 50/20 51/15 GIPER
EAST LVLS 310 320 330 340 350 360 370 380 390
WEST LVLS NIL
EUR RTS WEST NIL
NAR N63B N67B-

Z YYT 48/50 49/40 49/30 49/20 50/15 KENUK
EAST LVLS 310 320 330 340 350 360 370 380 390
WEST LVLS NIL
EUR RTS WEST NIL
NAR N53B N55A

REMARKS.

1. CLEARANCE DELIVERY FREQUENCY ASSIGNMENTS FOR AIRCRAFT OPERATING FROM MOATT TO BOBTU INCLUSIVE:

LOACH AND NORTH	*128.7*
SCROD TO YAY	*135.45*
DOTTY TO YQX	*135.05*
VIXUN AND SOUTH	*119.425*

2. TRACK MESSAGE IDENTIFICATION 282.

3. MNPS AIRSPACE EXTENDS FROM FL285 TO FL420. OPERATORS ARE REMINDED THAT MNPS APPROVAL IS REQUIRED TO FLY IN THIS AIRSPACE. IN ADDITION, RVSM APPROVAL IS REQUIRED TO FLY WITHIN THE NAT REGION BETWEEN FL310 AND FL390 INCLUSIVE. PLEASE REFER TO CANADIAN NOTAM 980097 OR A3797.

4. 80 PERCENT OF GROSS NAVIGATION ERRORS OCCUR AFTER A REROUTE. ALWAYS CARRY OUT WAYPOINT CROSS CHECKS.

END OF PART ONE OF ONE PART)

[This Diagram is held in a separate file]

Figure 2 - Example of Night-time Eastbound Organised Track System

Chapter 3: The Polar Track Structure (PTS)

GENERAL

A Polar Track Structure (PTS) has been established, consisting of 10 fixed tracks in Reykjavik CTA and 5 fixed tracks through Bodø OCA. The PTS tracks through Bodø OCA constitute a continuation of relevant PTS tracks in Reykjavik CTA (see Fig 3).

Although not mandatory, operators proposing to fly on the Europe-Alaska axis from FL310 to FL390 inclusive are recommended to submit flight plans in accordance with one of the promulgated PTS tracks.

ABBREVIATED CLEARANCES

An abbreviated clearance may be issued to an aircraft to follow one of the polar tracks throughout its flight within the Reykjavik CTA and/or the Bodø OCA. When an abbreviated clearance is issued it should include:

- clearance limit, which will normally be destination airfield;
- the cleared track specified by the track code;
- the cleared flight level(s); and
- the cleared Mach Number (if required).

On receipt of an abbreviated clearance the pilot must read back the contents of the clearance message and in addition the full details of the track specified by the track code.

ABBREVIATED POSITION REPORTS

When operating on the PTS within the Reykjavik CTA and/or Bodø OCA, position reports may be abbreviated by replacing the normal latitude co-ordinate with the word 'Polar' followed by the track code.

Example: *"Position, Japanair 422, Polar Romeo 20 West at 1620, Flight Level 330, Estimating Polar Romeo 40 West at 1718, Polar Romeo 69 West Next"*

Unless otherwise required by ATC, a position report should be made at the significant points listed in the appropriate AIP for the relevant PTS track.

ADDITIONAL INFORMATION ON THE PTS

Flight planning procedures for the PTS are covered in Chapter 5 of this Document. Further information on PTS procedures, track co-ordinates etc., is contained in *AIP Iceland or Norway* and/or Icelandic or Norwegian NOTAMs.

[This Diagram is held in a separate file]

Figure 3 - Polar Track Structure (PTS)

Chapter 4: Other Routes and Route Structures Within or Adjacent to NAT MNPS Airspace

GENERAL

The Organised Track System and the Polar Track Structure are the most significant route structures within NAT MNPS Airspace. Other route structures within and adjacent to MNPS Airspace are detailed below.

OTHER ROUTES WITHIN NAT MNPS AIRSPACE

Other routes within NAT MNPS Airspace (illustrated in Fig 4) are as follows:

(1) A699 and A700 in the western part of the New York OCA;

(2)***** 'Blue Spruce' Routes, established as special routes for aircraft equipped with only one serviceable LRNS. (Chapter 1 refers.) **State approval for MNPS operations is required in order to fly along these routes**. (See Chapter 11 for full route definitions);

(3) routes between Northern Europe and Spain/Canaries/Lisbon FIR. (T9*, T14 and T16);

(4)***** routeings between the Azores and the Portuguese mainland and between the Azores and the Madeira Archipelago;

(5) special routes of short stage lengths where aircraft equipped with normal short-range navigation equipment can meet the MNPS track-keeping criteria (G3 and G11). **State approval for MNPS operations is required in order to fly along these routes**.

** Note: routes identified with an asterisk in sub paragraphs (2), (3) and (4) above may be flight planned and flown by approved aircraft equipped with normal short-range navigation equipment (VOR, DME, ADF) and at least one approved fully operational LRNS.*

ROUTE STRUCTURES ADJACENT TO NAT MNPS AIRSPACE

SST Route Structure

The SST Route structure (also illustrated in Fig 4) comprises four fixed tracks: SM, SN, SO and SP. SST flights on these tracks normally operate above MNPS Airspace (FL450+), the exceptions being in the event of a delayed supersonic acceleration or an emergency descent. In the first case, standard separation is applied by ATC; in the latter case, emergency descent contingency procedures take into account the possible existence of OTS traffic operating below the SST tracks.

Irish/UK Domestic Route Structures

The *UK AIP* and *AIP Ireland* both specify the domestic routes to be used for westbound and eastbound NAT traffic, based upon entry points into and exit points from oceanic airspace.

[This Diagram is held in a separate file]

Figure 4 - Other Routes and Structures Within and Above NAT MNPS Airspace

North American Routes (NARs)

The North American Routes (NARs) consist of a numbered series of predetermined routes which provide an interface between oceanic and domestic airspace. The NAR System is designed to accommodate major airports in North America.

Full details of all NAR routeings together with associated procedures are published in *the United States Airport Facility Directory - Northeast* and *the Canada Flight Supplement*.

Canadian Domestic Track Systems

Within Canada there are two track systems: the Northern Control Area tracks and the Southern Control Area tracks; these provide links for NAT traffic operating between Europe and North America to central and western North American airports. Track procedures and details are published in *AIP Canada*.

Routes between North America and the Caribbean area

An extensive network of routes linking points in the United States and Canada with Bermuda, the Bahamas and the Caribbean area are defined in the New York OCA to the west of 60^{o}W. This network is known as the Western Atlantic Route System (WATRS). Details of these routes and associated procedures are contained in the *United States AIP*.

Shannon Oceanic Transition Area (SOTA)

Part of the Shanwick OCA is designated as the Shannon Oceanic Transition Area (SOTA). MNPS Airspace requirements are still applicable from FL285 to FL420. SOTA has the same vertical extent as the Shanwick OCA, and is bounded by lines joining successively the following points:

N5100 W01500 – N5100 W00800 – N4830 W00800 – N4900 W01500 – N5100 W01500

Air Traffic Service is provided by Shannon ACC using the call sign SHANNON CONTROL. Full details of the service provided and the procedures used are contained in *AIP Ireland*.

Brest Oceanic Transition Area (BOTA)

Part of the Shanwick OCA is designated as the Brest Oceanic Transition Area (BOTA). MNPS Airspace requirements are still applicable from FL285 to FL420. BOTA has the same vertical extent as the Shanwick OCA, and is bounded by lines joining successively the following points:

N4834 W00845 – N4830 W00800 – N4500 W00800 – N4500 W00845 – N4834 W00845

Air Traffic service is provided by the Brest ACC, callsign BREST CONTROL.

Chapter 5: Flight Planning

PREFERRED ROUTE MESSAGES (PRMs)

To enable oceanic planners to take into consideration operators' preferred routes in the construction of the OTS, all NAT operators (both scheduled and non-scheduled) should provide information by AFTN message to the appropriate OACs regarding their proposed flights and optimum tracks during the peak traffic periods. Such information should be provided, in the correct format, as far in advance as possible, but not later than 1900 UTC for the following day-time OTS and 1000 UTC for the following night-time OTS. Addresses and formats are published in the relevant *AIPs*/NOTAMs.

FLIGHT PLAN REQUIREMENTS

General

It is essential that care is taken when feeding track information into a computer and the information should be cross-checked before it is given to the operating crew. Where applicable, the crew should be given both the organised track message and relevant amendments to it. Should more than one version of the daily Track Message have been issued, then explanation may be required, in order to relate differences between versions; each successive version will be identified by the TMI and an alphabetic suffix. i.e. 243A, 243B etc.

All flights which generally route in an eastbound or westbound direction should normally be flight planned so that specified ten degrees of longitude (20°W, 30°W, 40°W etc.) are crossed at whole degrees of latitude; and all generally northbound or southbound flights should normally be flight planned so that specified parallels of latitude spaced at five degree intervals (65°N, 60°N, 55°N etc.) are crossed at whole degrees of longitude.

All flights should plan to operate on great circle tracks joining successive significant waypoints.

Routeings

During the hours of validity of the OTS, operators are encouraged to flight plan as follows:

- in accordance with the OTS; or
- along a route to join or leave an outer track of the OTS; or
- on a random route to remain clear of the OTS

Nothing in the paragraph above prevents operators from flight planning across the OTS. However they should be aware that whilst ATC will make every effort to clear random traffic across the OTS at published levels, re-routes or significant changes in flight level are likely to be necessary during most of the OTS traffic periods.

Outside of the OTS periods operators may flight plan any random routeing, except that during the two hours prior to each OTS period the following restrictions apply:

(1) eastbound flights that cross 30°W less than one hour prior to the incoming/pending westbound OTS (i.e. after 1029 UTC), or westbound flights that cross 30°W less than one hour prior to the incoming/pending eastbound OTS (i.e. after 2359 UTC), should plan to remain clear of the incoming/pending OTS structure.

(2) any such opposite direction flights crossing 30°W between one and two hours prior to the incoming OTS (i.e. any eastbound flights between 0930 and 1029 UTC, or any westbound flights between 2300 and 2359 UTC) where the route beyond 30°W would coincide with the incoming/pending OTS structure at any point, should plan to join an outer track at any point, or backtrack the length of one of the incoming/pending tracks.

Flight Levels

Flight levels for use under Phase 2 RVSM are published in *the UK and Canada AIPs*, as the Flight Level Allocation Scheme (FLAS).

Note: the FLAS as published in the AIPs applies only to the current phase of NAT RVSM operations. Different flight level allocation schemes which apply when subsequent phases of RVSM operations are implemented will be similarly published as and when these new phases occur.

During the OTS Periods (eastbound 0100-0800 UTC, westbound 1130-1800 UTC) aircraft intending to follow an OTS Track for its entire length may plan at any of the levels as published for that track on the current daily OTS Message. Flights which are planned to remain entirely clear of the OTS or which join or leave an OTS Track (i.e. follow an OTS track for only part of its published length), are all referred to as Random Flights. Pilots intending to fly on a random route or outside the OTS time periods, should normally plan flight level(s) appropriate to the direction of flight.

Note: "Appropriate Direction Levels" are specified by the Semi-circular Rule. ICAO Annex 2, Appendix 3:
For Phase 2 NAT RVSM implementation (FL310-FL390 inclusive)
Table a) specifies appropriate direction levels from FL 310 to 390 inclusive and
Table b) specifies appropriate direction levels below FL 310 or above FL 390.
These levels are as follows:
Appropriate Direction Eastbound levels are therefore:
270,290,310,330,350,370,390,410,450,etc
Appropriate Direction Westbound levels are therefore:
260,280,320,340,360,380,430,470,etc

Planners should note however that the *AIPs* specify some exceptions to use of "Appropriate Direction Levels" both during the OTS time periods and outside them. At specified times, appropriate direction levels are reserved for use by (opposite direction) traffic flows that then predominate. These exceptions may be modified in future to accommodate changes in traffic flows. Hence, pilots and planners should always consult the current *AIPs* and any supporting NOTAMs when flight planning random routes through NAT MNPS Airspace.

If a flight is expected to be level critical, operators should contact the initial OAC prior to filing of the flight plan to determine the likely availability of specific flight levels.

ATC Flight Plans

Correct completion and addressing of the flight plan is extremely important as errors can lead to delays in data processing and to the subsequent issuing of clearances to the flights concerned.

Flight plans for flights departing from points in other Regions and entering the NAT Region without intermediate stops should be submitted as far in advance of departure as possible.

In order to signify that a flight is approved to operate in NAT MNPS Airspace, the letter 'X' shall be inserted, in addition to the letter 'S', within Item 10 of the flight plan. If the flight is approved to operate at RVSM levels a 'W' must also be included in Item 10.

For turbojet aircraft the Mach Number planned to be used for each portion of the flight in the NAT Region should be specified in Item 15 of the flight plan.

Item 15 of the flight plan should reflect the proposed speeds in the following sequence:

- cruising True Airspeed (TAS);
- oceanic entry point and cruising Mach Number;
- oceanic landfall and cruising TAS.

FLIGHT PLANNING REQUIREMENTS ON SPECIFIC ROUTES

Flights Planning on the Organised Track System

If (and only if) the flight is planned to operate along the entire length of one of the organised tracks, from oceanic entry point to oceanic exit point, as detailed in the NAT Track Message, should the intended organised track be defined in Item 15 of the flight plan using the abbreviation 'NAT' followed by the code letter assigned to the track.

Flights wishing to join or leave an organised track at some intermediate point are considered to be random route aircraft and full route details must be specified in the flight plan. **The track letter must not be used to abbreviate any portion of the route in these circumstances.**

The planned Mach Number and flight level for the organised track should be specified at either the last domestic reporting point prior to oceanic airspace entry or the organised track commencement point.

Each point at which a change of Mach Number or flight level is planned must be specified by geographical co-ordinates in latitude and longitude or as a named waypoint.

For flights operating along the whole length of one of the organised tracks, estimates are only required for the commencement point of the track.

Flights Planning on Random Route Segments at/or South of 70°N

The requested Mach Number and flight level should be specified at either the last domestic reporting point prior to oceanic airspace entry or the OCA boundary.

The route of flight should be specified in terms of the following significant points, with estimates included in Item 18 of the flight plan:

(1) the last domestic reporting point prior to the oceanic entry point;

(2) the OCA boundary entry point (only required by the Shanwick, New York and Santa Maria OACs);

(3) significant points formed by the intersection of half or whole degrees of latitude, with meridians spaced at intervals of ten degrees of longitude from the Zero degree E/W (Greenwich) Meridian to longitude 70^{o}W;

(4) the OCA boundary exit point (only required by the Shanwick, New York and Santa Maria OACs); and

(5) the first domestic reporting point after ocean exit.

Each point at which a change of Mach Number or flight level is requested must be specified and followed in each case by the next significant point.

Flights Planning on a Generally Eastbound or Westbound Direction on Random Route Segments North of 70°N

Flight planning requirements for flights in this category are identical to those listed for flights on random route segments at/or south of 70°N except that a route should be specified in terms of significant points formed by the intersection of parallels of latitude expressed in degrees and minutes with meridians normally spaced at intervals of 20° from the Zero degree E/W (Greenwich) Meridian to longitude 60°W.

Flights Planning on Random Routes in a Generally Northbound or Southbound Direction

Flight planning requirements for flights in this category are identical to those listed for flights operating on random route segments at/or south of 70°N except that the route should be specified in terms of significant points formed by the intersection of whole degrees of longitude with specified parallels of latitude which are spaced at 5° intervals from 20°N to 90°N.

Flights Planning on the Polar Track Structure (PTS)

If (and only if) the flight is planned to operate along the whole length of one of the Polar tracks, the intended track should be defined in Item 15 of the flight plan using the abbreviation 'PTS' followed by the track code.

Flights wishing to join or leave a polar track at some intermediate point are considered to be following a random route and full track details must be specified in the flight plan. **The track code must not be used to abbreviate any portion of the route in these circumstances.**

Estimated times over significant points must be specified in Item 18 of the flight plan.

The requested Mach Number and flight level should be specified at the commencement point of the PTS or at the NAT Oceanic boundary.

Each point at which a Mach Number or flight level change is planned must be specified as geographical co-ordinates in latitude and longitude followed in each case by the abbreviation 'PTS' and the track code.

Flights Planning to Operate Without HF Communications

The carriage of HF communications is mandatory for flight in the Shanwick OCA. Aircraft with only functioning VHF communications equipment should plan their route outside the Shanwick OCA and ensure that they remain within VHF coverage of appropriate ground stations throughout the flight. Theoretical VHF coverage charts are included in ICAO *NAT Doc 001, T13.5N*. Details of communication requirements are published in State *AIPs*.

Chapter 6: Oceanic ATC Clearances

GENERAL

Oceanic Clearances are required for all flights within the NAT Airspace at or above FL55. Pilots should request Oceanic Clearances from the ATC unit responsible for the first OCA within which they wish to operate, following the procedures and the time-frame laid down in appropriate *AIPs*. Such clearances, although in most cases obtained some time before reaching the Oceanic entry point, are applicable only from that entry point. It is recommended that pilots should request their Oceanic Clearance at least 40 minutes prior to the Oceanic entry point ETA and, if requesting an OTS track, should include the next preferred alternative.

When requesting an oceanic clearance the pilot should notify the OAC of the maximum acceptable flight level possible at the boundary, taking into account that a climb to the assigned oceanic flight level must normally be achieved whilst the aircraft is within radar coverage. The pilot should also notify the OAC of any required change to the oceanic flight planned level, track or Mach Number as early as practicable after departure to assist the OAC in pre-planning optimum airspace utilisation.

Methods of obtaining Oceanic Clearances include:

(1) use of published VHF clearance delivery frequencies;

(2) by HF communications to the OAC through the appropriate aeradio station (at least 40 minutes before boundary/entry estimate);

(3) a request via domestic or other ATC agencies;

(4) by data link, when arrangements have been made with designated airlines to request and receive clearances using on-board equipment. This method of Oceanic Clearance delivery is only possible from participating OACs with the necessary means of automation. Detailed procedures for its operation may vary.

At some airports situated close to oceanic boundaries, the Oceanic Clearance must be obtained before departure (e.g. from Prestwick, Shannon, Glasgow, Dublin, Belfast, Gander, Goose Bay).

If an aircraft, which would normally be RVSM and/or MNPS approved, encounters whilst en-route to the NAT Oceanic Airspace, a critical in-flight equipment failure, or at dispatch is unable to meet the MEL requirements for RVSM or MNPS approval on the flight, then the pilot must advise ATC at initial contact when requesting Oceanic Clearance.

After obtaining and reading back the clearance, the pilot should monitor the forward estimate for oceanic entry and if this changes by 3 minutes or more should pass a revised estimate to ATC. As planned longitudinal spacing by these OACs is based solely on the estimated times over the oceanic entry fix or boundary, failure to adhere to this ETA amendment procedure may jeopardise planned separation between aircraft, thus resulting in reclearance to a less economical track/flight level for the complete crossing; any such failure may also penalise following aircraft.

If the oceanic route on which the flight is cleared differs from that originally requested and/or the oceanic flight level differs from the current flight level, the pilot is responsible for obtaining the necessary domestic reclearance to ensure that the flight is in compliance with its Oceanic Clearance when entering oceanic airspace.

There are three elements to an Oceanic Clearance: route, Mach Number and flight level. These elements serve to provide for the three basic elements of separation: lateral, longitudinal and vertical.

The Oceanic Clearance issued to each aircraft is at a specific flight level and cruise Mach Number. Flight level or Mach Number changes should not normally be made without prior ATC clearance. (See Chapter 8 for 'Application of Mach Number Technique'.)

Prior to reaching the Shanwick OCA boundary, if pilots have not received their Oceanic Clearance then they are to remain clear of Oceanic Airspace whilst awaiting such Clearance. This is not the case for other NAT OCAs into any of which flights may enter whilst pilots are awaiting receipt of a delayed Oceanic Clearance.

An example of a pilot voice request for Oceanic Clearance is as follows:

"ACA 865 request Oceanic Clearance. Estimating 56N010W at 1131. Request Mach decimal eight zero, Flight Level three five zero, able Flight Level three six zero, second choice Track Charlie".

If the request also includes a change to the original flight plan, affecting the OCA, then it should be according to the following example:

"BAW 123 request Oceanic Clearance. Estimating 55N010W at 1147. Request Mach decimal eight zero, Flight Level three four zero. Now requesting Track Charlie, able Flight Level three six zero, second choice Track Delta".

CONTENTS OF CLEARANCES

An abbreviated clearance is issued by Air Traffic Services when clearing an aircraft to fly along the whole length of an Organised Track, or along a Polar Track within the Reykjavik CTA and/or Bodø OCA. When an abbreviated clearance is issued it includes:

- clearance Limit, which will normally be destination airfield;
- cleared track specified as "Track" plus code letter, or "Polar Track" plus code ident;
- cleared flight level(s);
- cleared Mach Number; and
- if the aircraft is designated to report Met information en route, the phrase "SEND MET REPORTS".

Procedures exist for an abbreviated read back of an Oceanic Clearance issued on VHF. A typical example of such a clearance is as follows:

"ACA865 is cleared to Toronto via Track Bravo, from 56N010W maintain Flight Level three five zero, Mach decimal eight zero".

The flight crew will confirm that they are in possession of the current NAT Track message by using the TMI number in the read-back of the Oceanic Clearance, as follows:

*"ACA865 is cleared to Toronto via Track Bravo **283,** from 56N010W maintain Flight Level three five zero, Mach decimal eight zero".*

If the TMI number is included in the read-back there is no requirement for the pilot to read back the NAT Track co-ordinates even if the cleared NAT Track is not the one which was originally requested. If any doubt exists as to the TMI (see fuller explanation of this term in Chapter 2) or the NAT Track co-ordinates, the pilot should request the complete track co-ordinates from the OAC. Similarly, if the pilot cannot correctly state the TMI, the OAC will read the cleared NAT Track co-ordinates in full and request a full read back of those co-ordinates.

For aircraft cleared by Shanwick OAC on random routeings in the NAT Region the present procedure of reading the full track co-ordinates as part of the Oceanic Clearance and requesting from the pilot a full read back of the co-ordinates is expected to continue. Gander and Reykjavik OACs may, however, issue clearances for random routeings which specify “via flight plan route”. Nevertheless, in all circumstances regarding random route clearances, pilots are required to read back the full track co-ordinates of the flight plan route, from the oceanic entry point to the exit point.

OCEANIC CLEARANCES FOR FLIGHTS INTENDING TO OPERATE WITHIN THE NAT REGION AND SUBSEQUENTLY ENTER THE EUR OR NAM REGIONS

Oceanic Clearances issued to most flights in this category are strategic clearances intended to provide a safe separation for each flight, from oceanic entry to oceanic track termination point. Should a pilot receive a clearance on a track other than originally flight planned, special caution should be exercised to ensure that the co-ordinates of the assigned track and of the associated landfall and domestic routeings are fully understood and correctly inserted into the automated navigation system. Appropriate cross checks should be carried out. In all cases when an en-route reclearance is requested, the pilot should ensure that the revised ATC clearance includes the new routeing from the oceanic exit point to the first landfall point or coastal fix. If at the time of being given a clearance or reclearance, the pilot has any doubt, details should be checked with the ATC unit issuing the clearance/reclearance.

OCEANIC CLEARANCES FOR RANDOM FLIGHTS INTENDING TO OPERATE WITHIN THE NAT REGION AND SUBSEQUENTLY ENTER REGIONS OTHER THAN NAM OR EUR

Oceanic Clearances issued to flights in this category are similar to domestic ATC clearances in that clearances are to destination on the assumption that co-ordination will be effected ahead of the aircraft's passage. In this case, the flight profile may be changed en-route, prior to hand-over from one centre to another, depending upon traffic conditions in the adjacent area.

OCEANIC FLIGHTS ORIGINATING FROM THE CAR OR SAM REGIONS AND ENTERING NAT MNPS AIRSPACE VIA THE NEW YORK OCA

Pilots are reminded that Oceanic Clearances from the New York OAC do not need to be requested until first contact with New York is established on HF frequencies. Note that Oceanic Clearances are not required for entry to or transit of that portion of the New York OCA outside MNPS Airspace.

ERRORS ASSOCIATED WITH OCEANIC CLEARANCES

Navigation errors associated with Oceanic Clearances fall into several categories of which the most significant are ATC System Loop errors and Waypoint Insertion errors.

ATC System Loop Errors

An ATC system loop error is any error caused by a misunderstanding between the pilot and the controller regarding the assigned flight level, Mach Number or route to be followed. Such errors can arise from incorrect interpretation of the NAT Track Message by dispatchers, errors in co-ordination between OACs, or misinterpretation of Oceanic Clearances or reclearances by pilots. Errors of this nature, which are detected by ATC from pilot position reports will normally be corrected. However, timely ATC intervention cannot always be guaranteed, especially as it may depend on HF communications.

Waypoint Insertion Errors

Experience has shown that many of the track keeping errors which occur result from:

- failure to observe the principles of checking waypoints to be inserted in the navigation systems, against the ATC cleared route;
- failure to load waypoint information carefully; or
- failure to cross-check on-board navigation systems.

More detailed guidance on this subject is contained in Chapters 9, 14 and 15 of this Document.

Many of the navigation error occurrences are the product of one or both of these causes. **It is therefore extremely important that pilots double check each element of the Oceanic Clearance on receipt, and at each waypoint, since failure to do so may result in inadvertent deviation from cleared route and/or flight level.**

Chapter 7: Communications and Position Reporting Procedures

HF COMMUNICATIONS

Most NAT air/ground communications are conducted on single side-band HF frequencies. Pilots communicate with OACs via aeradio stations staffed by communicators **who have no executive ATC authority**. Messages are relayed, from the ground station to the relevant OAC for action. Aeradio stations and OACs are not necessarily co-located. For example in the case of Shanwick operations, the OAC is located at Prestwick in Scotland whilst the associated aeradio station is at Ballygirreen in the Republic of Ireland. The allocation of the families of SSB frequencies (A, B, C, D, E and F) is by State of Registry of the aircraft and according to the route to be flown. *AIPs* list the families to be used and additionally, the aeradio stations may advise individual aircraft as to which frequencies are to be used, after initial contact by the pilot.

VHF COMMUNICATIONS

The carriage of HF communications equipment is mandatory for flight in the Shanwick OCA. Aircraft with only functioning VHF communications equipment should plan their route outside the Shanwick OCA and ensure that they remain within VHF coverage of appropriate ground stations throughout the flight. Theoretical VHF coverage charts are included in ICAO *NAT Doc 001, T13.5N*. Details of communication requirements are published in State *AIPs* and ICAO publications.

TIME AND PLACE OF POSITION REPORTS

Unless otherwise requested by Air Traffic Control, position reports from flights on routes which are not defined by designated reporting points should be made at the significant points listed in the flight plan.

Air Traffic Control may require any flight operating in a North/South direction to report its position at any intermediate parallel of latitude when deemed necessary.

In requiring aircraft to report their position at intermediate points, ATC is guided by the requirement to have positional information at approximately hourly intervals and also by the need to cater for varying types of aircraft and varying traffic and MET conditions.

Pilots must always report to ATC as soon as possible on reaching any new cruising level.

CONTENTS OF POSITION REPORTS

For flights outside the PTS and domestic ATS route network, position should be expressed in terms of latitude and longitude except when flying over named reporting points. For flights whose tracks are predominantly east or west, latitude should be expressed in degrees and minutes, longitude in degrees only. For flights whose tracks are predominantly north or south, latitude should be expressed in degrees only, longitude in degrees and minutes. All times should be expressed in four digits giving both the hour and the minutes UTC.

In respect of the above, where the need to report degrees and minutes is referred to, it should be noted that when such minutes are zero then the position report may refer solely to degrees (as per examples below).

Within the PTS, the position reporting procedure is as described in Chapter 3.

STANDARD MESSAGE TYPES

Standard air/ground message types and formats are used within the NAT Region and are published in State *AIPs* and *Atlantic Orientation charts*. To enable ground stations to process messages in the shortest possible time, pilots should observe the following rules:

(1) use the correct type of message applicable to the data transmitted;

(2) state the message type in the contact call to the ground station or at the start of the message;

(3) adhere strictly to the sequence of information for the type of message;

(4) **all times** in any of the messages should be expressed in hours and minutes **UTC**.

The message types are shown below with examples:

POSITION
Example: "*Position, Swissair 100, 56 North 10 West at 1235, Flight Level 330, Estimating 56 North 20 West at 1310, 56 North 30 West Next*"

REQUEST CLEARANCE
Example: "*Request Clearance, American 123, 56 North 20 West at 1308, Flight Level 330, Estimating 56 North 30 West at 1340, 56 North 40 West Next. Request Flight Level 350"*

or if a position report is not required
"*Request Clearance, Speedbird 212, Request Flight Level 370"*

REVISED ESTIMATE
Example: "*Revised Estimate, Speedbird 212, 57 North 40 West at 0305"*

MISCELLANEOUS
Plain language – free format

ADDRESSING OF POSITION REPORTS

Position reports made by aircraft operating within an OCA at a distance of 60 nm or less from the common boundary with an adjacent OCA, including aircraft operating on tracks through successive points on each boundary, should also be made to the ACC serving the adjacent OCA. (In practice this only requires an addition to the address. e.g. "Shanwick copy Santa Maria".)

"WHEN ABLE HIGHER" (WAH) REPORTS

Prior advice to ATC of the time or position that a flight will be able to accept the next higher level can assist ATC in ensuring optimal usage of available altitudes. These reports can also be used to help plan the altitudes for flights as they transition from RVSM to conventional altitudes. A WAH Report must be provided by all flights entering the MNPS Airspace portion of the New York OCA and entering the Santa Maria OCA. Provision of WAH Reports on entering other NAT OCAs is optional or they may be requested by any OAC.

When required or when otherwise provided, upon entering an oceanic FIR, pilots should include in the initial position report the time or location that the flight will be **able** to accept the next higher altitude. The report may include more than one altitude if that information is available.

Example: *"Global Air 543, 40 North 40 West at 1010, Flight Level 350, Estimating 40 North 50 West at 1110, 40 North 60 West Next. Able Flight Level 360 at 1035, Able Flight Level 370 at 1145, Able Flight Level 390 at 1300"*

Information thus provided of the aircraft's future altitude "ability" will **not** automatically be interpreted by ATC as an advance "request" for a step climb. It will be used as previously indicated to assist ATC in planning airspace utilisation. However, should the pilot wish to register a request for one or more future step climbs, this may be incorporated in the WAH report by appropriately substituting the word "Request" for the word "Able".

Example: *"Global Air 543, 42 North 40 West at 1215, Flight Level 330, Estimating 40 North 50 West at 1310, 38 North 60 West Next. Request Flight Level 340 at 1235, Able Flight Level 350 at 1325, Request Flight Level 360 at 1415"*

Although optimal use of the WAH reports is in conjunction with a Position Report, a WAH report can be made or updated separately at any time.

Example: *"Global Air 543, Able Flight Level 360 at 1035, Request Flight Level 370 at 1145, Able Flight Level 390 at 1300"*

Note: ATC acknowledgement of a WAH report (and any included requests) is NOT a clearance to change altitude.

METEOROLOGICAL REPORTS

From among the aircraft intending to operate on the organised track system, OACs designate those which will be required to report routine meteorological observations at, and midway between, each prescribed reporting point. The designation is made by the OAC when issuing the Oceanic Clearance using the phrase "SEND MET REPORTS", and is normally made so as to designate one aircraft per track at approximately hourly intervals, unless otherwise requested by the associated MET Office. Pilots flying tracks partly or wholly off the OTS should include routine Met observations with every prescribed report. The midpoint observation should be recorded then transmitted at the next designated reporting point.

SELCAL

When using HF communications, pilots should maintain a listening watch on the assigned frequency, unless SELCAL is fitted, in which case they should ensure the following sequence of actions:

(1) provision of the SELCAL code in the flight plan; (any subsequent change of aircraft for a flight will require passing the new SELCAL information to the OAC);

(2) checking the operation of the SELCAL equipment, at or prior to entry into Oceanic airspace, with the appropriate aeradio station. (This SELCAL check must be completed prior to commencing SELCAL watch); and

(3) maintenance thereafter of a SELCAL watch.

Twelve Tone SELCAL

Flight management staffs and crews of aircraft equipped with 12-tone SELCAL equipment should be made aware that SELCAL code assignment is predicated on the usual geographical area of operation of that aircraft. If the aircraft is later flown in geographical areas other than as originally specified by the aircraft operator, the aircraft may encounter a duplicate SELCAL code situation. Whenever an aircraft is to be flown routinely beyond the area of normal operations or is changed to a new geographic operating area, the aircraft operator should contact the SELCAL Registrar and request a SELCAL code appropriate for use in the new area.

When acquiring a previously owned aircraft equipped with SELCAL, many aircraft operators mistakenly assume that the SELCAL code automatically transfers to the purchaser or lessee. This is not true. As soon as practical, it is the responsibility of the purchaser or lessee to obtain a SELCAL code from the Registrar, or, if allocated a block of codes for a fleet of aircraft, to assign a new code from within the block of allocated codes. In the latter instance, if 12-tone equipment is involved, the Registrar should be consulted when there is any question as to the likely geographical area of operation and the possibility of code duplication.

The registrar can be contacted via the AFTN address KDCAXAAG, and by including “ATTN. OPS DEPT. (forward to SELCAL Registrar)” as the first line of message text.

GENERAL PURPOSE VHF COMMUNICATIONS (GP/VHF)

Aeradio stations are also responsible for the operation of GP/VHF outlets. These are especially valuable in the vicinity of Iceland, Faroes and Greenland since VHF is not as susceptible to sunspot activity as HF. Outlets are situated at Prins Christian Sund, which is remotely controlled from Gander Aeradio station, and at Qaqatoqaq, Kulusuk and the Faroes, via Iceland Radio. When using GP/VHF frequencies in areas of fringe coverage however, care should be taken to maintain a SELCAL watch on HF thus ensuring that if VHF contact is lost the aeradio station is still able to contact the aircraft. It is important for the pilot to appreciate that when using GP/VHF communications they are with an aeradio station and not by direct contact with ATC. However Direct Controller/Pilot Communications (DCPC) can be arranged if necessary on some GP/VHF frequencies.

DATA LINK COMMUNICATIONS

Data link communications are gradually being introduced into the NAT environment for position reporting. AIS publications of the NAT ATS Provider States should be consulted to determine the extent of their implementation and any associated procedures.

HF COMMUNICATIONS FAILURE

Each aeradio station continuously listens out on its appropriate family/families of NAT HF frequencies. In the event of failure of HF communications every effort should be made by the pilot to relay position reports through other aircraft. An air-to-air VHF frequency for the Region has been agreed; when out of range of VHF ground stations on the same or adjacent frequencies, 131.8 MHz may be used to relay position reports. If necessary initial contact for such relays can be established on 121.5 MHz - although great care must be exercised should this be necessary, as the frequency 121.5 MHz is monitored by all aircraft operating in the NAT Region, in case it is being used by aircraft experiencing emergencies. Therefore in order to minimise unnecessary use of 121.5 MHz, it is recommended that aircraft additionally monitor 131.8 MHz when flying through NAT airspace.

Solely when flying in the Shanwick OCA, pilots of aircraft which are Satellite Communications (SATCOM) equipped, who have experienced total HF failure and are unable to relay by any other means, may, **as a last resort**, make contact with the Shanwick HF aeradio station at Ballygirreen on the special SATCOM number shown in the *UK AIP* and *AIP Ireland* for that purpose.

The following procedures are intended to provide general guidance for aircraft operating in or proposing to operate in the NAT Region, which experience communications failure. These procedures are intended to complement and not supersede State procedures/regulations. It is impossible to provide guidance for all situations associated with a communications failure.

General

If so equipped, the pilot of an aircraft experiencing a two way communications failure should operate the SSR Transponder on identity Mode A Code 7600 and Mode C.

The pilot should attempt to contact any ATC facility or another aircraft and inform them of the difficulty and request they relay information to the ATC facility with whom communications are intended.

Communications Failure Prior to Entering NAT Region

Due to the potential length of time in oceanic airspace, it is strongly recommended that a pilot experiencing communications failure whilst still in domestic airspace does not enter the OCA but adopts the procedure specified in the appropriate domestic AIP and lands at a suitable airport. However, if the pilot elects to continue, then, to allow ATC to provide adequate separation, one of the following procedures should be followed:

(1) if operating with a received and acknowledged Oceanic Clearance, the pilot must enter oceanic airspace at the cleared oceanic entry point, level and speed and proceed in accordance with the received and acknowledged Oceanic Clearance. Any level or speed changes required to comply with the Oceanic Clearance must be completed within the vicinity of the oceanic entry point.

(2) if operating without a received and acknowledged Oceanic Clearance, the pilot must enter oceanic airspace at the first oceanic entry point, level and speed contained in the filed flight plan and proceed via the filed flight plan route to landfall. **The initial oceanic level and speed must be maintained until landfall.**

Communications Failure After Entering NAT Region

If cleared on the filed flight plan route, the pilot must proceed in accordance with the last received and acknowledged Oceanic Clearance, including level and speed, to the last specified oceanic route point (normally landfall) then continue on the filed flight plan route. After passing the last specified oceanic route point, the flight should conform with the relevant State procedures/regulations.

If cleared on other than the filed flight plan route, the pilot must proceed in accordance with the last received and acknowledged Oceanic Clearance, including level and speed, to the last specified oceanic route point (normally landfall). After passing this point, the pilot should conform with the relevant State procedures/regulations, rejoining the filed flight plan route by proceeding, via the published ATS route structure where possible, to the next significant point contained in the filed flight plan.

Note: the relevant State procedures/regulations to be followed by an aircraft in order to rejoin its filed Flight Plan route are specified in detail in the appropriate State AIP.

Aircraft with a destination within the NAT Region should proceed to their clearance limit and follow the ICAO standard procedure to commence descent from the appropriate designated navigation aid serving the destination aerodrome at, or as close as possible to, the expected approach time. Detailed procedures are promulgated in relevant State *AIPs*.

OPERATION OF TRANSPONDERS

Unless otherwise directed by ATC, pilots of aircraft equipped with SSR transponders flying in the NAT FIRs will operate transponders continuously in Mode A/C Code 2000, except that the last assigned code will be retained for a period of 30 min after entry into NAT airspace. Pilots should note that it is important to change from the last assigned domestic code to the Mode A/C Code 2000 since the original domestic code may not be recognised by the subsequent Domestic Radar Service on exit from the oceanic airspace.

Note: this procedure does not affect the use of the special purpose codes (7500, 7600 and 7700) in cases of: unlawful interference, radio failure, emergency.

It should, however, be noted that Reykjavik ACC provides a radar control service in the south-eastern part of its area and consequently transponder codes issued by Reykjavik ACC must be retained throughout the Reykjavik OCA until advised by ATC.

AIRBORNE COLLISION AVOIDANCE SYSTEMS (ACAS)

Pilots should report all ACAS Resolution Advisories which occur in the NAT Region to the controlling authority for the airspace involved. (See further on this in Chapter 12.)

Chapter 8: Application of Mach Number Technique

DESCRIPTION OF TERMS

The term 'Mach Number Technique' is used to describe a technique whereby subsonic turbojet aircraft operating successively along suitable routes are cleared by ATC to maintain appropriate Mach Numbers for a relevant portion of the en-route phase of their flight.

OBJECTIVE

The principal objective of the use of Mach Number Technique is to achieve improved utilisation of the airspace on long route segments where ATC has no means other than position reports of ensuring that the longitudinal separation between successive aircraft is not reduced below the established minimum. Practical experience has shown that when two or more turbojet aircraft, operating along the same route at the same flight level, maintain the same Mach Number, they are more likely to maintain a constant time interval between each other than when using other methods. This is due to the fact that the aircraft concerned are normally subject to approximately the same wind and air temperature conditions, and minor variations in speed which might increase and decrease the spacing between them tend to be neutralised over long periods of flight.

PROCEDURES IN NAT OCEANIC AIRSPACE

The ATC clearance includes the assigned Mach Number which is to be maintained. It is therefore necessary that information on the desired Mach Number be included in the flight plan for turbojet aircraft intending to fly in NAT oceanic airspace. ATC uses Mach Number together with pilot position reports to calculate estimated times for significant points along track. These times provide the basis for longitudinal separation between aircraft and for co-ordination with adjacent ATC units.

ATC will try to accommodate pilot/dispatcher requested or flight planned Mach Numbers when issuing Oceanic Clearances. It is rare that ATC will assign a Mach Number more than 0.01 faster or 0.02 slower than that requested. The prescribed longitudinal separation between successive aircraft flying a particular track at the same flight level is established over the oceanic entry point. Successive aircraft following the same track may be assigned different Mach Numbers but these will be such as to ensure that prescribed separations are assured throughout the oceanic crossing. Intervention by ATC thereafter should normally only be necessary if an aircraft is required to change its Mach Number due to conflicting traffic or to change its flight level. It is, however, important to recognise that the establishment and subsequent monitoring of longitudinal separation is totally reliant upon aircraft providing accurate waypoint passing times in position reports. It is therefore essential that pilots conducting flights in MNPS Airspace utilise accurate clocks and synchronise these with a standard time signal, based on UTC, prior to entering MNPS Airspace. It should be noted that some aircraft clocks can only be re-set while the aircraft is on the ground. (See further comments on time-keeping/longitudinal navigation in Chapters 1 & 9.)

In the application of Mach Number Technique, pilots must adhere strictly to their assigned Mach Numbers unless a specific reclearance is obtained from the appropriate ATC unit. However, as the aircraft weight reduces it may be more fuel efficient to adjust the Mach Number. Since the in-trail and crossing track separations between individual aircraft are established on the basis of ETAs passed to or calculated by ATC, it is essential that ATC approval is requested prior to effecting any change in cruise Mach Number. Such approval will be given if traffic conditions permit. If an immediate temporary change in the Mach Number is essential, e.g. due to turbulence, ATC must be notified as soon as possible.

Pilots should maintain their last assigned Mach Number during step-climbs in oceanic airspace. If due to aircraft performance this is not feasible ATC should be advised at the time of the request.

PROCEDURE AFTER LEAVING OCEANIC AIRSPACE

After leaving oceanic airspace pilots must maintain their assigned Mach Number in domestic controlled airspace unless and until the appropriate ATC unit authorises a change.

Chapter 9: MNPS Flight Operation & Navigation Procedures

INTRODUCTION

The aircraft navigation systems necessary for flying in NAT MNPS Airspace are capable of high-performance standards. However it is essential that stringent cross-checking procedures are employed, both to ensure that these systems perform to their full capabilities and to minimise the consequences of equipment failures and possible human errors.

Navigation systems are continuously evolving and early editions of this Manual concentrated on offering specific guidance on the use of individual systems. Rather than specifying the types of equipment required for flying in defined airspace, current thinking is moving towards specifying a Required Navigation Performance (RNP), in other words a track keeping capability. As an example, the navigation performance accuracy of the aircraft population operating in airspace designated RNP X airspace would be expected to be X nm on a 95% containment basis. The NAT MNPS *inter alia* defines a requirement for the standard deviation of lateral track errors to be less than 6.3 nm. This effectively equates to an RNP value of 12.6 nm - or two standard deviations. (For more detailed information on RNP and MNPS see the following ICAO Documents: *Doc 9613 – 'Manual on Required Navigation Performance'* and *NAT Doc 001 – 'Consolidated Guidance Material North Atlantic Region'*.)

Obviously, there are several combinations of airborne sensors, receivers, computers with navigation data bases and displays which are capable of producing like accuracies, with inputs to automatic flight control systems giving track guidance. However, regardless of how sophisticated or mature a system is, it is still essential that stringent navigation and cross checking procedures are maintained if Gross Navigation Errors (GNEs) are to be avoided.

Note: a GNE within NAT Airspace is defined as a deviation from cleared track of 25 nm or more. These errors are normally detected by means of long range radars as aircraft leave oceanic airspace. Such errors may also be identified through the scrutiny of routine position reports from aircraft.

The procedures listed in this Chapter are not intended to be equipment specific and may not all be pertinent to every aircraft. For specific equipment, reference should be made to Manufacturers' and operators' handbooks and manuals.

There are various references in this material to two pilots; however when carried, a third crew member should be involved in all cross check procedures to the extent practicable. Maintenance of a high standard of navigation performance is absolutely essential to the maintenance of safety in the NAT MNPS Airspace.

GENERAL PROCEDURES

Importance of Accurate Time

It must be recognised that proper operation of a correctly functioning LRNS will ensure that the aircraft follows its cleared track. ATC applies standard separations between cleared tracks and thereby assures the safe **lateral** separation of aircraft. However, longitudinal separations between subsequent aircraft following the same track and between aircraft on intersecting tracks are assessed in terms of differences in ETAs/ATAs at common waypoints. Aircraft clock errors resulting in position report time errors can therefore lead to an erosion of actual longitudinal separations between aircraft. It is thus vitally important that prior to entry into the NAT MNPS Airspace the time reference system to be used during the flight is accurately synchronised to UTC and that the calculation of waypoint ETAs and the reporting of waypoint ATAs are referenced to this system. Many modern aircraft master clocks can only be reset while the aircraft is on the ground. Thus the Pre-flight Procedures for any NAT MNPS flight **must include** a UTC time check and resynchronisation of the aircraft master clock. Lists of acceptable time sources for this purpose have been promulgated by NAT ATS Provider States.

The following are examples of acceptable time standards:

(1) GPS (Corrected to UTC) - Available at all times to those crews who can access time via approved on-board GPS (TSO-C129) equipment.

(2) WWV - National Institute of Standards (NIST - Fort Collins, Colorado). WWV operates continually H24 on 2500, 5000, 10,000, 15,000 and 20,000 kHz (AM/SSB) and provides UTC (voice) once every minute.

(3) CHU - National Research Council (NRC - Ottawa, Canada) - CHU operates continually H24 on 3330, 7335 and 14,670 kHz (SSB) and provides UTC (voice) once every minute (English even minutes, French odd minutes).

(4) BBC - British Broadcasting Corporation (United Kingdom). The BBC transmits on a number of domestic and world-wide frequencies and transmits the Greenwich time signal (referenced to UTC) once every hour on most frequencies, although there are some exceptions.

Further details of these and other acceptable time references can be found in AIS documentation of the NAT ATS Provider States. In general, any other source of UTC, that can be shown to the State of the Operator or the State of Registry of the aircraft to be equivalent, may be allowed for this purpose.

The Use of a Master Document

Navigation procedures must include the establishment of some form of master working document to be used on the flight deck. This document may be based upon the flight plan, navigation log, or other suitable document which lists sequentially the waypoints defining the route, the track and distance between each waypoint, and other information relevant to navigation along the cleared track. When mentioned subsequently in this guidance material, this document will be referred to as the 'Master Document'.

Misuse of the Master Document can result in GNEs occurring and for this reason strict procedures regarding its use should be established.

These procedures should include the following:

- only one Master Document to be used on the flight deck. However, this does not preclude other crew members maintaining a separate flight log.

- on INS equipped aircraft a waypoint numbering sequence should be established from the outset of the flight and entered on the Master Document. The identical numbering sequence should be used for storing waypoints in the navigation computers.

- for aircraft equipped with FMS data bases, FMS generated or inserted waypoints should be carefully compared to Master Document waypoints and cross checked by both pilots.

- an appropriate symbology should be adopted to indicate the status of each waypoint listed on the Master Document.

The following is a typical example of Master Document annotation. An individual operator's procedures may differ slightly but the same principles should be applied:

- the waypoint number is entered against the relevant waypoint co-ordinates to indicate that the waypoint has been inserted into the navigation computers.
- the waypoint number is circled, to signify that insertion of the correct co-ordinates in the navigation computers has been double-checked independently by another crew member.
- the circled waypoint number is ticked, to signify that the relevant track and distance information has been double-checked.
- the circled waypoint number is crossed out, to signify that the aircraft has overflown the waypoint concerned.

All navigational information appearing on the Master Document must be checked against the best available prime source data. When a reroute is necessary, it is recommended that a new Master Document is prepared for the changed portion of the flight. If the original Master Document is to be used the old waypoints should be clearly crossed out and the new ones entered in their place.

When ATC clearances or reclearances are being obtained, headsets should be worn, because the inferior clarity of loud-speakers has, in the past, caused errors during receipt. Two qualified crew members should monitor such clearances, one of them recording the clearance on the Master Document as it is received, the other cross-checking the receipt and read-back. All waypoint co-ordinates should be read back in detail, adhering strictly to standard ICAO phraseology, except where approved local procedures make this unnecessary. Detailed procedures pertaining to abbreviated clearances/read-backs are contained in the appropriate *AIPs*, and in Chapter 6, 'Oceanic ATC Clearances'.

Position Plotting

It is very helpful to use a simple plotting chart to provide a visual presentation of the intended route which, otherwise, is defined only in terms of navigational co-ordinates. Plotting the intended route on such a chart may reveal errors and discrepancies in the navigational co-ordinates which can then be corrected immediately, before they reveal themselves in terms of a deviation from the ATC cleared route. As the flight progresses, plotting the aircraft's position on this chart will also serve the purpose of a navigation cross check, provided that the scale and graticule are suitable.

As the flight progresses in oceanic airspace, plotting the aircraft's position on this chart will help to confirm (when it falls precisely on track) that the flight is proceeding in accordance with its clearance. However, if the plotted position is laterally offset, the flight may be deviating unintentionally, and this possibility should be investigated at once.

It is recommended that a chart with an appropriate scale be used for plotting. Many company Progress Charts are of the wrong scale or too small. The *AERAD Charts NAT 1 and NAT 2,* plus *AT(H)2 and AT(H)3* are all useful compromises between scale and overall chart size, while the *NOAA/FAA North Atlantic Route Chart* has the advantage, for plotting purposes, of a 1° latitude/longitude graticule.

Provision of Step-Climbs

Tactical radar control and tactical procedural control are exercised in some areas of the NAT MNPS Airspace. However, oceanic ATC clearances for most NAT flights are of a strategic nature, whereby flights are allocated a conflict-free route and profile, from coast-out to coast-in. Almost all such strategic clearances specify a single entry flight level and assume that this level will be maintained throughout the NAT portion of flight. Prior to the introduction of RVSM in the NAT MNPS Airspace there were few opportunities for subsequent step climb reclearances. With the increased number of available flight levels in RVSM airspace there is now greater scope for en-route tactical reclearances which afford the possibility of step-climbs. Controllers will accommodate requests for step-climbs whenever possible. **It is important that pilots always report to ATC immediately on reaching any new cruising level.**

Relief Crew Members

Very long range operations may include the use of relief crew. In such cases it is necessary to ensure that navigational procedures are such that the continuity of the operation is not interrupted, particularly in respect of the handling and treatment of the navigational information.

PRE-FLIGHT PROCEDURES

Initial Insertion of Latitude and Longitude (Inertial Systems)

For inertial systems any latitude error in the initial position can introduce a systematic error which cannot be removed in flight, even by updating the present position. Correct insertion of the initial position must therefore be checked before inertial systems are aligned and the position should be recorded in the flight log and/or Master Document. Subsequent 'silent' checks of the present position should be carried out independently by both pilots during an early stage of the pre-flight checks.

With regard to the insertion of the initial co-ordinates whilst on the ramp, the following points should be taken into account:

- in some inertial systems, insertion errors exceeding about one degree of latitude will illuminate a malfunction light. It should be noted that very few systems provide protection against longitude insertion errors.

- at all times, but particularly in the vicinity of the Zero Degree E/W (Greenwich) Meridian or near to the Equator, care should be taken to ensure that the co-ordinates inserted are correct. (i.e. E/W or N/S).

Inertial Systems Alignment

The alignment of inertial systems must be completed and the equipment put into navigation mode prior to releasing the parking brake at the ramp. Some systems will align in about 10 minutes, others can take 15 minutes or more; expect alignment to take longer in extreme cold or at higher latitudes. A rapid realignment feature is sometimes provided but should only be used if, during an intermediate stop, it becomes necessary to increase the system accuracy. The aircraft must be stationary during rapid realignment which typically will take about one minute.

To ensure that there is adequate time for the initial alignment, the first crew member on the flight deck should normally put the inertial system(s) into the align mode as soon as practicable.

GPS Pre-departure Procedures

When both required LRNSs are GPSs their operation must be approved in accordance with FAA HBAT 95-09 or equivalent national or JAA documentation and special pre-departure procedures are required. In these cases, operators conducting GPS primary means navigation in MNPS Airspace must utilise a Fault Detection and Exclusion (FDE) Availability Prediction Programme for the installed GPS equipment; one that is capable of predicting, prior to departure for flight on a specified route*, the following:

- the maximum outage duration of the loss of fault exclusion;
- the loss of fault detection; and
- the loss of navigation function.

**Note: "specified route" is defined by a series of waypoints (to perhaps include the route to any required alternate), with the time between waypoints based on planned speeds. Since flight planned ground speeds and/or departure times may not be met, the pre-departure prediction must be performed for a range of expected ground speeds.*

This FDE programme must use the same FDE algorithm that is employed by the installed GPS equipment. In order to perform the prediction accurately, the FDE prediction programme must provide the capability to manually designate satellites that are scheduled to be unavailable. Information on GPS satellite outages is promulgated via the U.S. NOTAM Office. Details on how to obtain this information are published in the *French AIC* reproduced at Attachment 4.

When GPS is being used as a supplementary navigation means or when GPS is only one of the two LRNSs required for MNPS approval (e.g. when the second LRNS is an IRS/INS installation) then some States of Registry may not require the operator to conduct pre-flight FDE checks.

<u>Operational Control Restrictions</u>

Any predicted satellite outages that affect the capability of GPS navigation may require that the flight be cancelled, delayed or re-routed.

<u>Effects of Satellite Availability</u>

Given suitable geometry:

- four appropriately configured satellites are required to determine position;
- five appropriately configured satellites are required to detect the presence of a single faulty satellite; and
- six appropriately configured satellites are required to identify the faulty satellite and exclude it from the navigation solution.

Note: the above number of satellites may be reduced if barometric aiding is used.

<u>The Capability to Determine Position</u>

Prior to departure, the operator must use the FDE prediction programme to demonstrate that there are no outages in the capability to determine position on the specified route of flight. If such outages are detected by the program, the flight must be cancelled, delayed or re-routed.

<u>Determination of the Availability of Fault Exclusion</u>

Once the position determination function is assured, the operator must use the FDE prediction programme to demonstrate that the maximum outage of the fault exclusion function, (i.e. 6 satellites available), for the specified route of flight, does not exceed 51 minutes in MNPS Airspace; otherwise the flight must be cancelled, delayed or re-routed.

Loading of Initial Waypoints

The manual entry of waypoint data into the navigation systems must be a co-ordinated operation by two persons, working in sequence and independently: one should key in and insert the data, and subsequently the other should recall it and confirm it against source information. It is not sufficient for one crew member just to observe another crew member inserting the data.

The ramp position of the aircraft, plus at least two additional waypoints, or, if the onboard equipment allows, all the waypoints relevant to the flight, should be loaded while the aircraft is at the ramp. However, it is more important initially to ensure that the first enroute waypoint is inserted accurately.

During flight, at least two current waypoints beyond the leg being navigated should be maintained in the Control Display Units (CDUs) until the destination ramp co-ordinates are loaded. Two pilots should be responsible for loading, recalling and checking the accuracy of the inserted waypoints; one loading and the other recalling and checking them independently. Where remote loading of the units is possible, this permits one pilot to cross-check that the data inserted automatically is accurate. This process should not be permitted to engage the attention of both pilots simultaneously during the flight.

An alternative and acceptable procedure is for the two pilots silently and independently to load their own initial waypoints and then cross-check them. The pilot responsible for carrying out the verification should work from the CDU display to the Master Document rather than in the opposite direction. This may lessen the risk of the pilot 'seeing what is expected to be seen’ rather than what is actually displayed.

Flight Plan Check

The purpose of this check is to ensure complete compatibility between the data in the Master Document and the calculated output from the navigation systems. Typical actions could include:

- checking the distance from the ramp position to the first waypoint. Some systems will account for the track distance involved in an ATC SID; in others, an appropriate allowance for a SID may have to be made to the great circle distance indicated in order to match that in the Master Document. If there is significant disagreement, rechecking initial position and waypoint co-ordinates may be necessary.

- selecting track waypoint 1 to waypoint 2 and doing the following:

  - checking accuracy of the indicated distance against that in the Master Document;

  - checking, if possible, that the track displayed is as listed in the Master Document. (This check will show up any errors made in lat/long designators (i.e. N/S or E/W).)

- similar checks should be carried out for subsequent pairs of waypoints and any discrepancies between the Master Document and displayed data checked for possible waypoint insertion errors. These checks can be co-ordinated between the two pilots checking against the information in the Master Document.

- when each leg of the flight has been checked in this manner it should be annotated on the Master Document by means of a suitable symbology as previously suggested.

- some systems have integral navigation databases and it is essential that the recency of the database being used is known. It must be recognised that even the co-ordinates of waypoint positions contained in a data base have been keyed in at some point by another human. The possibility of input errors is always present. **Do not assume the infallibility of navigation databases and always maintain the same thorough principles which are applied in the checking of your own manual inputs.**

Leaving the Ramp

The aircraft must not be moved prior to the navigation mode being initiated, otherwise inertial navigation systems must be realigned.

After leaving the ramp, inertial groundspeeds should be checked (a significantly erroneous reading may indicate a faulty or less reliable unit). A check should be made on any malfunction codes whilst the aircraft is stopped but after it has taxied at least part of the way to the take-off position; any significant ground-speed indications whilst stationary may indicate a faulty unit such as a tilted platform.

IN FLIGHT PROCEDURES

Initial flight

During the initial part of the flight, ground navaids should be used to verify the performance of the LRNSs.

ATC Oceanic Clearance

Where practicable, two flight crew members should listen to and record every ATC clearance and both agree that the recording is correct. Any doubt should be resolved by requesting clarification from ATC.

If the ATC oceanic cleared route is identical to the flight planned track, it should be drawn on the plotting chart and verified by the other pilot.

If the aircraft is cleared by ATC on a different track from that flight planned, it is strongly recommended that a new Master Document be prepared showing the details of the cleared track. Overwriting of the existing flight plan can cause difficulties in reading the waypoint numbers and the new co-ordinates. For this purpose, a pro-forma should be carried with the flight documents. One flight crew member should transcribe track and distance data from the appropriate reference source onto the new flight plan pro-forma and this should be checked by another crew member. If necessary, a new plotting chart may be used on which to draw the new track. The new document(s) should be used for the oceanic crossing. If the subsequent domestic portion of the flight corresponds to that contained in the original flight plan, it should be possible to revert to the original Master Document at the appropriate point.

Experience suggests that when ATC issues a reclearance involving re-routing and new waypoints, there is a consequential increase in the risk of errors being made. Therefore, this situation should be treated virtually as the start of a new flight; and the procedures employed with respect to the following, should all be identical to those procedures employed at the beginning of a flight:

- copying the ATC reclearance;
- amending the Master Document;
- loading and checking waypoints;

- extracting and verifying flight plan information, tracks and distances, etc.; and

- the preparation of a new chart;

Strict adherence to the above procedures should minimise the risk of error. However, flight deck management should be such that one pilot is designated to be responsible for flying the aircraft whilst the other pilot carries out any required amendments to documentation and reprogramming of the navigation systems - appropriately supervised by the pilot flying the aircraft, as and when necessary.

Approaching the Ocean

Prior to entering MNPS Airspace, the accuracy of the LRNSs should be thoroughly checked, if necessary by using independent navigation aids. For example, INS position can be checked by reference to en-route or proximate VOR/DMEs, etc.

When appropriate, the navigation system which, in the opinion of the pilot, has performed most accurately since departure should be selected for automatic navigation steering.

In view of the importance of following the correct track in oceanic airspace, it is advisable at this stage of flight that, if carried, a third pilot or equivalent crew member should check the clearance waypoints which have been inserted into the navigation system, using source information such as the track message or data link clearance if applicable.

Entering the MNPS Airspace and Reaching an Oceanic Waypoint

When passing waypoints, the following checks should be carried out:

- just prior to the waypoint, check the present position co-ordinates of each navigation system against the cleared route in the Master Document, and

- check the next two waypoints in each navigation system against the Master Document.

- at the waypoint, check the distance to the next waypoint, confirm that the aircraft turns in the correct direction and takes up a new heading and track appropriate to the leg to the next waypoint.

- before transmitting the position report to ATC, verify the waypoint co-ordinates against the Master Document and those in the steering navigation system. When feasible the position report “next” and “next plus 1” waypoint co-ordinates should be read from the CDU of the navigation system coupled to the autopilot.

Even if Automatic Waypoint Reporting (AWPR) via data link is being used to provide position reports to ATC the above checks should still be performed.

The crew should be prepared for possible ATC follow-up to the position report.

Routine Monitoring

It is important to remember that there are a number of ways in which the autopilot may unobtrusively become disconnected from the steering mode. Therefore, regular checks of correct engagement with the navigation system should be made.

It is recommended that where possible the navigation system coupled to the autopilot should display the present position co-ordinates throughout the flight. If these are then plotted as suggested above, they will provide confirmation that the aircraft is tracking in accordance with its ATC clearance. Distance to go information should be available on the instrument panel, whilst a waypoint alert light, where fitted, provides a reminder of the aircraft's imminent arrival over the next waypoint.

A position check should be made at each waypoint and the present position plotted 10 minutes after passing each waypoint. For a generally east-west flight, it may be simpler to plot present position a further 2 degrees of longitude after each 10 Degree waypoint. There may be circumstances, (e.g. when, due to equipment failure, only one LRNS remains serviceable) that additional plots midway between each waypoint may be justified.

The navigation system not being used to steer the aircraft should display cross-track distance and track angle error. Both of these should be monitored, with cross-track distance being displayed on the HSI where feasible.

Approaching Landfall

When the aircraft is within range of land based navaids, and the crew is confident that these navaids are providing reliable navigation information, consideration should be given to updating the LRNSs. Automatic updating of the LRNSs from other navaids should be closely monitored, and before entry into airspace where different navigation requirements have been specified (e.g. RNP5 in European BRNAV airspace), crews should use all aids (including VORs and DMEs) to confirm that the in-use navigation system is operating to the required accuracy. If there is any doubt regarding system accuracy, the appropriate ATC unit should be informed.

SPECIAL IN FLIGHT PROCEDURES

Monitoring during Distractions from Routine

Training and drills should ensure that minor emergencies or interruptions to normal routine are not allowed to distract the crew to the extent that the navigation system is mishandled.

If during flight the autopilot is disconnected (e.g. because of turbulence), care must be taken when the navigation steering is re-engaged to ensure that the correct procedure is followed. If the system in use sets specific limits on automatic capture, the across-track indications should be monitored to ensure proper recapture of the programmed flight path/profile.

Where crews have set low angles of bank, perhaps 10° or less, say for passenger comfort considerations, it is essential to be particularly alert to possible imperceptible departures from cleared track.

Avoiding Confusion between Magnetic and True Track Reference

To cover all navigation requirements, some airlines produce flight plans giving both magnetic and true tracks. However, especially if crews are changing to a new system, there is a risk that at some stage (e.g. during partial system failure, reclearances, etc.), confusion may arise in selecting the correct values. Operators should therefore devise procedures which will reduce this risk, as well as ensuring that the subject is covered during training.

Crews who decide to check or update their LRNSs by reference to VORs should remember that in the Canadian Northern Domestic Airspace these may be oriented with reference to **true north**, rather than magnetic north.

Navigation in the Area of Compass Unreliability

In areas of compass unreliability basic inertial navigation requires no special procedures but most operators feel it is desirable to retain an independent heading reference in case of system failure.

Different manufacturers may offer their own solutions to the special problems existing in areas of compass unreliability. Such solutions should not however involve the use of charts and manual measurement of direction.

Deliberate Deviation from Track

Deliberate temporary deviations from track are sometimes necessary, usually to avoid severe weather; whenever possible, prior ATC approval should be obtained. Such deviations have often been the source of gross errors as a consequence of failing to re-engage the autopilot with the navigation system. It should also be noted that selection of the 'turbulence' mode of the autopilot on some aircraft may have the effect of disengaging it from the aircraft navigation system. After use of the turbulence mode, extra care should be taken to ensure that the desired track is recaptured by the steering navigation system.

POST-FLIGHT PROCEDURES

Inertial Navigation System Accuracy Check

At the end of each flight, an evaluation of accuracy of the aircraft's navigation systems should be carried out. Equipment operating manuals specify maxima for radial errors before a system is considered to be unserviceable. For inertial systems these are in the order of 3 or 4 nm per hour. One method used to determine radial error is to input the shutdown ramp position; in other systems error messages are output giving differences between raw inertial reference positions and computed radio navigation updated positions. Whatever method is used, a record should be kept of the performance of each INS.

HORIZONTAL NAVIGATION PERFORMANCE MONITORING

The navigation performance of operators within NAT MNPS Airspace is monitored on a continual basis. The navigation accuracy achieved by NAT MNPS aircraft is periodically measured and additionally all identified instances of significant deviation from cleared track are subject to thorough investigation by the NAT Central Monitoring Agency (CMA), currently operated on behalf of the NAT SPG by the UK National Air Traffic Services Limited.

When a GNE is identified, follow-up action after flight is taken, both with the operator and the State of Registry of the aircraft involved, to establish the reason/cause and to confirm the approval of the flight to operate in NAT MNPS Airspace. The format of the (navigation) Error Investigation Form used for follow-up action is as shown at Attachment 1. Operational errors can have a significant effect on the assessment of risk in the system. For their safety and the safety of other users, crews are reminded of the importance of co-operating with the reporting OAC in the provision of incident information.

The overall navigation performance of all aircraft in the MNPS Airspace is continually assessed and compared to the standards established for the Region, to ensure that the TLS is being maintained.

Chapter 10: Procedures for Flight at RVSM Levels in MNPS Airspace

GENERAL

The aircraft altimetry systems necessary for flying at RVSM levels are capable of high-performance standards. However it is essential that stringent operating procedures are employed, both to ensure that these systems perform to their full capabilities and to minimise the consequences of equipment failures and possible human errors.

Pre-Flight

For flight through the NAT MNPS Airspace at RVSM levels the aircraft and the operator must have the requisite State Approvals for both MNPS and RVSM operations. The crew must be qualified for flight in RVSM airspace and the aircraft must be fitted with a fully serviceable MASPS compliant altimetry system. The Minimum Equipment List (MEL) for RVSM operations must be strictly observed*. Equipment requirements for RVSM Approval are described in Chapter 1 of this Document.

Note:* *if following a failure of an air data computer (ADC), both the Captain's and Co-pilot's altimeter instruments are connected to a remaining single functional ADC, this arrangement does* ***not* *meet the RVSM MASPS requirement for* ***two independent primary altimetry systems.*** *Any previously granted RVSM Approval is therefore invalidated until corrective action has been taken.*

A 'W' must be entered into Item 10 of the ICAO flight plan to indicate that the aircraft is approved for flight at RVSM levels; the letter 'X' must still be included to show that the aircraft satisfies MNPS lateral navigation performance requirements.

Pre-flight checks of the altimeters must be conducted and it is essential that all altitude indications are within the tolerances specified in the aircraft operating manual.

Special arrangements exist for non-RVSM approved aircraft/operators to climb or descend through RVSM airspace; and in very specific circumstances arrangements may be made for non-approved aircraft to fly at RVSM levels. Both such arrangements are explained in Chapter 1.

In-Flight - Before Operating at RVSM Levels

Confirmation is necessary that aircraft serviceability still allows flight to be made in RVSM airspace. An altimeter cross check should be carried out shortly before entering RVSM airspace; **at least two primary altimeters must agree within plus or minus 200 ft.** The readings of the primary and standby altimeters should be recorded to be available for use in possible contingency situations.

In-Flight - Entering, Flying at and leaving RVSM Levels

One automatic altitude-control system should be operative and engaged throughout the cruise. This system should only be disengaged when it is necessary to retrim the aircraft, or when the aircraft encounters turbulence and operating procedures dictate.

When passing waypoints, or at intervals not exceeding 60 minutes (whichever occurs earlier), a cross-check of primary altimeters should be conducted. **If at any time the readings of the two primary altimeters differ by more than 200 ft, the aircraft's altimetry system should be considered defective and ATC must be informed as soon as possible.**

When changing flight levels within RVSM airspace **all vertical speeds should be within 500 to 1000 ft per minute.** This can reduce the likelihood of TCAS TAs and RAs occurring and should also help to ensure that the aircraft neither undershoots or overshoots the cleared flight level by more than 150 feet.

Abnormal operational circumstances (e.g. engine failures, pressurisation problems, freezing fuel, turbulence, etc.), sometimes require a pilot to change level prior to obtaining a re-clearance from ATC. Such a re-clearance is more difficult to obtain in oceanic or remote areas where DCPC are not necessarily available. In NAT MNPS Airspace, the vast majority of ATS communications are conducted indirectly through a third party radio operator, utilising HF or GP/VHF facilities.

Even under normal operations when using these indirect communication methods, there is the potential for misunderstanding between pilot and controller regarding the detail of any issued clearances or re-clearances. Occasionally, such ATC Loop Errors can lead to an aircraft being flown at a level other than that expected by the controller. In such circumstances separation safety margins may be eroded. To avoid possible risks from any of the foregoing situations, it is therefore essential in NAT MNPS Airspace, and particularly when flying in the prime RVSM level band, that **pilots always report to ATC immediately on reaching any new cruising level.**

EQUIPMENT FAILURES

The following equipment failures must be reported to ATC as soon as practicable following their identification:

- loss of one or more primary altimetry systems; or
- failure of all automatic altitude-control systems

The aircraft should then follow the appropriate procedure described in Chapter 12, "Special Procedures for In-Flight Contingencies", or as instructed by the controlling ATC unit.

VERTICAL NAVIGATION PERFORMANCE MONITORING

The vertical navigation performance of operators within NAT MNPS Airspace is monitored on a continual basis by the NAT CMA. Such monitoring includes both measurement of the technical height-keeping accuracy of RVSM approved aircraft and assessment of collision risk associated with all reported operational deviations from cleared levels.

All identified operational situations or errors which lead to aircraft deviating from ATC cleared levels are subject to thorough investigation. Follow-up action after flight is taken, both with the operator and the State of Registry of the aircraft involved, to establish the reason for the deviation or cause of the error and to confirm the approval of the flight to operate in NAT MNPS and/or RVSM Airspace. Operational errors, particularly those in the vertical plane, can have a significant effect on risk in the system. For their safety and the safety of other users, crews are reminded of the importance of co-operating with the reporting OAC in the compilation of appropriate documentation including the completion of an 'Altitude Deviation Report Form', as illustrated at Attachment 2.

The detailed circumstances of all operational errors, both in the vertical and horizontal planes, are thoroughly reviewed by the CMA, together with a Scrutiny Group of the NAT SPG, which includes current NAT pilots and controllers. Any lessons learned from this review, which may help to limit the possibility of recurrences of such errors, are communicated back to NAT operators and ATS authorities. The intent is to improve standard operating procedures, thereby reducing the future frequency of operational errors and thus contribute to the safety of the overall system.

At RVSM levels, moderate and severe turbulence may also increase the level of system risk and crews should report **all** occasions, whilst flying in MNPS Airspace, when a 300 ft or more deviation occurs. The form at Attachment 2 may also be used for this purpose.

The technical height-keeping accuracies of NAT aircraft are passively monitored during flight over one or other of two Height Monitoring Units (HMUs) located near to Gander in Newfoundland and Strumble in Wales. Alternatively, individual aircraft can be monitored through temporary carriage of portable GPS (Height) Monitoring Units (GMUs). This monitoring allows the height-keeping accuracies of aircraft types and individual operator's fleets to be assessed. Any airframe which does not meet required standards can also be identified. In any such (very rare) cases the operator and the State of Registry are advised of the problem and corrective action must be undertaken before further flights in RVSM airspace are conducted.

The overall vertical navigation performance of all aircraft in NAT RVSM airspace is continually assessed and compared to the standards established for the Region, to ensure that the relevant TLS is being maintained.

Intentionally Blank

Chapter 11: Procedures in the Event of Navigation System Degradation or Failure

GENERAL

The navigation systems fitted to MNPS approved aircraft are generally very accurate and very reliable and GNEs in NAT MNPS Airspace are rare. Nevertheless, the risks that such errors pose can be significant and crews must employ rigorous procedures to ensure early detection of any possible errors and hence mitigation of the ensuing risk. The NAT CMA thoroughly investigates the circumstances of all reported GNEs in the MNPS Airspace. The majority are the result of human error, and diligent application by crews of operating procedures such as those described in Chapter 9 should help to minimise the frequency of such errors. Actual failures of navigation systems or equipment in MNPS approved aircraft occur very rarely. However, their potential effects on the aircraft's navigation capability can be subtle or progressive, resulting in a gradual and perhaps not immediately discernible degradation of performance. 'Vigilance' must be the watchword when navigating in NAT MNPS Airspace. Complacency has no place here.

For unrestricted operation in MNPS Airspace an approved aircraft must be equipped with a minimum of **two fully serviceable** LRNSs. MNPS approved aircraft that have suffered any equipment failures that result in only a single LRNS remaining serviceable may still be flight planned and flown through the MNPS Airspace but **only** on specified routes established for this purpose.

Crew training and consequent approval for MNPS operations should include instruction on what actions are to be considered in the event of navigation system failures. This Chapter provides guidance on the detection of failures and what crew action should be considered, together with details of the routes that may be used when the aircraft's navigation capability is degraded below that required for unrestricted operations in NAT MNPS Airspace.

Detection of Failures

Normally, navigation installations include comparator and/or warning devices, but it is still necessary for the crew to make frequent comparison checks. When an aircraft is fitted with three independent systems, the identification of a defective system should be straightforward.

Methods of Determining which System is Faulty

With only two systems on board, identifying the defective unit can be difficult. If such a situation does arise in oceanic airspace any or all of the following actions should be considered:

- checking malfunction codes for indication of unserviceability.
- obtaining a fix. It may be possible to use the following:
  - the weather radar (range marks and relative bearing lines) to determine the position relative to an identifiable landmark such as an island; or
  - the ADF to obtain bearings from a suitable NDB, in which case magnetic variation at the position of the aircraft should be used to convert the RMI bearings to true; or
  - if within range, a VOR, in which case the magnetic variation at the VOR location should be used to convert the radial to a true bearing (except when flying in the Canadian Northern Domestic Airspace where VOR bearings may be oriented with reference to true as opposed to magnetic north).

- contacting a nearby aircraft on VHF, and comparing information on spot wind, or ground speed and drift.

- if such assistance is not available, and as a last resort, the flight plan wind speed and direction for the current DR position of the aircraft, can be compared with that from navigation system outputs.

Action if the Faulty System Cannot be Identified

Occasions may still arise when distance or across track differences develop between systems, but the crew cannot determine which system is at fault. The majority of operators feel that the procedure most likely to limit gross tracking errors under such circumstances is to fly the aircraft half way between the across track differences as long as the uncertainty exists. In such instances, ATC should be advised that the flight is experiencing navigation difficulties so that appropriate separation can be effected if necessary.

Guidance on What Constitutes a Failed System

Operations or navigation manuals should include guidelines on how to decide when a navigation system should be considered to have failed, e.g. failures may be indicated by a red warning light, or by self diagnosis indications, or by an error over a known position exceeding the value agreed between an operator and its certifying authority. As a generalisation, if there is a difference greater than 15 nm between two aircraft navigation systems (or between the three systems if it is not possible to detect which are the most reliable) it is advisable to split the difference between the readings when determining the aircraft's position. However, if the disparity exceeds 25 nm one or more of the navigation systems should be regarded as having failed, in which case ATC should be notified.

Inertial System Failures

INSs have proved to be highly accurate and very reliable in service. Manufacturers claim a drift rate of less than 3 nm per hour; however in practice IRSs with laser gyros are proving to be capable of maintaining accuracy to better than 1 nm per hour. This in itself can lead to complacency, although failures do still occur. Close monitoring of divergence of output between individual systems is essential if errors are to be avoided and faulty units identified.

GPS Failures

If the GPS displays a "loss of navigation function alert", the pilot should immediately revert to other available means of navigation, including DR procedures if necessary, until GPS navigation is regained. The pilot must report the degraded navigation capability to ATC.

<u>Satellite Fault Detection Outage</u>

If the GPS receiver displays an indication of a fault detection function outage (i.e. RAIM is not available), navigation integrity must be provided by comparing the GPS position with the position indicated by another LRNS sensor (i.e. other than GPS), if the aircraft is so equipped. However, if the only sensor for the approved LRNS is GPS, then comparison should be made with a position computed by extrapolating the last verified position with airspeed, heading and estimated winds. If the positions do not agree within 10 nm, the pilot should adopt navigation system failure procedures as subsequently described, until the exclusion function or navigation integrity is regained, and should report degraded navigation capability to ATC.

Fault Detection Alert

If the GPS receiver displays a fault detection alert (i.e. a failed satellite), the pilot may choose to continue to operate using the GPS-generated position if the current estimate of position uncertainty displayed on the GPS from the FDE algorithm is actively monitored. If this exceeds 10 nm, the pilot should immediately begin using the following navigation system failure procedures, until the exclusion function or navigation integrity is regained, and should report degraded navigation capability to ATC.

PARTIAL OR COMPLETE LOSS OF NAVIGATION/FMS CAPABILITY BY AIRCRAFT HAVING STATE APPROVAL FOR UNRESTRICTED OPERATIONS IN MNPS AIRSPACE

Some aircraft carry triplex equipment (3 LRNSs) and hence if one system fails, even before take off, the two basic requirements for MNPS Airspace operations may still be met and the flight can proceed normally. The following guidance is offered for aircraft equipped with only two operational LRNSs:

One System Fails Before Take-Off

The pilot should consider:

- delaying departure if timely repair is possible;
- obtaining a clearance above or below MNPS Airspace;
- planning on the special routes known as the 'Blue Spruce' Routes, which have been established for use by aircraft suffering partial loss of navigation capability. These are:
  - (Stornoway/Benbecula) STN/BEN – 61°N 10°W – ALDAN – KEF (Keflavik)
    (VHF coverage exists. Non HF equipped aircraft can use this route)
  - (Stornoway/Benbecula) STN/BEN – 60°N 10°W – 61°N 12°34'W – ALDAN – KEF (Keflavik) (HF is required on this route)
  - (Shannon/Machrihanish/Belfast/Glasgow) SHA/MAC/BEL/GOW – 57°N 10°W – 60°N 15°W – 61°N 16°30'W – BREKI – KEF (Keflavik)
    (HF is required on this route)
  - (Keflavik) KEF – EMBLA – 63°N 30°W – 61°N 40°W – OZN (Prins Christian Sund)
  - (Keflavik) KEF – GIMLI – DA (Kulusuk) – SF (Sondre Stromfjord) – YFB (FROBAY)
  - (Prins Christian Sund) OZN – 59°N 50°W – PRAWN – NAIN
  - (Prins Christian Sund) OZN – 59°N 50°W – PORGY – HO (Hopedale)
  - (Prins Christian Sund) OZN – 58°N 50°W – LOACH – YYR (Goose Bay)
- The following special routes may also be flown without an LRNS (i.e. with only short-range navigation equipment such as VOR, DME, ADF), **but it must be noted that State approval for operation within MNPS Airspace is still necessary:**
  - (Flesland) FLS - VALDI - MY (Myggenes) - ING (Ingo) - KEF(Keflavik)
    (UN623 from FLS to VALDI and G3 thereafter)

- (Sumburgh) SUM - SIDER - AB (Akraberg) - MY (Myggenes)
  (UG11 from SUM to SIDER and G11 thereafter)

Such use of the foregoing routes is subject to the following conditions:

- sufficient navigation capability remains to ensure that MNPS accuracy and the *ICAO Annex 6 (Chapter 7 of Parts I and II)* requirements for redundancy can be met by relying on short-range navaids;
- a revised flight plan is filed with the appropriate ATS unit;
- an appropriate ATC clearance is obtained.

(Further information on the requisite procedures to follow can be obtained from *Section RAC 1-1-5 to 1-1-8 in AIP Iceland* and in *Section RAC 11.22 in AIP Canada*.)

Note: detailed information (including route definitions and operating procedures), which enables flight along other special routes within MNPS Airspace, may be found in relevant AIPs. This is specifically so, for aircraft operating without 2 LRNSs between Iceland and Greenland and between Greenland and Canada.

One System Fails Before the OCA Boundary is Reached

The pilot must consider:

- landing at a suitable aerodrome before the boundary or returning to the aerodrome of departure;
- diverting via one of the special routes described previously;
- obtaining a reclearance above or below MNPS Airspace.

One System Fails After the OCA Boundary is Crossed

Once the aircraft has entered oceanic airspace, the pilot should normally continue to operate the aircraft in accordance with the Oceanic Clearance already received, appreciating that the reliability of the total navigation system has been significantly reduced.

The pilot should however,

- assess the prevailing circumstances (e.g. performance of the remaining system, remaining portion of the flight in MNPS Airspace, etc.);
- prepare a proposal to ATC with respect to the prevailing circumstances (e.g. request clearance above or below MNPS Airspace, turn-back, obtain clearance to fly along one of the special routes, etc.);
- advise and consult with ATC as to the most suitable action;
- obtain appropriate reclearance prior to any deviation from the last acknowledged Oceanic Clearance.

When the flight continues in accordance with its original clearance (especially if the distance ahead within MNPS Airspace is significant), the pilot should begin a careful monitoring programme:

- to take special care in the operation of the remaining system bearing in mind that routine methods of error checking are no longer available;

- to check the main and standby compass systems frequently against the information which is still available;

- to check the performance record of the remaining equipment and if doubt arises regarding its performance and/or reliability, the following procedures should be considered:

  - attempting visual sighting of other aircraft or their contrails, which may provide a track indication;

  - calling the appropriate OAC for information on other aircraft adjacent to the aircraft's estimated position and/or calling on VHF to establish contact with such aircraft (preferably same track/level) to obtain from them information which could be useful. e.g. drift, groundspeed, wind details.

The Remaining System Fails After Entering MNPS Airspace

The pilot should:

- immediately notify ATC;

- make best use of procedures specified above relating to attempting visual sightings and establishing contact on VHF with adjacent aircraft for useful information;

- keep a special look-out for possible conflicting aircraft, and make maximum use of exterior lights;

- if no instructions are received from ATC within a reasonable period consider climbing or descending 500 feet, broadcasting action on 121.5 MHz and advising ATC as soon as possible.

Note: this procedure also applies when the remaining system gives an indication of degradation of performance, or neither system fails completely but the system indications diverge widely and the defective system cannot be determined.

Complete Failure of Navigation Systems Computers

A characteristic of the navigation computer system is that the computer element might fail, and thus deprive the aircraft of steering guidance and the indication of position relative to cleared track, but the basic outputs of the IRS (LAT/LONG, Drift and Groundspeed) are left unimpaired. A typical drill to minimise the effects of a total navigation computer system failure is suggested below. It requires the carriage of a suitable plotting chart.

- draw the cleared route on a chart and extract mean true tracks between waypoints.

- use the basic IRS/GPS outputs to adjust heading to maintain mean track and to calculate ETAs.

- at intervals of not more than 15 minutes plot position (LAT/LONG) on the chart and adjust heading to regain track.

Note: the AERAD Charts NAT 1 and NAT 2 at 1:8.5 Million scale; the AERAD Charts AT(H)2 and AT(H)3 at 1:5 Million; and the JEPPESEN North/Mid Atlantic Plotting Chart (1:8.75 Million) are considered suitable for this purpose.

Intentionally Blank

Chapter 12: Special Procedures for In-Flight Contingencies

INTRODUCTION

The following procedures are intended for guidance only. Although all possible contingencies cannot be covered, they provide for such cases as:

- inability to maintain assigned level due to weather (for example severe turbulence);
- aircraft performance problems; or
- pressurisation failure.

They are applicable primarily when rapid descent, turn-back, or diversion to an alternate aerodrome is required. The pilot's judgement will determine the specific sequence of actions taken, having regard to the prevailing circumstances.

GENERAL PROCEDURES

If an aircraft is unable to continue its flight in accordance with its ATC clearance, a revised clearance should be obtained whenever possible, prior to initiating any action, using the radio telephony distress (MAYDAY, MAYDAY, MAYDAY) signal or urgency (PAN PAN, PAN PAN, PAN PAN) signal as appropriate.

For SATCOM equipped aircraft, in the event that all other means of communication have failed, emergency satellite voice transmissions may be made to the controlling ATC unit. In addition, allocated airborne numbers to be used only in emergency situations (excluding communications failure), are listed in appropriate *AIPs*. To prepare for this unlikely eventuality, consideration should be given by pilots to pre-programming any possible required numbers into the flight deck voice unit prior to entry into the NAT Region.

If prior clearance cannot be obtained, an ATC clearance should be obtained at the earliest possible time and, in the meantime, the aircraft should broadcast its position (including the ATS Route designator or the Track Code as appropriate) and its intentions, at frequent intervals on 121.5 MHz (with 131.8 MHz as a back-up frequency).

Until a revised clearance is obtained the specified NAT in-flight contingency procedures should be carefully followed. Detailed procedures are contained within the *ICAO NAT Regional Supplementary Procedures (Doc.7030)* and appropriate NAT Provider States' *AIPs* and are paraphrased below.

In general terms, the aircraft should be flown at a flight level and/or on a track where other aircraft are least likely to be encountered. Maximum use of aircraft lighting should be made and a good look-out maintained. If TCAS is carried, the displayed information should be used to assist in sighting proximate traffic.

SPECIAL PROCEDURES

The general concept of these NAT in-flight contingency procedures is, whenever operationally feasible, to offset from the assigned route by 30 nm and climb or descend to a level which differs from those normally used by 500 ft if below FL410 or by 1000 ft if above FL410.

Initial Action

The aircraft should leave its assigned route or track by initially turning 90° to the right or left whenever this is possible. The direction of the turn should, where possible, be determined by the position of the aircraft relative to any organised route or track system (e.g. whether the aircraft is outside, at the edge of, or within the system). Other factors which may affect the direction of turn are: direction to an alternate airport, terrain clearance and levels allocated on adjacent routes or tracks.

Subsequent Action

An aircraft that is able to maintain its assigned flight level should, once established on the offset track:

- climb or descend 1000 ft if above FL410
- climb or descend 500 ft when below FL410
- climb 1000 ft or descend 500 ft if at FL410

An aircraft that is unable to maintain its assigned flight level should, whenever possible, minimise its rate of descent while acquiring the 30 nm offset track; and for the subsequent level flight, a flight level should be selected which differs from those normally used: by 1000 ft if above FL410 or by 500 ft if below FL410.

Before commencing any diversion across the flow of adjacent traffic, aircraft should, whilst maintaining the 30 nm offset track, expedite climb above or descent below the vast majority of NAT traffic (i.e. to a level above FL410 or below FL285), and then maintain a flight level which differs from those normally used: by 1000 ft if above FL410, or by 500 ft if below FL410. However, if the pilot is unable or unwilling to carry out a major climb or descent, then any diversion should be carried out at a level 500 ft different from those in use within MNPS Airspace, until a new ATC clearance is obtained.

If these contingency procedures are employed by a twin engine aircraft as a result of the shutdown of a power unit or the failure of a primary aircraft system the pilot should advise ATC as soon as practicable of the situation, reminding ATC of the type of aircraft involved and requesting expeditious handling.

WAKE TURBULENCE

Any pilot who encounters a wake turbulence incident when flying in NAT MNPS Airspace or within an adjacent RVSM transition area should ensure that a detailed report is provided to the NAT CMA. A suggested ‘Wake Turbulence Report Form’ for this purpose is shown at Attachment 3 to this Manual.

When flying within NAT MNPS Airspace (but **not** in adjacent domestic airspace RVSM transition areas), if considered necessary, the pilot may offset from cleared track by up to a maximum of 2 nm (upwind) in order to alleviate the effects of wake turbulence. ATC should be advised of this action and the aircraft should be returned to cleared track as soon as the situation allows. It must be noted, however, that such a manoeuvre is considered a contingency procedure and ATC will not issue a clearance for any such lateral offset.

TCAS ALERTS AND WARNINGS

In the event that a Traffic Advisory (TA) is issued, commencement of a visual search for the threat aircraft should be carried out and preparation made to respond to a Resolution Advisory (RA), if one should follow. In the event that an RA is issued, the required manoeuvre should be initiated **immediately**, subsequently adjusting power and trim. Note that manoeuvres should never be made in a direction opposite to those required by the RA, and that RAs should be disregarded only when the potentially conflicting traffic has been **positively** identified and it is evident that no deviation from the current flight path is needed. All RAs should be reported to ATC:

- verbally, as soon as practicable; and

- in writing, to the Controlling Authority, after the flight has landed, using the necessary procedure and forms, including, when appropriate, the ‘Altitude Deviation Report Form’ shown at Attachment 2 to this Manual.

Pilots should be aware that under certain conditions in NAT RVSM airspace, TCAS equipment utilising Version 6.04a Logic (current at the date of publication of this Document) can issue nuisance Traffic Advisories relating to another aircraft which is following the same track but is correctly separated vertically by 1,000 ft above or below. Such TAs will normally be issued when the two aircraft are separated horizontally by 1.2 nm, this being the approach criterion used in the 6.04a Version Logic. It is expected that Logic Version 7, anticipated to be available in 1999, will correct this anomaly and eliminate such nuisance TAs.

Intentionally Blank

Chapter 13: A Check List for Pilots Not Familiar With Operations in NAT MNPS Airspace

To assist those pilots who are less familiar with operating in NAT MNPS Airspace, the following short check list has been prepared:

(1) Are you sure that your State of Registry has granted MNPS approval to this flight (and if applicable has the aircraft also received RVSM approval)? (See Chapter 1.)

(2) If it has, is the letter 'X' (and 'W', if relevant) in Item 10 of your flight plan?

(3) If you are intending to follow an organised track, and bearing in mind that the OTS changes every 12 hours, do you have a copy of the valid track message and, if applicable, any changes to it? (See Chapter 2.)

(4) Are you familiar with the Mach Number Technique? (See Chapter 8.)

(5) Have you had an accurate time check referenced to UTC, and is the system you will be using on the flight deck for MNPS operation also accurately referenced to UTC? Is this time accuracy going to be maintained for the planned duration of the flight ? (See Chapter 9.)

(6) If using GPS, have you checked the latest NOTAMs regarding the serviceability of GPS satellites and have you performed an FDE prediction program analysis? (See Chapter 9.)

(7) If flying via the special Greenland/Iceland routes, have you checked the serviceability of your one remaining LRNS and of your short range navigation systems plus the ground navigation aids which you will use? (See Chapter 11.)

(8) If flying a non-HF equipped aircraft, is your route approved for VHF only? (See Chapter 11.)

(9) If flying other than on the special routes, are you sure of the serviceability of both your LRNSs? (See Chapter 11.)

(10) Have you planned ahead for any actions you might need to take should you suffer a failure of one LRNS? (See Chapter 11.)

(11) If you intend to fly at RVSM levels, are you sure of the serviceability of both your primary altimetry systems and at least one altitude alerter and one autopilot? (See Chapter 1.)

(12) Are you familiar with the required procedures for flight at RVSM levels? (See Chapter 10.)

If, as a pilot, you have any doubt about your answers to these questions, it may be necessary for you to consult with the Civil Aviation Department of your State of Registry.

Intentionally Blank

Chapter 14: Guarding Against Complacency

INTRODUCTION

Since 1977, when the MNPS rules were introduced, careful monitoring procedures have provided a good indication both of the frequency with which navigation errors occur and their causes. Their frequency is low: only one flight in around ten thousand flights commits a serious navigation error. However because of the accuracy and reliability of modern navigation systems, the errors which do occur are most often seen to be as a result of aircrew error.

Operational errors in the vertical plane also occur. Aircraft are sometimes flown at levels other than those for which ATC clearance has been issued. As in the horizontal plane, the frequency of vertical errors is low. However, the potential risk of even a single incidence of flying at an uncleared level can be significant.

It is therefore essential that crews do not take modern technology for granted. They should at all times, especially during periods of low workload, guard against complacency and over-confidence, by adhering rigidly to approved cockpit procedures which have been formulated over many years, in order to help stop operational errors from being an inevitability.

RARE CAUSES OF ERRORS

To illustrate the surprising nature of things which can go wrong, the following are examples of some extremely rare faults which have occurred:

- the lat/long co-ordinates displayed near the gate position at one international airport were wrong.

- because of a defective component in one of the INS systems on an aircraft, although the correct forward latitude was inserted by the crew (51°) it subsequently jumped by one degree (to 52°).

- the aircraft was equipped with an advanced system with all the co-ordinates of the waypoints of the intended route already in a database; the crew assumed that these co-ordinates were correct, but one was not.

- when crossing longitude 40°W westbound the Captain asked what co-ordinates he should insert for the 50°W waypoint and was told 48 50. He wrongly assumed this to mean 48°50'N at 50°00W (when it really meant 48°N 50°W) and as a result deviated 50 nm from track.

- the flight crew had available to them the correct co-ordinates for their cleared track, but unfortunately the data which they inserted into the navigation computer was from the company flight plan, in which an error had been made.

- at least twice since 1989, longitude has been inserted with an error of magnitude of times 10. e.g. 100°W instead of 10°W, or 5°W instead of 50°W. Because of low angles of bank, the aircraft departed from track without the crews being aware, and both lateral and longitudinal separations with other aircraft were compromised.

- a crew based at and usually operating from London Heathrow was positioned at London Gatwick for a particular flight. One pilot inadvertently loaded the Heathrow co-ordinates into the INS, instead of those for Gatwick. This initialisation error was only discovered when the aircraft had turned back within the NAT after experiencing a GNE.

- the pilot of a flight departing from the Caribbean area input the wrong departure airfield co-ordinates prior to departure. This error was discovered when deviation from cleared route seriously eroded separation with two other opposite direction aircraft.

MORE COMMON CAUSES OF ERRORS

The most common causes of GNEs, in approximate order of frequency, have been as follows:

- a mistake of one degree of latitude has been made in inserting a forward waypoint. There seems to be a greater tendency for this error to be made when a track, after passing through the same latitude at several waypoints (e.g. 57°N 50°W, 57°N 40°W, 57°N 30°W) then changes by one degree of latitude (e.g. 56°N 20°W). Other circumstances which can lead to this mistake being made include receiving a reclearance in flight.

- the crew have been recleared by ATC, or have asked for and obtained a reclearance, but have omitted to re-programme the navigation system(s).

- the autopilot has been inadvertently left in the heading or de-coupled mode after avoiding clouds, or left in the VOR position after leaving the last domestic airspace VOR. In some cases, the mistake has arisen during distraction caused by SELCAL or by some flight deck warning indication.

- an error has arisen in the ATC Controller/Pilot communications loop, so that the controller and the crew have had different understandings of the clearance. In some cases, the pilot has heard not what was said, but what was expected to be heard.

Operational Height Errors

Most common height errors are caused by:

- not climbing or descending as cleared

  e.g. a crew was cleared for a climb to cross 4030W at FL350. The crew mis-interpreted the clearance and took it to mean climb to cross 40°N 30°W (instead of 40° 30′W) at FL350.

  While this was caused by a seemingly ambiguous clearance, crews must be on their guard and query the clearance if in any doubt.

- not following the correct contingency procedures

  e.g. following an engine failure a crew descended the aircraft on track rather than carrying out the correct contingency procedures (see Chapter 12).

An occasional error is to fly at one (uncleared) level and report at the cleared level!

e.g. the crew of a major airline reported at FL360 (the cleared level), all the way across the ocean but were in fact at FL350!! They had been cleared to cross 40°W at FL360 and correctly entered the cleared level into the FMC but did not execute the command prior to 40°W. During position reporting the aircraft level was reported by reference to the FMC altitude hold box.

LESSONS TO BE LEARNED

Never relax or be casual in respect of the cross-check procedure; this is especially important towards the end of a long night flight.

Avoid casual R/T procedures. A number of GNEs have been the result of a misunderstanding between pilot and controller as to the cleared route. Adhere strictly to proper R/T phraseology and do not be tempted to clip or abbreviate details of waypoint co-ordinates.

Make an independent check on the gate position. Do not assume that the gate co-ordinates are correct without cross-checking with an authoritative source. Normally one expects co-ordinates to be to the nearest tenth of a minute. Therefore, ensure that the display is not to the hundredth, or in minutes and seconds. If the aircraft is near to the Zero Degree E/W (Greenwich) Meridian, remember the risk of confusing east and west.

Before entering Oceanic Airspace make a careful check of LRNS positions at or near to the last navigation facility – or perhaps the last but one.

Do not assume that the aircraft is at a waypoint merely because the alert annunciator indicates; cross-check by reading present position.

Flight deck drills. There are some tasks on the flight deck which can safely be delegated to one member of the crew, but navigation using automated systems is emphatically not one of them, and the Captain should participate in all navigation cross-check procedures.

Initialisation errors. Always return to the ramp and re-initialise inertial systems if the aircraft is moved before the navigation mode is selected. If after getting airborne, it is found that during initialisation a longitude insertion error has been made, unless the crew thoroughly understand what they are doing, and have also either had recent training on the method or carry written drills on how to achieve the objective, the aircraft should not proceed into MNPS Airspace, but should turn back or make an en-route stop.

Waypoint loading. Before departure, check that the following agree: computer flight plan, ICAO flight plan, track plotted on chart, and if appropriate, the track message. In flight, involve two different sources in the cross-checking, if possible. Do not be so hurried in loading waypoints that mistakes become likely, and always check waypoints against the current ATC clearance.

Use a flight progress chart on the flight deck. It has been found that making periodic plots of position on a suitable chart and comparing with current cleared track, greatly helps in the identification of errors before getting too far from track.

Consider making a simple use of basic DR Navigation as a back-up. Outside polar regions, provided that the magnetic course (track) is available on the flight log, a check against the magnetic heading being flown, plus or minus drift, is likely to indicate any gross tracking error.

Always remember that something absurd may have happened in the last half-hour. There are often ways in which an overall awareness of directional progress can be maintained; the position of the sun or stars; disposition of contrails; islands or coast-lines which can be seen directly or by using radar; radio nav-aids, and so forth. This is obvious and basic, but some of the errors which have occurred could have been prevented if the crew had shown more of this type of awareness.

If the crew suspects that equipment failure may be leading to divergence from cleared track, it is better to advise ATC sooner rather than later.

In conclusion, navigation equipment installations vary greatly between operators; but lessons learned from past mistakes may help to prevent mistakes of a similar nature occurring to others in the future.

Chapter 15: The Prevention of Deviations From Track as a Result of Waypoint Insertion Errors

THE PROBLEM

During the monitoring of navigation performance in the NAT MNPS Airspace, a number of GNEs are reported. (There were 24 in 1997 and 17 in 1998.) Such errors are normally detected by means of long range radars as aircraft leave oceanic airspace. Occasionally, potential errors are identified by ATC from routine aircraft position reports.

Investigations into the causes of all recent deviations show that about 75% are attributable to equipment control errors by crews and that almost all of these errors are the result of programming the navigation system(s) with incorrect waypoint data – otherwise known as waypoint insertion errors.

THE CURE

Waypoint insertion errors can be virtually eliminated if all operators/crews adhere at all times to approved operating procedures and cross checking drills. This Manual provides a considerable amount of guidance and advice based on experience gained the hard way, but it is quite impossible to provide specific advice for each of the many variations of navigation systems fit.

The following procedures are recommended as being a good basis for MNPS operating drills/checks:

- record the initialisation position programmed into the navigation computer. This serves two purposes:
  - it establishes the starting point for the navigation computations; and
  - in the event of navigation difficulties it facilitates a diagnosis of the problem.
- ensure that your flight log has adequate space for the ATC cleared track co-ordinates, and always record them. This part of the flight log then becomes the flight deck Master Document for:
  - read back of clearance;
  - entering the route into the navigation system;
  - plotting the route on your chart.
- plot the cleared route on a chart with a scale suitable for the purpose (e.g. *Aerad, Jeppesen, NOAA en-route charts*). This allows for a visual check on the reasonableness of the route profile and on its relationship to the OTS, other aircraft tracks/positions, diversion airfields, etc.
- plot your Present Position regularly on your chart.
  - this may seem old-fashioned but, since the present position output cannot normally be interfered with and its calculation is independent of the waypoint data, it is the one output which can be relied upon to detect gross tracking errors.
  - **a position should be checked and preferably plotted approximately 10 minutes after passing each waypoint, and, if circumstances dictate, midway between waypoints. e.g. if one system has failed.**

- check the present, next and next+1 waypoint co-ordinates against those in the steering CDU before transmitting position reports.

The procedures outlined in this Section will detect any incipient gross errors, providing that the recorded/plotted cleared route is the same as that provided by the controlling ATS authority. If there has been a misunderstanding between the pilot and controller over the actual route to be flown (i.e. an ATC loop error has occurred), then the last drill above, together with the subsequent passing of the position report, will allow the ATS authority the opportunity to correct such misunderstanding before a hazardous track deviation can develop.

Sample of Error Investigation Form

(Name and address of reporting agency):
Please complete Parts 2 and 3 (and Part 4 if applicable) of this investigation form. A copy, together with copies of all relevant flight documentation (fuel flight plan, ATC flight plan and ATC clearance) should then be returned to the above address and also to: the North Atlantic Central Monitoring Agency, T8G7, CAA House, 45/59 Kingsway, London WC2B 6TE, England
Part 1 – General Information

Operator's name	
Aircraft identification	
Date/time of observed deviation	
Position (latitude and longitude)	
Observed by (radar unit)	
Aircraft flight level	

Part 2 – Detail of Aircraft and Navigation Equipment Fit

Number Type	**INS**	**GNSS**	**IRS/FMS**	**OTHER (please specify)**
Single Dual Triple				
Model No				
Navigation system Programme No				
State which system coupled to autopilot				
Aircraft Registration and Model/Series				

Part 3 – Detailed description of incident

Please give your assessment of the actual track flown by the aircraft and the cause of the deviation (continue on a separate sheet if required)

Part 4 – Only to be completed in the event of partial or full navigation failure

Indicate the number of equipment units which failed	**INS**			**GNSS**			**IRS/FMS**			**OTHER**			
Circle estimated longitude at which equipment failed	60°W	55°W	50°W	45°W	40°W	35°W	30°W	25°W	20°W	15°W	10°W	5°W	0°E/W
Give an estimate of the duration of the equipment failure	Time of failure : Time of exit from MNPS : Duration of failure in MNPS :												
At what time did you advise ATC of the failure													

Thank you for your co-operation

Altitude Deviation Report Form

MESSAGE FORMAT FOR A REPORT TO THE CENTRAL MONITORING AGENCY OF AN ALTITUDE DEVIATION OF 300 FT OR MORE, INCLUDING THOSE DUE TO TCAS, TURBULENCE AND CONTINGENCY EVENTS

1. REPORT OF AN ALTITUDE DEVIATION OF 300 FT OR MORE
2. REPORTING AGENCY
3. DATE AND TIME
4. LOCATION OF DEVIATION
5. RANDOM / OTS[1]
6. FLIGHT IDENTIFICATION AND TYPE
7. FLIGHT LEVEL ASSIGNED
8. OBSERVED / REPORTED[1] FINAL FLIGHT LEVEL[2] MODE “C” / PILOT REPORT[1]
9. DURATION AT FLIGHT LEVEL
10. CAUSE OF DEVIATION
11. OTHER TRAFFIC
12. CREW COMMENTS, IF ANY, WHEN NOTIFIED
13. REMARKS[3]

1\. State one of the two choices.

2\. In the case of turbulence, state extent of deviation from cleared flight level.

3\. In the event of contingency action, indicate whether prior clearance was given and if contingency procedures were followed

When complete please send this form to:

North Atlantic Central Monitoring Agency
T8G7, CAA House
45/59 Kingsway
London WC2B 6TE
United Kingdom

Wake Turbulence Report Form

For use by pilots involved in Wake Vortex incidents which have occurred in NAT MNPS Airspace.

This information is requested by the North Atlantic Central Monitoring Agency and will be forwarded for inclusion in the UK National Air Traffic Services Limited Wake Vortex database.

SECTION A

DATE OF OCCURRENCE	TIME (UTC) *DAY/NIGHT	OPERATOR	FLIGHT NUMBER
AIRCRAFT TYPE & SERIES		REGISTRATION	AIRCRAFT WEIGHT (KG)
ORIGIN & DESTINATION	POSITION IN LAT & LONG	CLEARED TRACK CO-ORDINATES	
FLIGHT LEVEL	SPEED/MACH NBR.	FLIGHT PHASE: *CRUISE/CLIMB/DESCENT	WERE YOU TURNING? *YES/NO
DID YOU APPLY A TRACK OFFSET? *YES/NO	SIZE OF TRACK OFFSET? Nautical Miles	WAS ATC INFORMED? *YES/NO	
MET CONDITIONS IMC VMC	ACTUAL WEATHER WIND VISIBILITY CLOUD TEMPERATURE / km / °C	DEGREE OF TURBULENCE *LIGHT/MODERATE/SEVERE	
OTHER SIGNIFICANT WEATHER?			

(*Circle the appropriate reply only)

SECTION B

1 What made you suspect Wake Vortex as the cause of the disturbance? ____________________

____

____

____

2 Did you experience vertical acceleration? *YES/NO
If YES please describe briefly ____________________

____

3 What was the change in attitude? (please estimate angle)
Pitch ____________ º Roll ____________ º Yaw ____________ º

4 What was the change in height if any? ____________ *INCREASE/DECREASE

Page 1 of 2

5 Was there buffeting? *YES/NO

6 Was there stick shake? *YES/NO

7 Was the Autopilot engaged? *YES/NO

8 Was the Autothrottle engaged? *YES/NO

9 What control action was taken?

Please describe briefly ______________________________

____

____

10 Could you see the aircraft suspected of causing the wake vortex? *YES/NO

11 Did you contact the aircraft suspected of causing the vortex? *YES/NO

12 Was the aircraft suspected of causing the vortex detected by TCAS? *YES/NO

If YES to any of questions 10 to 12, what type of aircraft was it? ______________________________

and where was it relative to your position? ______________________________

(Estimated separation distance) ______________________________

Were you aware of the preceding aircraft before the incident? *YES/NO

OTHER INFORMATION

13 Have you any other comments which you think may be useful? ______________________________

____

____

____

____

____

Signed ______________________________

Name (BLOCK CAPITALS) ______________________________ DATE ______________

(*Circle the appropriate reply only)

When complete please send this form to:

North Atlantic Central Monitoring Agency
T8G7, CAA House
45/59 Kingsway
London WC2B 6TE
United Kingdom

Page 2 of 2

FRENCH AIC ON GPS (A 22/98)

Subject Procedures for GPS NOTAM consultation

1. Preamble :

The possibility to use - under certain conditions - GPS as a navigation system is accepted:

- firstly, within MNPS (Minimum Navigation Performance Specification) Airspace over the North Atlantic, instead of OMEGA, between Flight Levels 290 and 410, and

- secondly, within the scope of the future implementation of B-RNAV within the airspace of the CEAC member States, as from April 23, 1998

(see AIC A 47/97, Nov. 31, 1997).

This acceptance implies the requirement to provide the air users with the pertinent information concerning the availability of the GPS constellation satellites.

On their side, when preparing their flight, air users are responsible for checking for the availability of the GPS constellation satellites.

2. Responsibility for information release :

At present, the KNMH transmitting station (US Coast Guard Station, Washington D.C.) is responsible for release (in NOTAM format) of information relating to the operating condition of the GPS constellation satellites.

3. Availability of information for air users :

These NOTAMs can be obtained :

- through direct query to the USA data bank, via the AFTN, using the following service message format :

***SVC RQ INT LOC = KNMH** addressed to **KDZZNAXX**, or,*

*- through a query to the French Aeronautical Data Base (BDA), via an **ODIN** terminal (available in an information and Flight Support Regional Office), or a **MINITEL**.*

*On an **ODIN** terminal (Tool for access to NOTAM Information), the GPS NOTAMs are obtained by establishing a FIR bulletin and selecting the following elements :*

FIR	*:*	***KZDC***
Traffic	*:*	***I***
NOTAM Code Q	*:*	***NG***

*On a **MINITEL** (3614 NOTAM), the GPS NOTAMs are obtained by establishing an area bulletin and selecting the following elements :*

FIR	*:*	***KZDC***
Traffic	*:*	***I***

*In this case, the GPS NOTAMs should be selected among the **KZDC** FIR NOTAMs listed.*